LAKE SUPERIOR
STATE UNIVERSITY

Academic Program Review

DUE DATE: November 21, 2018

The HLC Criteria for Accreditation, specifically Core Component 4.A, require institutions to maintain a "practice of regular program review[1]" as one component for ensuring the quality of our educational programs and evaluating our effectiveness in achieving our stated student learning outcomes. For academic units, "Program" means an academic School.

School:	**School of Engineering & Technology**
Degree Programs of the School: (indicate which, if any, hold specialized programmatic accreditation)	**B.S. Computer Engineering – ABET Accredited** **B.S. Electrical Engineering – ABET Accredited** **B.S. Electrical Engineering Technology – ABET Accredited** **B.S. Manufacturing Engineering Technology – ABET Accredited** **B.S. Mechanical Engineering – ABET Accredited** **B.S. Robotics Engineering (Plan to Pursue ABET Accreditation)** **A.S. Electrical Engineering Technology** **A.S. General Engineering** **A.S. General Engineering Technology** **A.S. Manufacturing Engineering Technology**
Academic Program Review Submission Date:	**November 20, 2018**
Dean:	**Kimberly Muller**
School Chair:	**Paul Weber**
Names of Faculty Members Completing Program Review Report:	**Jim Devaprasad, Robert Hildebrand, Andrew Jones, David Leach, Paul Weber**

Guidelines for Completing the Academic Program Review

Questions in Part 1 are focused at the School level, and should reflect School-level data, findings, etc.

Questions in Part 2 should be completed for each distinct academic degree program in the School. In the cases where an academic degree holds specialized programmatic accreditation, Schools can cite the page(s) which address the prompt question. In all cases, attach evidence where available using the appendix cover sheet to identify how the evidence supports the relevant criteria or prompt.

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[1] https://www.hlcommission.org/Policies/criteria-and-core-components.html

PART 1: School-Level Review

For references to ABET self-study reports, the 2018 Computer Engineering Self-Study Report is used an example. Similar sections would also be available in the Mechanical Engineering and Electrical Engineering reports as well as the past Manufacturing Engineering Technology and Electrical Engineering Technology reports, although the specific section numbering and page numbers may vary.

School Mission and Goals

1. Provide the School's mission statement and explain its connection to the University mission.

The School of Engineering & Technology's mission is to "To produce sought-after engineers and engineering technologists with multi-disciplinary competence by providing an academically thorough education that is both foundational and applied, led by faculty and staff dedicated to undergraduate learning." This has been updated some since this summer, but the connection to the University mission remains the same as specified in Section 2-A of the Computer Engineering ABET Self-Study Report.

2. List the School-level goals and explain how they support and connect to the CAFE Master Goals of the Strategic Plan.
https://www.lssu.edu/wp-content/uploads/2018/09/2018-2023-LSSU-Strategic-Plan.pdf

SET's goals are to:

1. Deliver an undergraduate education that is current and provides knowledge and skills to be successful in professional careers or graduate school.

2. Provide programs that focus on the applications of fundamental principles of engineering, technology, mathematics, science, and computing to benefit society.

3. Provide courses which incorporate and develop skills in communication, design, ethics, teamwork, technology, and capstone experiences relevant to the students' degrees.

4. Provide an education and opportunities for students with diverse abilities to enhance their professional growth and capacity for life-long learning.

5. Engage in continuous improvement activities through ongoing external and internal reviews.

6. Enable faculty, staff, and students to apply engineering solutions that support regional economic growth and develop intellectual property.

7. Maintain the School's viability, productivity, and effectiveness by supporting enrollment, retention, and placement initiatives.

8. Provide a supportive environment in which faculty, staff, and students are recognized as essential in the realization of the mission.

Culture is covered by Goals 5 (C3) and 8 (C1).

Academics is covered by Goals 1 (A1), 2 (A1), 3 (A2), and 4 (A3).

Finance is covered by Goal 6 (F3).

Enrollment is covered by Goal 7 (E1).

Explain how the School works to address each of the following questions. For each question, respond with a narrative and supporting evidence.

Teaching and Learning Programs Evaluation and Improvement: (CC 4.A)

3. Explain how faculty determine program and course learning outcomes, course prerequisites, rigor of courses, expectations for student achievement, and student access to resources.

Refer to Sections 1-B (Evaluating Student Performance), 1-D (Advising and Career Guidance), 4-A.4 (Course Assessment), and 5 (Curriculum) of the Computer Engineering ABET Self-Study Report.

4. Explain how faculty ensure the equivalence of learning outcomes and achievement in all modes and locations where degrees are delivered. Provide examples of course syllabi from multiple delivery modes and locations of the same course(s).

Presently all courses are taught in a single mode and at the Sault Ste. Marie, MI campus. For example, there are presently no online courses taught within SET.

5. If applicable, attach the most recent report, findings and recommendations from specialized programmatic accreditations within the School.

*The ABET reports and findings from the 2016 visits for the B.S. EET and MfgET programs as well as the reports from the 2018 visits for the B.S. CE, EE, and ME programs are attached. Please note that **these reports contain confidential Information that should not be posted publicly** (e.g. to the LSSU website).*

6. Report data from the past two years to show what students are doing after graduation from the programs in your School. For example, statistical data should report the numbers of students in specific areas (*i.e.,* business, government, education, military, unemployed, pursuing advanced degrees, etc.). Attach representative data.

Data for graduates of SET is attached.

Assessment (CC 4.B and CC 4.C)

Explain how the School uses assessment to promote ongoing growth and improvement. As evidence for each question, you may choose to include content from the 'Use of Results' column in the 4-Column Program Assessment Report, or provide broader assessment results from an alternative source.

7. School-level goals and their connections to the university's CAFE Master Goals Strategic Plan were listed in Question 2 of this report. Select 3-5 of those goals as a focus for the School's 4-Column School Assessment Report; add the selected goals to the 4-Column report document, and attach the document.

All SET goals have been uploaded into TracDat/Improve and a 4-column report is attached.

8. Describe how results from assessment have been used to improve your School. Include specific examples.

Refer to Section 4 (Continuous Improvement) of the Computer Engineering ABET Self-Study Report.

9. Describe how the School uses assessment results to inform and facilitate better planning and budgeting.

Refer to Sections 4 (Continuous Improvement) and 7-D (Maintenance and Upgrading of Facilities) of the Computer Engineering ABET Self-Study Report. Another example would be the curricular proposal for the B.S. Robotics Engineering program with the associated budgetary requests (attached).

10. In addition to LSSU's campus-wide programs designed to support retention and degree completion, list any additional activities of the School specifically intended to increase retention and degree completion.

SET places a high priority on engaging with students early in their time at LSSU, especially in EGNR101. Within EGNR101, students:

- *Learn about, and are encouraged to join, student chapters of professional engineering organizations (IEEE, SWE, ASME, SAE, etc.).*
- *Are guided through the process of accessing online resources; one full lab session is dedicated to this.*
- *Gain experience finding LSSU resources via a scavenger hunt.*
- *Meet advisors from their area, are acclimated to how to find class-related information, etc.; one full lecture and one full lab session are dedicated to advising.*

- *Improve time management strategies, attend study skill sessions, have the opportunity to ask questions of senior engineering and engineering technology students in a personal setting, attend Senior Project scope presentations, and gain insights into different areas of engineering via engineering modules.*

Other SET activities related to this include the development of degree plans of study and prerequisite charts (attached to individual degrees; ECE is of particular note with the new drafts showing flowcharts of courses) and the formation of a retention working group within SET. The retention group is presently focused on tailoring the LSSU advising syllabus to meet the needs of SET faculty and students so that it can be used in subsequent semesters.

Resources (CC 5.A and CC 5.C).

11. Describe how the School allocates resources to adequately support the mission. Include explanations of faculty/staff, fiscal, and infrastructure allocations. For example, describe the process used to ensure that each faculty member or instructor in the program is qualified to teach the courses they are assigned, as consistent with HLC guidelines. (https://www.hlcommission.org/Publications/determining-qualified-faculty.html)

The School ensures that courses within SET cover foundational topics within engineering and engineering technology as well as relevant topics so that graduates will have sought-after knowledge and skills. Furthermore, classes/concentrations/programs that emphasize systems-level material (e.g. robotics, vehicles, energy conversion) have received some additional attention to facilitate multi-disciplinary interactions. Loads for the set of classes are projected via an Excel file (attached), which was especially helpful when determining how to hire and incorporate new faculty.

Budgets are discussed at School meetings. The money from CSSM, course fees, and program fees are utilized to purchase basic supplies, lab material, and equipment for SET. A prioritized list of budget items is attached as an example from this past year in preparation for FY19.

Teaching qualifications are determined via the attached spreadsheet, which was set by the faculty in collaboration with the dean. Degrees are specified in submitted transcripts. When needed faculty can also submit resumes/CVs and memos explaining how work experience has prepared them to teach specific courses. Teaching qualifications of all tenure-track faculty were reviewed and approved within the last year.

12. Explain how the School ensures that the curriculum for each program is current. For example, evidence may include specialized program accreditation, advisory boards, input from industry, discipline standards, previous School reviews or reports, etc.

Each of the bachelor's degrees is accredited by ABET. We also strongly utilize feedback from our Industrial Advisory Board (IAB), alumni, and industrial contacts. An examples of the latter was when we constructed the B.S. Robotics Engineering program, a sizeable portion of the Spring 2018 IAB meeting was dedicated to discussing trends within industry that will be incorporated into some of the upper level classes.

LAKE SUPERIOR
STATE UNIVERSITY

Academic Program Review

Appendix Cover Sheet

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**School of Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**LSSU EET Self Study Report (2016)**
This documentation is relevant to Question number:	**EET-related reports (multiple questions)**
Briefly summarize the content of the file and its value as evidence supporting program review:	**This file contains the self-study report for the ABET ETAC Fall 2016 visit, including a variety of information that is useful for the assessment of the EET programs as well as the other engineering technology programs.**

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School:	**School of Engineering & Technology**
Document Title (If attached) or Filename (If emailed):	**LSSU MfgT Self Study Report (2016)**
This documentation is relevant to Question number:	**MfgET-related reports (multiple questions)**
Briefly summarize the content of the file and its value as evidence supporting program review:	**This file contains the self-study report for the ABET ETAC Fall 2016 visit, including a variety of information that is useful for the assessment of the MfgET programs as well as the other engineering technology programs.**

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School:	**School of Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**2018 ABET CE Report - Final**
This documentation is relevant to Question number:	**CE-related reports and School-level review (multiple questions)**
Briefly summarize the content of the file and its value as evidence supporting program review:	**This file contains the self-study report for the ABET ETAC Fall 2018 visit, including a variety of information that is useful for the assessment of the CE programs as well as the other engineering programs.**

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School:	**School of Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**2018 ABET CE Report - Final**
This documentation is relevant to Question number:	**EE-related reports and School-level review (multiple questions)**
Briefly summarize the content of the file and its value as evidence supporting program review:	**This file contains the self-study report for the ABET ETAC Fall 2018 visit, including a variety of information that is useful for the assessment of the EE programs as well as the other engineering programs.**

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School:	**School of Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**2018 ABET ME Report - Final**
This documentation is relevant to Question number:	**ME-related reports and School-level review (multiple questions)**
Briefly summarize the content of the file and its value as evidence supporting program review:	**This file contains the self-study report for the ABET ETAC Fall 2018 visit, including a variety of information that is useful for the assessment of the ME programs as well as the other engineering programs.**

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School:	**School of Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**2017-18 Seniors and Graduates Job Placement**
This documentation is relevant to Question number:	**6**
Briefly summarize the content of the file and its value as evidence supporting program review:	**This file provides data about job placement of graduates.**

2017-18 Seniors

Name		# Interviews	# Offers	Employed At	Title	Site
[redacted]	MET			4D Systems	Robot Programmer	http://4dsysco.com/
[redacted]	ME			AMT		https://www.appliedmfg.com/
[redacted]	CE	4	3	Nexteer	Computer Engineer	https://www.nexteer.com/
[redacted]	ME			Superior Fabrication	Design Engineer	
[redacted]	ME			ZF		
[redacted]	MET	9	7	R & E Automated		http://www.reautomated.com/
[redacted]	CE	3	1	Pro Basketball - Jordan Team		https://www.esysautomation.com/
[redacted]	EE	1	1	Honeywell		https://www.honeywell.com/
[redacted]	ME			Graduate School - U of N Fl.		
[redacted]	ME			Continental		
[redacted]	ME			Sault Machine Works		
[redacted]	ME			December Graduate		
[redacted]	MET			December Graduate		
[redacted]	EE			Heliene		
[redacted]	CE			Education Program - Kansas		
[redacted]	EE			CE Power		
[redacted]	ME			Nexteer		
[redacted]	ME	1	1	Revolutionary Engineering		http://www.revoleng.com/
[redacted]	ME	3	1	Esys Automation		
[redacted]	ME			December Graduate		
[redacted]	CE			December Graduate		
[redacted]	ME-N	3	2	Industrial Air Tech Corp		http://indairtech.com/
[redacted]	ME	1	1	Entrepreneur		https://triceratopscustoms.com/
[redacted]	MET	2	1	R & E		http://www.reautomated.com/
[redacted]	ME	6	5	Esys Automation		https://www.esysautomation.com/
[redacted]	CE			December Graduate		
[redacted]	EE	8	7	KUKA		https://www.kuka.com/en-us
[redacted]	MET			Osprey Tech		
[redacted]	MET			Algoma		
[redacted]	ME			ZF		
[redacted]	MET			Lear Corporation		
[redacted]	ME			December Graduate		
[redacted]	ME	2	2	Plexus		https://www.plexus.com/en-us/
[redacted]	EET			Triton Automation		http://www.triton-automation.com/
[redacted]	ME	7	7	Esys Automation	Project Engineer	https://www.esysautomation.com/
[redacted]	EE			December Graduate		
[redacted]	ME			KUKA		
[redacted]	MET	3	2	Textron		

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School:	**School of Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**2017 spring graduates**
This documentation is relevant to Question number:	**6**
Briefly summarize the content of the file and its value as evidence supporting program review:	**This file provides data about job placement of graduates.**

2017 Graduate Information Form

Grad Date	First	Last	Degree	Interviews	Offers		Salary of Accepted Offer	Other
7/28/2017	[redacted]	[redacted]	ME			University of Colorado - Boulder		Grad School
12/15/2017	[redacted]	[redacted]	MET			4D Systems		
12/15/2017	[redacted]	[redacted]	ME			AMT		
4/28/2017	[redacted]	[redacted]	CE	2	1	LEONI Engineering Products and Services		
4/28/2017	[redacted]	[redacted]	MET	2		Kawasaki Robotics		
12/15/2017	[redacted]	[redacted]	ME	1	1	Superior Fabrication	15/hour	
4/28/2017	[redacted]	[redacted]	EE	5	2	Esser		
4/28/2017	[redacted]	[redacted]	ME	1	1	ZF TRW	73,500	
4/28/2017	[redacted]	[redacted]	ME	7	4	Recognition Robotics	55,000	
4/28/2017	[redacted]	[redacted]	EE	1	1	Cloverland Electric		
4/28/2017	[redacted]	[redacted]	ME	4		LEONI Engineering Products and Services		Grad School
4/28/2017	[redacted]	[redacted]	EE	3	2	Ford Motor Company	73,000	
4/28/2017	[redacted]	[redacted]	EE	9	2	ZF TRW	73,500	
4/28/2017	[redacted]	[redacted]	ME	1	1	Besser Company	50,000	
4/28/2017	[redacted]	[redacted]	ME	1	1	Lake Superior State University	52,000	
4/28/2017	[redacted]	[redacted]	ME	4		BACA Systems		
12/15/2017	[redacted]	[redacted]	ME	2	1	Revolutionary Engineering	14/hour	
4/28/2017	[redacted]	[redacted]	MET			Hanon Systems		
4/28/2017	[redacted]	[redacted]	ME	2	2	TranTrek	57,500	
4/28/2017	[redacted]	[redacted]	MET	2		BACA Systems		
4/28/2017	[redacted]	[redacted]	MET	6	4	Esys Automation		
4/28/2017	[redacted]	[redacted]	ME	3	1	Eddy Ongaro Engineering Corporation		
4/28/2017	[redacted]	[redacted]	MET	2	2	Triton Atuomation	58,000	
4/28/2017	[redacted]	[redacted]	ME	1	1	JR Automation	49,950	
4/28/2017	[redacted]	[redacted]	EE	4		Mac Valves Inc.		
4/28/2017	[redacted]	[redacted]	ME	4	1	AMT		
7/28/2017	[redacted]	[redacted]	ME	1	1	ACME Manufacturing	1,195/week	
4/28/2017	[redacted]	[redacted]	CE	7	2	ADD Software	25/hour	
4/28/2017	[redacted]	[redacted]	MET	4	1	Esys Automation	25/hour	
7/28/2017	[redacted]	[redacted]	EET	3	3	JR Automation	25/hour	
4/28/2017	[redacted]	[redacted]	MET	6	5	Esys Automation	25/hour	
4/28/2017	[redacted]	[redacted]	ME			Michigan Tech		Grad School
4/28/2017	[redacted]	[redacted]	MET			Osprey Technologies		
4/28/2017	[redacted]	[redacted]	ME	2		Iron Foundry and Machine		
12/15/2017	[redacted]	[redacted]	EET	4	5	Triton Automation	21/hour	
4/28/2017	[redacted]	[redacted]	ME	3	2	Esys Automation	25/hour	
4/28/2017	[redacted]	[redacted]	MET		2	Hellena, Inc		
4/28/2017	[redacted]	[redacted]	CE	2	2	Textron Aviation	58,000	
4/28/2017	[redacted]	[redacted]	MET	3	2	Esys Automation	65,000	

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School:	**School of Engineering & Technology**
Document Title (If attached) or Filename (If emailed):	**SET_Goals_Assessment_ Planning Unit Four Column**
This documentation is relevant to Question number:	**7**
Briefly summarize the content of the file and its value as evidence supporting program review:	**This is the four column report on 3 of the 8 School goals.**

Assessment: Planning Unit Four Column

School: Planning - Engineering and Technology

Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
Current Knowledge and Skills - Deliver an undergraduate education that is current and provides knowledge and skills to be successful in professional careers or graduate school. **Goal Status:** Active **Strategic Plan Outcome(s) addressed:** A1. We will cultivate continuous academic and co-curricular improvement to provide relevant programs and support services			
Application of Fundamental Principles - Provide programs that focus on the applications of fundamental principles of engineering, technology, mathematics, science, and computing to benefit society. **Goal Status:** Active **Strategic Plan Outcome(s) addressed:** A1. We will cultivate continuous academic and co-curricular improvement to provide relevant programs and support services			
Robust Coursework - Provide courses	**Strategic - Student Learning** - Course	**Finding Reporting Year:** 2018-2019	**Use of Result:** The current course

Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
which incorporate and develop skills in communication, design, ethics, teamwork, technology, and capstone experiences relevant to the students' degrees. **Goal Status:** Active **Strategic Plan Outcome(s) addressed:** A2. We will cultivate student educational experiences that add value and allow students to reach their full potential.	outcomes should cover communication, design, ethics, teamwork, and technology. Students should also be required to complete a capstone experience.	**Goal met:** Yes EGNR491 has course outcomes related to the areas discussed. EGNR491 is also the capstone experience. (11/20/2018)	setup provides valuable experience to the students and should be continued. (11/20/2018)
Professional Growth and Lifelong Learning - Provide an education and opportunities for students with diverse abilities to enhance their professional growth and capacity for life-long learning. **Goal Status:** Active **Strategic Plan Outcome(s) addressed:** A3. We will cultivate programs that support individual growth within the curricular, co-curricular, and non-curricular realms culminating in degree completion and endorsement of lifelong learning.			
Continuous Improvement - Engage in continuous improvement activities through ongoing external and internal reviews. **Strategic Plan Outcome(s) addressed:** C3. We cultivate continuous self-improvement through service, assessment, and accountability.	**Strategic - Activity or Event** - The School should obtain external accreditation for most, if not all, B.S. programs.	**Finding Reporting Year:** 2018-2019 **Goal met:** Yes The Computer Engineering, Electrical Engineering, and Mechanical Engineering B.S. programs all submitted ABET self studies and had a site visit in Fall 2018 They are actively seeking accreditation. (11/20/2018)	**Use of Result:** Accreditation allows LSSU engineering alumni to seek professional licensure. This process should be maintained. (11/20/2018)
Engineering Solutions - Enable faculty, staff, and students to apply engineering solutions that support			

Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
regional economic growth and develop intellectual property. **Goal Status:** Active **Strategic Plan Outcome(s) addressed:** F3. We will cultivate viable entrepreneurial efforts to efficiently support evolving institutional needs, and to support new financially-viable, mission-driven opportunities.			
Enrollment and Retention - Maintain the School's viability, productivity, and effectiveness by supporting enrollment, retention, and placement initiatives. **Goal Status:** Active **Strategic Plan Outcome(s) addressed:** E1. We will cultivate, maintain, and support an enrollment management strategic plan that will center on programs and activities that reach enrollment goals.	**Strategic - Activity or Event** - Faculty should support enrollment by coordinating with Admissions to provide tours to prospective students.	**Finding Reporting Year:** 2018-2019 **Goal met:** Yes For the vast majority, if not all, of the student tour requests, a faculty member was able to meet with the student. (11/20/2018)	**Use of Result:** From anecdotal feedback, students appreciated being able to meet with faculty; this is something that differentiates a student tour at LSSU compared to other universities. This process should be continued. (11/20/2018)
Supportive Environment - Provide a supportive environment in which faculty, staff, and students are recognized as essential in the realization of the mission. **Goal Status:** Active **Strategic Plan Outcome(s) addressed:** C1. We cultivate an environment of inclusion where all members treat others with dignity and respect.			

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School:	**School of Engineering & Technology**
Document Title (If attached) or Filename (if emailed):	**B.S. Robotics Engineering program proposal curriculum committee forms.**
This documentation is relevant to Question number:	**9**
Briefly summarize the content of the file and its value as evidence supporting program review:	**This document showcases resource planning (see the appropriate subsection of that document).**

[Click on any blue/italicized text below to enter data.] **Form C**

LAKE SUPERIOR
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New Program Proposal

(Applicable for all undergraduate degrees and certificates)

Date: 2/12/2018
Proposed Program: *Bachelor of Science in Robotics Engineering*

Faculty: *Jim Devaprasad, Andrew Jones, Paul Weber, Joe Moening*
School: *School of Engineering and Technology*
Upcoming Semester program will be first offered: *Fall 2018*
Minimum GPA Required for Graduation: *2.0*
Other GPA Requirements: *2.0*
Other Requirements: *Other requirements (admission requirements, Jr. standing, etc).*

Catalog Program Description	*Enter the Program description as it will appear in the Academic Catalog – typically 1-3 descriptive paragraphs* *LSSU was the first university in the nation to institute an accredited B.S. degree program in Robotics Engineering Technology in 1985. Since the 1990s, robotics has been offered as a concentration or minor within LSSU's engineering and engineering technology degree programs. With the maturing of robotics technology, the B.S. degree program in Robotics Engineering was developed at LSSU to meet the demand for engineers to design and implement robotics systems for industrial automation. Students in the program will also be introduced to mobile robotics technology and its application in warehousing, military, health care, and human assistance.* *Similar to other engineering programs, this Robotics Engineering program will build upon a solid foundation of courses in mathematics, sciences, English, humanities and the social sciences. In addition to the theoretical background presented in the program's courses by full-time faculty members in small class settings, the students will also have numerous opportunities to work hands-on in lab courses. They will have many opportunities to work with millions of dollars' worth of industry standard equipment including various types of industrial robots, PLCs, vision systems, conveying systems, simulation software, end-of-arm tools, and sensors. This facility was recognized by the Technology Accreditation Commission of ABET as one of the most complete and advanced facilities of its kind in the country.* *For several decades LSSU has been preparing graduates for industries involved in the design and implementation of automated systems for manufacturing. The demand for LSSU graduates with specialization in robotics has been well established over multiple decades. Industrial robotics and*

	systems integration companies specifically seek out robotics engineering talent from LSSU. Over the years, this has resulted in substantially more job offers for the graduates (with nationally competitive salaries) than the number of graduates. Robotics Engineering graduates are employed in several types of industries involving manufacturing, autonomous vehicles, prosthetics design and build, or service robotics (hospitals, military, healthcare, rehabilitation, etc.) *There is an explosive growth in the application of robotics in the manufacturing industries and in the human service areas. LSSU will continue to successfully prepare graduates to meet the growing demand for technical talent in robotics.*

1. New Program Rationale

(a) Program Learning Outcomes. (*List the principal educational objectives, the learning outcomes, of the proposed new academic program.*

Outcome statements should be measureable statements of student achievement or student performance. Outcomes should reflect the level of the program and appropriate student development over time. Higher level programs should focus more on higher level processes.	*The School of Engineering and Technology is planning to seek ABET (an engineering accrediting body) accreditation for this new Robotics Engineering degree. All ABET accredited engineering programs must meet a series of objectives labeled "A" through "K".* *ABET Outcomes for Engineering Programs:* *(A) an ability to apply knowledge of mathematics, science, and engineering* *(B) an ability to design and conduct experiments, as well as to analyze and interpret data* *(C) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability* *(D) an ability to function on multidisciplinary teams* *(E) an ability to identify, formulate, and solve engineering problems* *(F) an understanding of professional and ethical responsibility* *(G) an ability to communicate effectively* *(H) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context* *(I) a recognition of the need for, and an ability to engage in life-long learning* *(J) a knowledge of contemporary issues* *(K) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.*

(b) Program Assessment:

Describe the evidence collected related to the proposed program, and the	*The field of robotics has seen significant growth particularly in the last 10 years after the economic recession in 2007-08 which*

review/evaluation process used to establish the need/benefit for this program.	particularly hit Michigan hard. The growth has been both in industrial robotics as well as in service robotics. Here is specific data to show evidence that graduates with a degree in Robotics Engineering are (and will be) in demand and why LSSU in particular is positioned very well to offer such a degree: **Data related to Market conditions for Robotics:** 1) The number of robots at work in the USA grew from about 180,000 units in 2007 to about 280,000 units in 2017. 2) News release from the Robotics Industries Association on Dec. 12, 2017 titled, "North American Automation Market Shattering Records in 2017". Excerpt from the release – "For the first nine months of 2017, 27,294 orders of robots valued at approximately \$1.473 billion were sold in North America, which is the highest level ever recorded in any other year during the same time period." 3) From an article in Fortune on Feb. 24, 2016 – "International Data Corporation said worldwide spending on robotics and related services will hit \$135.4 billion in 2019. The research firm said that global robotics spending in 2015 was \$71 billion, and is set to grow at a compound annual growth rate of 17%" 4) Title of an article from The Robot Report on Oct. 5, 2017 – "22 research reports forecast sustained robotics industry growth." 5) Excerpt from a report from a Brookings Institution study – "If you believe the great robot takeover has begun, then Michigan appears to be ground zero. Michigan has the nation's highest rate of industrial robots as a percentage of workers, and the state's factories are now using nearly as many robots as the entire West Coast of the United States." 6) A third of the industrial robots used in the USA are in the Midwest. **Data on LSSU Robotics and the Need to Offer a B.S. degree in Robotics Engineering:** Even though there has been explosive growth in robotics, the enrollment in the current engineering and technology programs has only been steady. Within the current programs in the School of Engineering and Technology (School of Engineering and Technology), the robotics concentration has seen steady growth resulting in nearly 2/3 of all graduates from the School of Engineering and Technology graduating with a robotics concentration or minor. With the growth in FIRST Robotics

	programs in high schools as well as with many career centers now offering robotics courses for high school students, the opportunities to recruit students into a Robotics Engineering degree have increased substantially. Here are some specific numbers: *1) For several years in the past, there has been way more job offers than the number of graduates with the robotics concentration or minor. For example, during the 2017 Fall Career Fair at LSSU, 12 of the 33 companies who were here, were specifically recruiting graduates with the robotics background. There were 3 other companies who also were recruiting in robotics in October of 2017. Between the 15 companies, there were more than 50 job openings for the 22 graduates. There have been several other companies contacting LSSU since October of 2017 for recruiting graduates for jobs starting in May of 2018.* *2) With the data in 1) above, there is obviously ample opportunity to recruit more students into a robotics specific program and successfully place the graduates in industries that specifically seek out LSSU for such graduates.* *3) Numerous companies have expressed interest and support of the development of the Robotics Engineering Degree. They include – FANUC Robotics, JR Automation, 4D Systems, Esys Automation, KUKA Robotics, Applied Manufacturing Technologies, Acme Manufacturing, Kawasaki Robotics, Triton Automation, Edgewater Automation, R&E Automated Systems, Textron Aviation, and Recognition Robotics.* *4) In terms of recruitment of students, with a degree in Robotics Engineering in place, LSSU should be highly successful in recruiting new students seeking a college major in robotics.* *5) A degree in Robotics Engineering will particularly be useful while recruiting high school students who participate in FIRST Robotics (FIRST – For Inspiration and Recognition in Science and Technology). There are 2700 FIRST teams in the USA with 90,000 students participating. Michigan has the highest number of high schools involved in FIRST in the USA (~500 teams involving more than 10,000 students). In 2018 through 2020, Detroit will be hosting the FIRST World Championship event in Cobo Hall and Ford Field where 600 teams and 60,000 students are expected to participate. LSSU is planning to have a booth in this event. Further, LSSU also has been hosting a FIRST event (3-days) on our campus for the past two years. This year 42 teams have registered for LSSU's FIRST event in April.* *6) A report that was published in April of 2017 based on a study*

	by Brandeis University who tracked about 1300 FIRST students over 5 years found that, "among first-year college students, FIRST alumni report significantly higher interest in majoring in computer science, engineering, and robotics than comparison students and are 2.6 times more likely to take an engineering course." The interest for majoring in robotics for these high school students was nearly as high as the interest in studying in all of the engineering fields combined. *7) Through grant funding and support from various industries, LSSU has built a $2-million robotics lab. This in addition to existing faculty and staff, we are well positioned to move to the next level in offering a specific degree in Robotics Engineering.* *8) Already 4 other universities in Michigan have recently started a B.S. degree program in robotics engineering. They are Oakland University, University of Michigan – Dearborn, Lawrence Technological University and University of Detroit-Mercy.* *9) When a Google search is done to find out about undergraduate degrees in robotics, LSSU does not make the list in the first page (we are about 25th). With a degree specifically in Robotics Engineering, it is anticipated that the search engine results will elevate LSSU to the first page. This should also significantly help in our efforts to increase enrollment in the School of Engineering and Technology and LSSU.* *10) With the One Rate Lake State program in place, this robotics engineering program will be attractive to students not only in Michigan but throughout the Midwest and beyond. This is because, unlike other robotics programs in Michigan and in other States, this program is designed to focus on industrial robotics.*

Describe the student achievement and learning outcome assessment methods, both direct and indirect, the school will use to measure and evaluate student achievement of the program outcomes.	*The School of Engineering and Technology is planning to seek ABET (an engineering accrediting body) accreditation for this new Robotics Engineering degree. All ABET accredited engineering programs must meet a series of objectives labeled "A" through "K".* *A more detailed discussion of the assessment process can be seen in the attached documentation (Student Outcome Evaluation of BS-RE Program). However, a basic summary is included for convenience. To assess a given objective, samples of student work are collected from a particular assignment from a specific course. Faculty members then evaluate the work as it relates to that given objective. If there is a concern, faculty members make recommendations for changes to the course or program. A summary of the evaluation is then discussed with the entire faculty and changes are approved and implemented.*

(c) Mission:

Describe how the proposed program will assist the University in achieving its objectives as defined y the Mission Statements of the School, College and University.	***School of Engineering and Technology (School of Engineering and Technology) Mission Statement:*** *"To produce sought-after engineers and technologists by providing a rigorous undergraduate learning experience characterized by close student-faculty interaction."* *This Robotics Engineering program will be producing much sought after engineers that the robotics industries are in desperate need of (as noted in the statistics in 1. b. above). The proven track record of the robotics concentration in existing engineering and engineering technology degrees and the tremendous growth in the robotics field makes this degree program in-line with the mission statement of the School of Engineering and Technology. Further, close student-faculty interaction will continue in the courses of this program by keeping the student-faculty ratio around 14:1.* ***LSSU Mission Statement:*** *"We equip our graduates with the knowledge, practical skills and inner strength to craft a life of meaningful employment, personal fulfillment, and generosity of self, all while enhancing the quality of life of the Upper Great Lakes region."* *Similar to other engineering programs, this Robotics Engineering program is designed to build upon a solid foundation of courses in mathematics, sciences, humanities and the social sciences. The graduates will have a well-rounded education to appreciate the importance of their engineering functions and its relevance and impact on society. This degree also addresses a major growth area in engineering – namely, robotics. With the maturing of this field of study as well as its applications not only in industry but also in human service, the graduates should have many decades of meaningful employment and personal fulfillment. With a high concentration in the use of robotics in the Midwest, our robotics engineering graduates should be gainfully employed in the Midwest States thereby contributing to the economic growth in these States as well as adding to the quality of life in the Upper Great Lakes region.*

2. Curriculum Design

(a) Submit, as a Word document, the complete degree audit for the new program.
Include requirements of the program, cognates, general education requirements, minor-if any, graduation requirements, the semester the audit becomes effective for students, and the audit revision date The degree audit filename should be descriptive of the program name and include the effective date If approved, e.g. BA_Chemistry_PP_Audit_F12.doc

[Click on any blue/italicized text below to enter data.]

(b) Course changes: For each new course developed with this program, include the curriculum committee's Form B – New Course Proposal, or Form A for changes/deletions

List the new or modified courses required by this program (if any).	*Only one new course, EGRS372 – Mobile Robotics (3, 3) 4, which will cover mobile robotics is currently needed. The new course proposal form is provided in the attached documentation (FormB EGRS372 New Course Proposal).* *If enrollment in this new program grows significantly in the future additional technical elective courses covering other aspects of robotics could be added.*

(c) Curriculum Mapping: *link objectives to measures of student learning*

Provide details (e.g., through narrative, matrix, etc.) of how the degree requirements relate to the program learning outcomes. How will the school demonstrate that all learning outcomes are assessed in the program and that graduates have achieved those outcomes? Resources to assist in developing of a curriculum map include http://manoa.hawaii.edu/assessment/howto/mapping.htm	*The School of Engineering and Technology is planning to seek ABET (an engineering accrediting body) accreditation for this new Robotics Engineering degree. All ABET accredited engineering programs must meet a series of student outcomes labeled "A" through "K".* *A mapping of courses to the objectives is provided in the attached documentation (Student Outcome Evaluation of BS-RE Program). The table shows the core robotics courses and how they map to the A-K student outcomes. To assess a given outcome, samples of student work are collected from a particular assignment from the specified course. Faculty members then evaluate the work as it relates to that given outcome. If there is a concern, faculty members make recommendations for changes to the course or program. A summary of the evaluation is then discussed with the entire faculty and changes are approved and implemented.* *In addition to the general engineering student outcomes, graduates should also have technical knowledge appropriate to the specific field of robotics engineering. To this end, the core robotics engineering classes include topics on basic robot programming and concepts (EGRS215), programmable logic controllers for industrial control (EGRS365), mobile robotics (EGRS372), kinematics (EGRS385), machine vision and systems integration (EGRS430), manufacturing automation (EGRS435) and classical controls (EGRS460). Safety, risk assessment, and contemporary topics will also be addressed through a special topics course (EGNR490). This set of courses will prepare students to work in either industrial automation or service robotics.*

3. Related Programs

(a) Impact on existing LSSU Academic programs:

i) Schools

What other schools or units at LSSU would provide support (facilities,	*At present, the facilities and faculty will all be supported within the School of Engineering and Technology. The supporting*

faculty, supporting courses, etc.) to the proposed program and how would this support be provided?	*classes outside of engineering will be the same as those in the other engineering programs, namely general education courses, CHEM115, MATH151, MATH152, MATH251, MATH308, MATH310, PHYS231, and PHYS232. Students may also choose to take supporting electives from BUSN, CSCI, ECON, MGMT, and/or MATH. This might result in increased enrollment in these courses.*

ii) Resources

How will additional staff and facilities (if any needed) for the proposed program strengthen related schools or areas at LSSU? What are the projected costs for full program development/deployment?	*The projected costs for the full program development/deployment are:* • *3 additional load hours release per semester for robotics lab coordinator will be needed for continued work on the B.S. in Robotics Engineering; exploration of a certificate program: oversight of accreditation and marketing of the program; collaborations with schools, career centers, community colleges, and programs like FIRST and VEX robotics; building a social media presence via LinkedIn; securing scholarship and recruitment support from external sources; expanding senior project and co-op opportunities within robotics; representing LSSU robotics in national events and conferences; leveraging robotics industry partnerships to obtain financial, equipment, and marketing support for the program.* • *A one-time allotment of 2 hours release time will be needed to develop the mobile robots course (EGRS372).* • *An 11th faculty member or potentially an additional staff member in the School of Engineering and Technology will be needed for Fall 2019 or Fall 2020. This is because additional sections of labs/classes will be needed for those in the robotics engineering core. There will also be a need for greater access to the robotics lab for students. Furthermore, more upper level robotics electives, if they were to be developed, could enhance the degree. The expected enrollment growth is estimated as roughly 20 students over the first couple years.* • *A 12th faculty member will be needed if the School of Engineering and Technology grows to 250 students. This 12th faculty member line should then allow the School of Engineering and Technology to grow to 300 students.* • *$75k in equipment will be needed for the program over the span of the next 3 years. Specifically needed*

	are multiple 'Turtle Bots' or their equivalent (~$18,000), two industrial mobile platforms with robot operating system (~$30,000). Industrial Internet of Things (IIoT) devices ($~12,000) will be an enhancement to the current industrial robotics lab. Software (~$15,000) will also need to be purchased to support robotics simulations. Lastly, the industrial robotics lab will need to be augmented with at least one collaborative robot, but this will be needed regardless of whether the B.S. in Robotics Engineering is offered. • *In terms of facilities, the only course which will require new space is the mobile robotics course (EGRS372). For this, a 30 ft. x 35 ft. area with open spaces along with electrical, mechanical or visual cues will be needed for the mobile robotics lab for mapping and navigation of the spaces.* • *We would request direct support for the B.S. in Robotics Engineering from Marketing, Admissions, and the webmaster immediately. As a new degree we want to capitalize on upcoming recruiting events (e.g. the April district FIRST Robotics Competition at LSSU and world FIRST Robotics Competition in Detroit) and the opportunity to influence the decisions of any potential students for the Fall 2018 semester.*

iii) Impact

List any similar/related existing programs at LSSU and describe the anticipated impact this program may have (either positive or negative) on the existing programs.	*It is possible that incoming students would select the robotics degree instead of one of the existing engineering degrees with a concentration in robotics. However, this program takes advantage of our existing courses as much as possible. As a result any incoming students to this program will help populate existing courses. In addition, the intention is to attract students who would have otherwise not considered LSSU due to the lack of a robotics engineering degree. Thus we think it will have a positive impact by increasing enrollment in our existing courses.*

iv) Affected Areas

Schools should communicate about proposed changes with affected programs in advance of submitting curriculum proposals. Programs needing additional time to respond to proposed changes should seek to postpone committee consideration of such items, e.g. agenda changes, motions to table, etc.

(b) Similar programs at other Michigan educational institutions:

i) Other institutions

What institutions now offer similar programs to this proposed program?	• ***Lawrence Tech***—*B.S. in Robotics Engineering* • ***Oakland University***—*B.S. in Industrial and Systems Engineering*

[Click on any blue/italicized text below to enter data.]

	- ***University of Detroit Mercy*—*B.S. in Robotics and Mechatronic Systems Engineering*** - ***University of Michigan Dearborn*—*B.S.E. in Robotics Engineering***

ii) Similar Programs

Compare the proposed program with programs offered by other institutions. For example, what special strengths or points of distinction will this program offer?	***The B.S. Robotics Engineering degree program is common with other similar programs in the nation as follows:*** *1) The program is designed to meet ABET accreditation standards and criteria. ABET is the national organization responsible for accrediting engineering and engineering technology programs.* *2) The courses in mathematics (Calculus I, II, III, Differential Equations, and Probability and Statistics), Physics (Calculus based Physics I and II), General Chemistry, English, and Intellectual Breadth (our general education courses) are similar to other engineering programs.* *3) Foundational Engineering courses such as structured programming language, control systems, statics, digital fundamentals, and robot kinematics are similar.* *4) A senior design project experience in our B.S. degree is also compatible to other similar curricula – although our two-course senior project sequence expectations are generally much higher than in other universities.* ***LSSU's B.S. Robotics Engineering degree will be distinct from other such programs as follows:*** *1) The strength and focus of our program is in industrial robotics. We offer specific specializations in areas like programmable logic controllers, machine vision, industrial robotics systems integration, design and simulation of robotics and manufacturing systems, and industrial robot safety and risk assessment that other programs do not.* *2) We have significant experience, as the only university in the nation, in educating students in industrial robotics over the past 3 decades. This has resulted in a network of employers of graduates and suppliers of automation equipment that are supportive of LSSU robotics.* *3) The industrial robotics lab at LSSU, with over $ 2-million in equipment and software, provides opportunities at the undergraduate level that are not typically available at other universities.* *4) Overall, in addition to the expected theoretical rigor as dictated by ABET accreditation guidelines, our program also has a heavy applied focus. Thus, employers have specifically sought out LSSU engineering graduates with the robotics concentration, indicating that our graduates can "hit the ground running".* *5) Finally, it would make sense to distinguish our program from other programs by saying, "We don't make useful robots, we make robots useful."*

4. Projected Enrollment and Costs

(a) Need for the proposed program.

Provide specific data and evidence of local, state, and/or national need for graduates of this program	*Please see the data and information provided in 1 (b) previously.* *In addition.....* *"According to Robotic Industries Association (RIA), North American companies ordered 31,464 robots, valued at $1.8 billion in 2015. This marked a 14 percent increase in such units.* *The number of robots shipped to the continent grew by 10 percent, with 28,049 units worth $1.6 billion coming in.* *These record breaking numbers are in part driven by the rising use of robotics in the automotive industry, which increased its orders over 2015 by 19 percent." Read more: http://www.dailymail.co.uk/sciencetech/article-3441166/Has-robot-taken-job-New-figures-reveal-America-record-breaking-260-000-robots-working-factories.html#ixzz57UI286FX Follow us: @MailOnline on Twitter | DailyMail on Facebook* *"In fact, the generation of career opportunities in North America due to robotic manufacturing is not to be viewed in isolation nor as a rare case of economic stimulation, as one global study notes that robot-driven job creation could reach 1.5 million by the end of 2016. " https://www.robotics.org/content-detail.cfm?content_id=6179* *The LSSU School of Engineering and Technology Industrial Advisory Board has, for at least two years, identified the need for a B.S. Robotics Engineering degree to be added to the School of Engineering and Technology.* *Individual communications with the employers that routinely hire LSSU engineering graduates that have taken the robotics concentration have indicated support for the B.S Robotics Engineering program.*

(b) Student interest and recruitment.

Summarize evidence of student interest in the proposed program and describe methods to be used to recruit students for the program.	*Along with the helping to fill employers demand for engineers knowledgeable in robotics, this B.S. in Robotic Engineering is hoping to capitalize on the increasing interest in robotics amongst prospective students. This interest in robotics is almost certainly due to the FIRST Robotics (For Inspiration & Recognition of Science & Technology) and VEX Robotics competitions, which have exploded in popularity. There are thousands of FIRST teams spread across the US and the world*

with 10's of thousands of students involved.

There are various FIRST programs that cover the entire K-12 grades. Ranging from FIRST Lego League Jr. for grades K-4, FIRST Lego League for grades 4-8, FIRST Tech Challenge for grades 7-8, up to FIRST Robotics Competition for grades 9-12. These programs expose these students to the STEM fields and make them particularly interested in robotics.

In a recent study of FIRST participants it was found that "Among first-year college students, FIRST alumni report significantly higher interest in majoring in computer science, engineering, and robotics that comparison students and are 2.6 times more likely to take an engineering course"
https://www.firstinspires.org/sites/default/files/uploads/resource_library/impact/first-longitudinal-study-summary-year-4.pdf

FIRST is particularly popular in Michigan which as of 2016 had the 410 teams, the most of any state. This has increased to 508 teams for 2018.
http://www.dbusiness.com/daily-news/Annual-2016/First-Robotics-Competitions-Expand-in-Michigan-Largest-Chapter-in-America/
http://frc-districtrankings.firstinspires.org/2018/FIM

Given the popularity of FIRST especially in Michigan, FIRST competitions and other robotics events are perfect recruiting opportunities. A FIRST District event is held at LSSU in April and will bring over 40 school teams to the LSSU campus. Booths will be setup at this event with information about the B.S. in Robotics Engineering as well as all other engineering degrees (other departments are encouraged to have booths as well). In addition to the district even, the FIRST World Championship event is being held in Detroit for the next three years. This event is once again an opportunity to highlight the B.S. in Robotics Engineering, the existing engineering degrees, as well as the other degrees offered at LSSU.

Anecdotally, many potential students and their families that tour the robotics lab inquire specifically about a "Robotics Engineering" degree. The degree is frequently raised as a comparison point with other Michigan universities that offer the 'named' degree in robotics. Having a B.S. in Robotics Engineering will help to sway those students who are intent on a "Robotics" degree.

Targeted online advertising will also be used to attract potential students such as those that search for "robotics engineering". Having a specific degree in Robotics Engineering will also help increase our relevance in online search results and thus will help expose more students to the program.

	Students will also be recruited through the development of articulation agreements, such as 2+2, with community colleges that have pre-engineering programs.

5. Other Considerations

(a) Scheduling

Describe plans for course delivery	*This program will be offered in the same mode as the currently offered Mechanical Engineering, Electrical Engineering and Computer Engineering programs. Specialized equipment necessitates on-campus delivery of laboratory sections.*

(b) Equipment

Describe available and needed equipment needed for this program	*The current robotics lab facilities provide students with experience in multiple robotics languages, teach pendant operation, conveyors, pallet handling, vision, and input/output systems. This industrial automation equipment will need to be augmented with Industrial Internet of Things (IIoT) and mobile robotic equipment to meet the additional lab needs of the B.S. Robotics Engineering program.* *$75k in equipment will be needed for the program over the span of the next 3 years. Specifically needed are multiple 'Turtle Bots' or their equivalent (~$18,000), two industrial mobile platforms with robot operating system (~$30,000). IIoT devices ($~12,000) will be an enhancement to the current industrial robotics lab. Software (~$15,000) will also need to be purchased to support robotics simulations. Lastly, the industrial robotics lab will need to be augmented with at least one collaborative robot. However, this will be needed regardless of whether the B.S. in Robotics Engineering is offered so it is not included in the $75k budget.*

(c) Resources: *Describe the extent to which existing resources are available and sufficient to fulfill the instructional objectives of this program:*

Describe resources (library holdings, laboratory space, budgets for consumables, computers, etc) needed for this program. If current resources are not sufficient, then use this box to additional describe specific needs, costs and funding sources necessary to achieve the instructional objectives.	*This degree program is built upon the strengths of our industrial robotics concentration. Our existing labs have been recognized in various publications. The existing industrial robotics and automation equipment combined with the courses and over 30 year experience in the robotics concentration have established a strong reputation among the industry employers that consistently hire our graduates from the robotics concentration.* *There is adequate scheduling opportunity to provide additional laboratory sections.*

[Click on any blue/italicized text below to enter data.]

Form C

	In terms of facilities, the only course which will require new space is the mobile robotics course (EGRS372). For this, a 30 ft. x 35 ft. area with open spaces along with electrical, mechanical or visual cues will be needed for the mobile robotics lab for mapping and navigation of the spaces. If this is newly allocated, a set of 8-12 computers will also be needed to facilitate student work with the mobile robots, including simulation and programming. *Please see the previous section for other equipment costs.*

(d) Accreditation

If this program is eligible for external accreditation, describe the accreditation requirements, costs/benefits to the university and identify other accredited programs in our state and/or region.	*As with existing engineering and engineering tech degrees the B.S. Robotics Engineering would be eligible for ABET EAC accreditation. The core courses for B.S. Robotics Engineering are the existing engineering core and robotics concentration courses. The assessment processes and procedures needed for the B.S. Robotics Engineering are already in place for our ABET accredited B.S. Electrical Engineering, B.S. Mechanical Engineering, and B.S. Computer Engineering. ABET on campus reviews are grouped for the existing programs. The B.S. Robotics Engineering program would be eligible for accreditation after the first students graduate from the program. For more Information see the ABET website: www.abet.org* *Of the 4 programs listed in Section 3 b i, those at Lawrence Tech, the University of Detroit Mercy, University of Michigan Dearborn, and Oakland University all are ABET accredited.* *The School of Engineering and Technology Industrial Advisory Board has on multiple occasions asserted that ABET accreditation was necessary to maintain for our programs.*

(e) Faculty

Describe any specialized requirements, expertise or licensure/certification required for faculty associated with this program. Identify and project faculty/staff requirements necessary for the program to meet the stated objectives, including practicum survision, laboratory managers, etc.	*Growth of the B.S. Robotics Engineering program will affect engineering and support courses such as math, physics and chemistry but, in particular, lab sections of robotics courses. Additional robotics lab sections and the increased need for greater lab availability will eventually require a dedicated robotics lab attendant staff member to supervise the use of the industrial robots and ensure safety.*

[Click on any blue/italicized text below to enter data.]

Form C

RECORD OF ACTION - Proposal for: ***Bachelor of Science in Robotics Engineering***

This form must be submitted to the Registrar's Office following school approval and concurrence of the dean. The Registrar's Office will distribute for the Curriculum Committee. An approved signed copy will be returned to the School with the original kept in the Registrar's Office, after final approval.

	Date	**For**	**Opposed**	**Abstained**	**Absent**
Departmental (Advisory) Vote:	*N/A*	N/A	N/A	N/A	N/A
School Faculty Vote:	*2/27/2018*	9	0	0	0
College Dean's Approval:	2/27/18	Signed:			
Curriculum Committee Vote:					
Provost Council (Advisory) Vote:					
Provost:		Signed:			

School of Engineering and Technology

BS Degree in Robotics Engineering

Effective Fall 2018

Student Name: ____________________ Advisor Approval: ____________________ Date: ________

Student ID: ____________________ Coordinator Approval: ____________________ Date: ________

Intended Month of Graduation: ____________________ SET Chair Approval: ____________________ Date: ________

All information below should be from the student's most recent transcript and/or transfer evaluation.

GENERAL EDUCATION REQUIREMENTS

Communication (6 credits)

ENGL110 - 3 _____

ENGL111 - 3 _____

Humanities (6 credits; different disciplines; see catalog)

Elective __________ - __ _____

Elective __________ - __ _____

Social Science (6 credits; different disciplines; see catalog)

Elective __________ - __ _____

Elective __________ - __ _____

Mathematics (3 credits)

(fulfilled by departmental requirements)

Natural Sciences (7 credits)

(fulfilled by departmental requirements)

Diversity (3 credits; see catalog)

Elective __________ - __ _____

Communication Skills (3 credits)

COMM101, 201, or 225 COMM____ - __ _____

☐ **GEN-ED Requirements met by MTA or MACRAO**

Students must satisfy all of the following minimum requirements for graduation from LSSU:

☐ 2.0 overall GPA
☐ 2.0 General Education GPA
☐ 2.0 departmental GPA
☐ 124 total credits (minimum for LSSU and this program)
☐ 30 credits from Mathematics and Natural Science
☐ 30 credits earned at LSSU
☐ 24 credits 300/400 level in major earned at LSSU

PROGRAM REQUIREMENTS

Complete the Robotics Engineering Core (81 credits required)

EGEE125 - 4 _____	EGRS215 - 2 _____	CHEM115 - 5 _____
EGEE210 - 4 _____	EGRS365 - 3 _____	MATH151 - 4 _____
EGEM220 - 3 _____	EGRS372 - 4 _____	MATH152 - 4 _____
EGME141 - 3 _____	EGRS385 - 4 _____	MATH251 - 4 _____
EGNR101 - 2 _____	EGRS430 - 4 _____	MATH308 - 3 _____
EGNR140 - 2 _____	EGRS435 - 3 _____	MATH310 - 3 _____
EGNR265 - 3 _____ (C or better required)	EGRS460 - 4 _____	PHYS231 - 4 _____
EGNR340 - 1 _____		PHYS232 - 4 _____
EGNR490 - 4 _____		

Complete one of the Senior Year Experiences (6-13 credits required)

Industrial Project	Cooperative Project	Research Project
EGNR491 - 3 _____	EGNR250 - 2 _____	EGNR260 - 2 _____
EGNR495 - 3 _____	EGNR450 - 4 _____	EGNR460 - 4 _____
	EGNR451 - 3 _____	EGNR461 - 2 _____
	EGNR491 - 3 _____	

Complete the Technical Electives (6 credits minimum required)

CSCI281 or higher; EGEE250 or higher; EGEM320; EGET310; EGME225 or higher; EGMT216; EGNR261 or higher; or EGRS481.

__________ - __ _____ __________ - __ _____

__________ - __ _____ __________ - __ _____

Complete the Support Elective (3 credits minimum required)

BUSN231 or higher; CSCI201 or higher; ECON302 or higher; EGME110; MATH215 or higher; MGMT280 or higher; or from Technical Electives.

__________ - __ _____ __________ - __ _____

Complete the Free Elective (4 credits minimum required)

__________ - __ _____ __________ - __ _____

__________ - __ _____ __________ - __ _____

Robotics Engineering

EXAMPLE STUDENT OUTCOME EVALUATION REPORT

This report contains:

1. Summary and Schematic diagram of the assessment process for the Robotics Engineering program
2. Chart depicting the extent of coverage and expected level of achievement of each student outcome in every course in the core of the Robotics Engineering curriculum
3. List of the Robotics Engineering student outcomes (A-K)
4. Template for each Robotics Engineering student outcome (A-K):
    - Statement of the related performance indicator(s)
    - Course assignments from which associated student work is evaluated
    - Summaries of the evaluations of student work
    - Survey responses of graduating Robotics Engineering students for the past two years
    - Review of the student outcome results
    - Recommended changes to the Robotics Engineering curriculum

Summary:

The School of Engineering & Technology (SET) is planning to seek ABET (an engineering accreditation society) accreditation for this new Robotics Engineering degree. All ABET accredited engineering programs must meet a series of student outcomes labeled "A" through "K". A schematic diagram seen below provides an overview of the assessment process.

The first step in this process is to determine how each course in the robotics core is related to each of the A-K outcomes. A mapping of courses to the objectives is provided in the table below. The table shows the core robotics courses and how they map to the A-K student outcomes.

The next step is select at least one course in which to assess each objective, some objectives will be assessed in more than one course. Ideally the objective is assessed in an upper level course in which that objective is a focus of the course. With the courses selected, performance indicators are written for each of the selected courses and objectives. The performance indicator is designed to provide a specific example of student achievement related to the outcome. Next the assignment that will be used to evaluate the students' performance is selected. An example developed for objective A can be seen below.

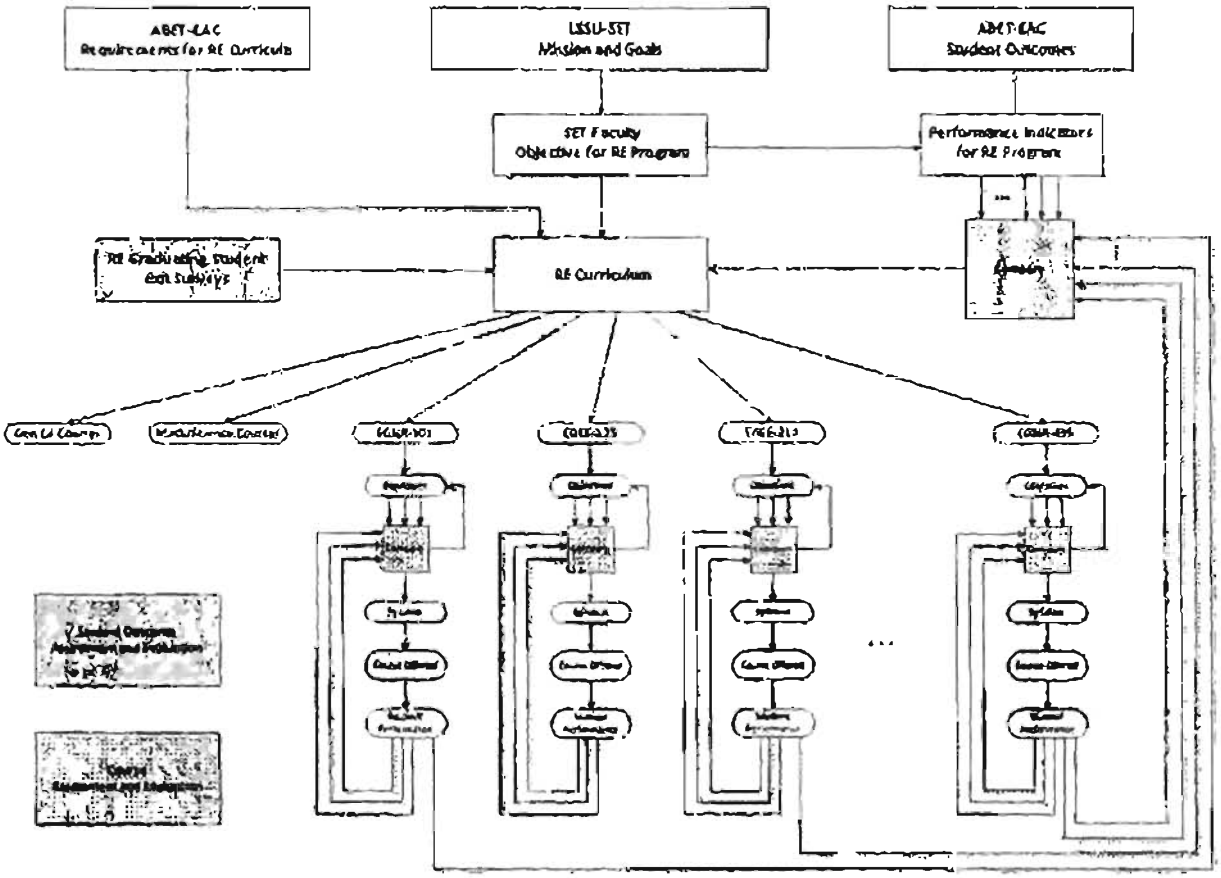
Objective	(A) *an ability to apply knowledge of mathematics, science, and engineering*
Course	EGRS-460
Performance Indicator	*the ability to mathematically characterize a physical system's input-output relationship and use it to predict its response to an input*
Assignment	Final exam question on step response of a physical system

When each course is offered samples of student work from the selected assignments are collected by the instructor. The instructor and at least one other faculty member then evaluates the samples of student work only as it pertains to that performance indicator and objective. Faculty members rate each sample using a score between 1 and 4 as seen below.

(1) Unacceptable	(2) Below Standard	(3) Meets Standard	**(4) Exemplary**

From this evaluation, if there is a concern, the evaluators make recommendations for changes to the course or program. Once complete, a summary of the evaluation is then discussed with the entire faculty and any changes are discussed and implemented.

Electrical Engineering Program Assessment Process



Core Robotics Engineering Courses
Extent of Coverage and Expected Achievement of ABET-EAC Student Outcomes

Course	Cores	A	B	C	D	E	F	G	H	I	J	K
EGEE-125	CE, EE, RE	✓✓✓ m	✓ *	✓✓ *	✓ *	✓✓ *		✓✓ *	✓ *	✓ *	✓ *	✓✓✓ *
EGEE-210	CE, EE, ME, RE	✓✓ m, S, E	✓ *	✓ *	✓ *	✓ *		✓ *				✓ *
EGEM-220	EE, ME, RE	✓✓✓ m, E						✓ *				✓ *
EGNR-101	CE, EE, ME, RE	✓ e		✓✓ *	✓✓ *	✓ *	✓✓ *	✓✓ *	✓ *	✓ *	✓ *	✓✓✓ *
EGNR-140	CE, EE, ME, RE	✓✓ m, e				✓✓ *		✓ *				✓✓✓ *
EGNR-265	EE, ME, RE	✓ m, e		✓ **		✓✓ **		✓ *		✓ *		✓✓✓ **
EGNR-490	RE	✓✓ E		✓✓ **			■		■	■	■	✓✓✓ **
EGNR-491	CE, EE, ME, RE	✓ E		▨ ✓✓✓ ***	✓✓✓ **	✓✓✓ **	✓✓ *	✓✓✓ ***	✓ *	▨		✓✓ ***
EGNR-495	CE, EE, ME, RE	✓ E	▨	✓✓✓ ***	▨	✓✓✓ **	▨	▨	✓✓ **	✓✓ **	▨	✓✓ ***
EGRS-215	RE	✓ m, e			✓ *	✓✓ *		✓ *			✓ *	✓ *
EGRS-365	RE	✓ e	✓ *	✓✓ ***		✓✓ **		✓✓ **				✓✓ **
EGRS-312	RE	■		■		■		✓✓ *	✓ *	✓ **	✓ *	✓✓✓ **
EGRS-385	RE	✓✓✓ M, e, s		✓ **		✓✓ **		✓✓ *	✓ *	✓ **	✓ *	✓✓✓ **
EGRS-430	RE	✓✓ E	✓ *	✓✓ **		✓ *		✓✓ **				✓✓✓ **
EGRS-435	RE	✓✓ e		✓✓ **	✓ *	✓✓ **		✓✓ **			✓✓ **	■
EGRS-460	EE, ME, RE	▨ ✓✓✓	✓ *	✓ *		■		✓ **				✓ *

■	evaluated for RE
▨	evaluated for EE, CE, and RE

▨	evaluated for EE, ME, and RE
▨	evaluated for CE, EE, ME, and RE

✓	exposure (for instance, one graded assignment)
✓✓	stress (for instance, one course objective)
✓✓✓	focus (for instance, multiple objectives or course title)
IP	incorporation into course is "in progress"

*	foundational – ready for further development
**	developed – prepared for practical application
***	high – approaching that of a practicing engineer
m (M)	basic-level (advanced-level) mathematics
s (S)	basic-level (advanced-level) science
e (E)	basic-level (advanced-level) engineering

(A) an ability to apply knowledge of mathematics, science, and engineering

(B) an ability to design and conduct experiments, as well as to analyze and interpret data

(C) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(D) an ability to function on multidisciplinary teams

(E) an ability to identify, formulate, and solve engineering problems

(F) an understanding of professional and ethical responsibility

(G) an ability to communicate effectively

(H) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(I) a recognition of the need for, and an ability to engage in life-long learning

(J) a knowledge of contemporary issues

(K) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ROBOTICS ENGINEERING STUDENT OUTCOME (A)

"an ability to apply knowledge of mathematics, science, and engineering"

Performance Indicator #A1

the ability to develop control algorithms for a steering mobile robot

EGRS-372 – final exam question

EGRS-372 (✓✓✓ = stress, MEs = advanced-level math, advanced-level engineering, basic-level science) Semester

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
	TBD	TBD	TBD	TBD	TBD

Reviewer Comments

- Comments regarding the evaluation of the objective.
- Comments regarding the evaluation of the objective.

Performance Indicator #A2

the ability to mathematically characterize a physical system's input-output relationship and use it to predict its response to an input

EGRS-460 – final exam question on step response of a physical system

EGRS-460 (✓✓✓= focus, MsE = advanced-level math, basic-level science, advanced-level engineering) Semester

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
	TBD	TBD	TBD	TBD	TBD

Reviewer Comments

- Comments regarding the evaluation of the objective.
- Comments regarding the evaluation of the objective.

Senior Exit Survey Results

"I have an ability to apply knowledge of mathematics, science, and engineering"

(1="not at all", 10 = "excellent")

Semester	Number of Students	Average Response
	TBD	TBD
	TBD	TBD
	TBD	TBD
	TBD	TBD

Analysis and Recommendations (Date)

- Recommendations as a result of the evaluation of the objective.

ROBOTICS ENGINEERING STUDENT OUTCOME (B)

"an ability to design and conduct experiments, as well as to analyze and interpret data"

Performance Indicator #B1

the ability to develop a valid and reliable experimental procedure that will validate a product

EGNR-495 – design review on final product testing

EGNR-495 (✓✓ = stress, •• = developed) Semester

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
	TBD	n/a	n/a	n/a	n/a

Reviewer Comments

- Comments regarding the evaluation of the objective.
- Comments regarding the evaluation of the objective.

Senior Exit Survey Results

"I have an ability to design and conduct experiments, as well as to analyze and interpret data."

(1="not at all", 10 = "excellent")

Semester	Number of Students	Average Response
	TBD	TBD
	TBD	TBD
	TBD	TBD
	TBD	TBD

Analysis and Recommendations (Date)

- Recommendations as a result of the evaluation of the objective.

ROBOTICS ENGINEERING STUDENT OUTCOME (C)

"an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability"

Performance Indicator #C1

the ability to reformulate implied customer needs as specifications and produce an acceptable design solution

EGNR-491 – product design review

EGNR-491 (✓✓✓= focus, *** = high) Semester

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
	TBD	TBD	TBD	TBD	TBD

Reviewer Comments

- Comments regarding the evaluation of the objective.
- Comments regarding the evaluation of the objective.

Performance Indicator #C2

the ability to program and configure a mobile robot to perform a practical application

EGRS-372 – final design project report

EGRS-372 (✓✓✓ = stress, MEs = advanced-level math, advanced-level engineering, basic-level science) Semester

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
DB	TBD	TBD	TBD	TBD	TBD

Reviewer Comments

- Comments regarding the evaluation of the objective.
- Comments regarding the evaluation of the objective.

Senior Exit Survey Results

"I have an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability."

(1="not at all", 10 = "excellent")

Semester	Number of Students	Average Response
	TBD	TBD
	TBD	TBD
	TBD	TBD
	TBD	TBD

Analysis and Recommendations (Date)

- Recommendations as a result of the evaluation of the objective.

ROBOTICS ENGINEERING STUDENT OUTCOME (D)

"an ability to function on multidisciplinary teams"

Performance Indicator #D1

the ability to provide constructive criticism of team members

EGNR-495 – peer evaluations

EGNR-495 (✓✓✓ = focus, ••• = high) Semester

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
	TBD	TBD	TBD	TBD	TBD

Reviewer Comments

- Comments regarding the evaluation of the objective.
- Comments regarding the evaluation of the objective.

Senior Exit Survey Results

"I have an ability to function on multidisciplinary teams."

(1="not at all", 10 = "excellent")

Semester	Number of Students	Average Response
	TBD	TBD
	TBD	TBD
	TBD	TBD
	TBD	TBD

Analysis and Recommendations (Date)

- Recommendations as a result of the evaluation of the objective.

ROBOTICS ENGINEERING STUDENT OUTCOME (E)

"an ability to identify, formulate, and solve engineering problems"

Performance Indicator #E1

the ability to use sensor data to develop a map of the environment and navigate through it
EGRS-372 – final design project report

EGRS-372 (✓✓✓ = stress, MEs = advanced-level math, advanced-level engineering, basic-level science) Semester

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
	TBD	TBD	TBD	TBD	TBD

Reviewer Comments

- Comments regarding the evaluation of the objective.
- Comments regarding the evaluation of the objective.

Performance Indicator #E2

the ability to develop a control algorithm that meets the required specifications
EGRS-460 – final design project report

EGRS-460 (✓= exposure, * = foundational) Semester

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
	TBD	TBD	TBD	TBD	TBD

Reviewer Comments

- Comments regarding the evaluation of the objective.
- Comments regarding the evaluation of the objective.

Senior Exit Survey Results

"I have an ability to identify, formulate, and solve engineering problems."
(1="not at all", 10 = "excellent")

Semester	Number of Students	Average Response
	TBD	TBD
	TBD	TBD
	TBD	TBD
	TBD	TBD

Analysis and Recommendations (Date)

- Recommendations as a result of the evaluation of the objective.

ROBOTICS ENGINEERING STUDENT OUTCOME (F)

"an understanding of professional and ethical responsibility"

Performance Indicator #F1

the ability to apply perspectives from established ethical philosophies in the analysis of a case study

EGNR-495 – ethics essay

EGNR-495 (✓✓✓ = focus, "" = developed) Semester

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
	TBD	TBD	TBD	TBD	TBD

Reviewer Comments

- Comments regarding the evaluation of the objective.
- Comments regarding the evaluation of the objective.

Senior Exit Survey Results

"I have an understanding of professional and ethical responsibility."

(1="not at all", 10 = "excellent")

Semester	Number of Students	Average Response
	TBD	TBD
	TBD	TBD
	TBD	TBD
	TBD	TBD

Analysis and Recommendations (Date)

- Recommendations as a result of the evaluation of the objective.

ROBOTICS ENGINEERING STUDENT OUTCOME (G)

"an ability to communicate effectively"

Performance Indicator #G1

the ability to make formal engineering presentations

EGNR-495 – final project presentations

EGNR-495 (✓✓✓ = focus, *** = high) Semester

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
	TBD	TBD	TBD	TBD	TBD

Reviewer Comments

- Comments regarding the evaluation of the objective.
- Comments regarding the evaluation of the objective.

Senior Exit Survey Results

"I have an ability to communicate effectively."

(1="not at all", 10 = "excellent")

Semester	Number of Students	Average Response
	TBD	TBD
	TBD	TBD
	TBD	TBD
	TBD	TBD

Analysis and Recommendations (Date)

- Recommendations as a result of the evaluation of the objective.

ROBOTICS ENGINEERING STUDENT OUTCOME (H)

"the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context"

Performance Indicator #H1

the ability to describe the possible impacts of service robots

EGNR-490 – research essays

EGNR-490 (✓= exposure, * = foundational) Semester

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
	TBD	TBD	TBD	TBD	TBD

Reviewer Comments

- Comments regarding the evaluation of the objective.
- Comments regarding the evaluation of the objective.

Senior Exit Survey Results

"I have the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context."

(1="not at all", 10 = "excellent")

Semester	Number of Students	Average Response
	TBD	TBD
	TBD	TBD
	TBD	TBD
	TBD	TBD

Analysis and Recommendations (Date)

- Recommendations as a result of the evaluation of the objective.

ROBOTICS ENGINEERING STUDENT OUTCOME (I)

"a recognition of the need for, and an ability to engage in life-long learning"

Performance Indicator #I1

the ability to define and clarify customer needs through technical investigation

EGNR-491 – scope presentation

EGNR-491 (✓✓= stress, ** = developed) Semester

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
	TBD	TBD	TBD	TBD	TBD

Reviewer Comments

- Comments regarding the evaluation of the objective.
- Comments regarding the evaluation of the objective.

Performance Indicator #I2

the ability to find and analyze appropriate sources of information about a topic not explicitly covered in the course material

EGNR-490 – research essay

EGNR-490 (✓✓= stress, ** = developed) Semester

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
	TBD	TBD	TBD	TBD	TBD

Reviewer Comments

- Comments regarding the evaluation of the objective.
- Comments regarding the evaluation of the objective.

Senior Exit Survey Results

"I have a recognition of the need for, and an ability to engage in life-long learning."

(1="not at all", 10 = "excellent")

Semester	Number of Students	Average Response
	TBD	TBD
	TBD	TBD
	TBD	TBD
	TBD	TBD

Analysis and Recommendations (Date)

- Recommendations as a result of the evaluation of the objective.

ROBOTICS ENGINEERING STUDENT OUTCOME (J)

"a knowledge of contemporary issues"

Performance Indicator #J1

the ability to use examples from a realistic case study in making arguments

EGNR-495 - ethics essay

EGNR-495 (✓= exposure, * = foundational) Semester

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
	TBD	TBD	TBD	TBD	TBD

Reviewer Comments

- Comments regarding the evaluation of the objective.
- Comments regarding the evaluation of the objective.

Performance Indicator #J2

the ability to explain a contemporary robotics topic

EGNR-490 – research essay

EGNR-490 (✓✓= stress, ** = developed) Semester

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
	TBD	TBD	TBD	TBD	TBD

Reviewer Comments

- Comments regarding the evaluation of the objective.
- Comments regarding the evaluation of the objective.

Senior Exit Survey Results

"I have a knowledge of contemporary issues."

(1="not at all", 10 = "excellent")

Semester	Number of Students	Average Response
	TBD	TBD
	TBD	TBD
	TBD	TBD
	TBD	TBD

Analysis and Recommendations (Date)

- Recommendations as a result of the evaluation of the objective.

ROBOTICS ENGINEERING STUDENT OUTCOME (K)

"an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice"

Performance Indicator #K1

the ability to apply principles of flow line analysis through the use of manufacturing simulation software

EGRS-435 – Modeling and lab write-up about a manufacturing system and its performance

EGRS-435 (✓✓= stress, ** = developed) Semester

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
	TBD	TBD	TBD	TBD	TBD

Reviewer Comments

- Comments regarding the evaluation of the objective.
- Comments regarding the evaluation of the objective.

Senior Exit Survey Results

"I have an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice."

[1="not at all", 10 = "excellent"]

Semester	Number of Students	Average Response
	TBD	TBD
	TBD	TBD
	TBD	TBD
	TBD	TBD

Analysis and Recommendations (Date)

- Recommendations as a result of the evaluation of the objective.

LAKE SUPERIOR
STATE UNIVERSITY
Engineering & Technology

To: Curriculum Committee
From: Paul J. Weber, Chair, School of Engineering & Technology
Date: March 2, 2018
Subject: Additional Supporting Evidence for B.S. Robotics Engineering

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Curriculum Committee members,

The purpose of this memo is to provide additional supportive evidence for your review for the proposed B.S. Robotics Engineering degree. This information was compiled after the formal vote at our School of Engineering & Technology meeting and gathered in response to questions and discussions with colleagues outside the School.

Thank you for your consideration of the program.

Sincerely,

Paul J. Weber, Chair, School of Engineering & Technology
on behalf of the School of Engineering & Technology

Attachments:
- Enrollment Data for Engineering Degrees at the University of Detroit-Mercy
- Degree and Assessment Information for Other LSSU Engineering Programs (for Comparison to Robotics Engineering Program)

University of Detroit Mercy Engineering Enrollment Data

Program: Robotics and Mechatronics System Engineering

	Academic Year		Enrollment Year (UG Only)					Total UG	Total GR	Degrees Awarded			
			1st	2nd	3rd	4th	5th			Associates	Bachelors	Masters	Doctorates
Current Year	2016-17	FT	13	4	4	2	0	23	0	N/A	N/A until end of 2016-17		
		PT	0	0	0	1	0	1	0				
1	2015-16	FT	6	3	3	5	0	17	0		3	0	0
		PT	0	0	0	1	0	1	0				
2	2014-15	FT	3	2	3	1	0	9	0		N/A		
		PT	0	0	0	0	0	0	0				
3	2013-14	FT	0	3	0	1	0	4	0				
		PT	0	0	0	0	0	0	0				
4	2012-13	FT	1	1	0	0	0	2	0				
		PT	0	0	0	0	0	0	0				
5	2011-12	FT	N/A										
		PT											
6	2010-11	FT											
		PT											

Program: Mechanical Engineering

	Academic Year		Enrollment Year (UG Only)					Total UG	Total GR	Degrees Awarded			
			1st	2nd	3rd	4th	5th			Associates	Bachelors	Masters	Doctorates
Current Year	2016-17	FT	26	12	31	22	0	91	24	N/A	N/A until end of 2016-17		
		PT	1	0	1	1	1	4	10				
1	2015-16	FT	16	27	18	14	0	75	21		8	13	1
		PT	0	1	0	3	0	4	7				
2	2014-15	FT	16	18	12	12	0	58	16		6	16	0
		PT	1	0	0	0	0	1	4				
3	2013-14	FT	17	10	8	17	0	52	54		12	11	1
		PT	0	0	0	3	0	3	5				
4	2012-13	FT	12	8	19	11	0	50	29		15	23	3
		PT	1	0	1	5	0	7	4				
5	2011-12	FT	13	10	14	11	0	48	30		12	15	0
		PT	1	1	1	3	3	9	17				
6	2010-11	FT	11	14	10	13	0	48	14		8	11	0
		PT	1	0	0	1	0	2	8				

Program: Electrical Engineering

	Academic Year		Enrollment Year (UG Only)					Total UG	Total GR	Degrees Awarded			
			1st	2nd	3rd	4th	5th			Associates	Bachelors	Masters	Doctorates
Current Year	2016-17	FT	10	4	4	11	2	33	14	N/A	N/A until end of 2016-17		
		PT	1	0	0	1	0	2	8				
1	2015-16	FT	4	4	7	1	0	16	18		1	8	1
		PT	0	0	2	0	0	2	9				
2	2014-15	FT	5	8	7	3	1	24	17		7	16	0
		PT	0	1	0	0	2	3	14				
3	2013-14	FT	7	5	2	8	0	22	16		6	12	1
		PT	0	1	0	2	0	3	15				
4	2012-13	FT	2	4	7	3	0	16	41		1	8	0
		PT	0	0	0	1	0	1	10				
5	2011-12	FT	1	7	3	4	0	15	17		5	10	1
		PT	0	0	0	0	0	0	12				
6	2010-11	FT	7	3	4	15	0	29	21		16	12	3
		PT	1	0	0	0	0	1	9				

[illegible]

Degree and Assessment Information for Other LSSU Engineering Programs

Core Engineering Courses
Extent of Coverage and Expected Achievement of ABET-EAC Student Outcomes

[Note: This is a sample showing primarily classes where work is selected.]

Course	Cores	A	B	C	D	E	F	G	H	I	J	K
EGEE-125	CE, EE	✓✓✓ E	✓ *	✓✓ *	✓ *	✓✓ *		✓✓ *	✓ *	✓ *	✓ *	✓✓✓ *
EGEE-310	EE	✓✓✓ M, E		■		■		✓ **				■
EGEE-320	CE	✓✓ m, e	✓ **	✓ **	✓✓✓ *	✓✓ **	✓ *	✓✓ *	✓ *	✓ *	✓ *	✓✓✓ **
EGEE-330	EE	✓✓ m, S, e	✓ *									✓✓ **
EGEE-345	EE	■				✓✓✓ **		■	■	✓ *		
EGEE-355	CE	✓✓ m, e	✓ **	▨ ✓✓ [illegible]	✓ *	✓✓ ***		▨ ✓ *		✓ *	✓ *	▨ [illegible]
EGEE-370	CE, EE	✓✓ m, S, e	✓ **		✓ *	✓✓ **		✓✓ *				✓✓ *
EGEE-425	CE	✓✓✓ M, e	✓ *	✓ *	✓ *	▨ ✓✓✓ **		✓✓ **	✓ *	✓ *	IP	✓✓✓ **
EGEE-475	EE	✓✓ m, e, E	✓ *		✓ *	✓✓ **		✓✓ **	IP	IP	IP	✓ **
EGEM-220	EE, ME	✓✓✓ m, E						✓ *				✓ *
EGMR-380	ME	■		■	✓✓ *	■		✓✓ **	■	✓✓ **		■
EGME-431	ME	✓✓ M, S, E				✓ *						✓ *
EGME-432	ME	✓✓ M, S, E	■					■		✓ **		✓ *
EGNR-101	CE, EE, ME	✓ e		✓✓ *	✓✓ *	✓ *	✓✓ *	✓✓ *	✓ *	✓ *	✓ *	✓✓✓ *
EGNR-340	CE, EE, ME	▨ [illegible]	✓ *			✓ **						▨ [illegible]
EGNR-348	CE, EE	✓✓ M, e	▨ [illegible]	✓ *				✓✓ **				✓✓ **
EGNR-491	CE, EE, ME	✓ E		▨ ✓✓✓ ***	✓✓✓ **	✓✓✓ **		✓✓✓ ***	✓ *	✓ **		✓✓✓ ***
EGNR-495	CE, EE, ME	✓ E	▨ [illegible] **	✓✓✓ ***	▨ ✓✓✓ ***	✓✓✓ ***	▨ ✓✓ **	▨ ✓✓✓ ***	✓✓ **	▨ ✓ **	▨ [illegible]	✓✓✓ ***
EGRM-460	EE, ME	▨ ✓✓✓ M, [illegible]	✓ *	✓ *		✓✓✓ ***		✓ **				✓ *

☐	evaluated for CE
■	evaluated for EE
■	evaluated for ME

▨	evaluated for CE and EE
▨	evaluated for EE and ME
▨	evaluated for CE, EE, and ME

✓	exposure (for instance, one graded assignment)
✓✓	stress (for instance, one course objective)
✓✓✓	focus (for instance, multiple objectives or course title)

*	foundational – ready for further development
**	developed – prepared for practical application
***	high – approaching that of a practicing engineer

IP	incorporation into course is "in progress

m (M)	basic-level (advanced-level) mathematics
s (S)	basic-level (advanced-level) science
e (E)	basic-level (advanced-level) engineering

ABET-EAC STUDENT OUTCOME (A)
[Note: There is similar documentation for Outcomes B – K.]

"an ability to apply knowledge of mathematics, science, and engineering"

Computer Engineering

Performance Indicator #A1

"the ability to solve a partial differential equation (PDE) numerically"

EGNR-340 – final exam question on PDE's

Performance Indicator #A2

"the ability to apply complex mathematics to transform from the discrete time domain to the frequency domain"

EGEE-425 – final exam problem on discrete Fourier transform

Performance Indicator #A3

"the ability to mathematically characterize a digital system's input-output relationship and use it to predict its response to an input"

EGEE-320 – final exam question on circuit timing

Electrical Engineering

Performance Indicator #A1

"the ability to solve a partial differential equation (PDE) numerically"

EGNR-340 – final exam question on PDE's

Performance Indicator #A2

"the ability to mathematically characterize a physical system's input-output relationship and use it to predict its response to an input"

EGRS-460 - final exam question on step response of a physical system

Performance Indicator #A3

"the ability to apply vector calculus and Maxwell's equations"

EGEE-345 – final exam problem on analyzing electric field due to ring of charge

Mechanical Engineering

Performance Indicator #A1

"the ability to solve a partial differential equation (PDE) numerically"

EGNR-340 – final exam question on PDE's

Performance Indicator #A2

"the ability to mathematically characterize a physical system's input-output relationship and use it to predict its response to an input"

EGRS-460 – final exam question on step response of a physical system

Performance Indicator #A3

"the ability to use eigenvalue analysis to analyze critical values of physical systems to predict failure points (e.g., resonances, buckling loads, critical shaft speeds, critical vehicle speeds, etc.)"

EGME-350 – buckling exam problem

School of Engineering and Technology

BS Degree in Computer Engineering

(For Students Entering the Program in the 2017-2018 Academic Year)

Student Name: ______ Advisor Approval: ______ Date: ______

Student ID: ______ ECE Coordinator Approval: ______ Date: ______

Intended Month of Graduation: ______ SET Chair Approval: ______ Date: ______

All information below should be from the student's most recent transcript and/or transfer evaluation.

GENERAL EDUCATION REQUIREMENTS

Communication (6 credits required)

- ENGL110 - 3 ______
- ENGL111 - 3 ______

Humanities (6 credits; different disciplines; see catalog)

- Elective ______ - __ ______
- Elective ______ - __ ______

Social Science (6 credits; different disciplines; see catalog)

- Elective ______ - __ ______
- Elective ______ - __ ______

Computational Literacy [Mathematics] (3 credits)

(fulfilled by departmental requirements)

Natural Sciences (7 credits)

(fulfilled by departmental requirements)

Diversity (3 credits; see catalog)

- Elective ______ - __ ______

Communication Skills (3 credits)

- COMM101, 201, or 225 COMM____ - __ ______

☐ **GEN-ED Requirements met by MTA or MACRAO**

Students must satisfy all of the following minimum requirements for graduation:

- ☐ 2.0 overall GPA
- ☐ 2.0 General Education GPA
- ☐ 2.0 departmental GPA
- ☐ 124 total credits (minimum)
- ☐ 32 credits from Mathematics (including EGNR340) and Natural Science
- ☐ 30 credits earned at LSSU
- ☐ 24 credits 300/400 level in major earned at LSSU

DEPARTMENT REQUIREMENTS

Complete the Computer Engineering Core (85 credits required)

- CHEM115 - 5 ______
- CSCI105 - 3 ______ (C or better required)
- CSCI121 - 4 ______ (C or better required)
- CSCI201 - 4 or CSCI221 - 3 ______
- [1]CSCI341 - 4 ______
- EGEE125 - 4 ______ (C or better required)
- EGEE210 - 4 ______ (C or better required)
- EGEE250 - 4 ______
- EGEE280 - 4 ______ (C or better required)
- [1]EGEE320 - 4 ______
- [1]EGEE355 - 4 ______
- EGEE370 - 4 ______
- [1]EGEE425 - 3 ______
- EGNR101 - 2 ______
- EGNR140 - 2 ______
- EGNR340 - 1 ______
- EGNR348 - 1 ______
- MATH151 - 4 ______ (C or better required)
- MATH152 - 4 ______ (C or better required)
- MATH251 - 4 ______
- MATH308 - 3 ______
- MATH310 - 3 ______
- PHYS231 - 4 ______ (C or better required)
- PHYS232 - 4 ______

Complete One of the Senior Year Experiences (6-13 credits required)

Industrial Project	Cooperative Project	Research Project
EGNR491 - 3 ______	EGNR250 - 2 ______	EGNR260 - 2 ______
EGNR495 - 3 ______	EGNR450 - 4 ______	EGNR460 - 4 ______
	EGNR451 - 3 ______	EGNR461 - 2 ______
	EGNR491 - 3 ______	

Complete Technical Electives (13 minimum credits required)

Technical Elective** ______ - __ ______

Robotics & Automation Concentration

Complete all of the following:

- EGRS385 - 4 ______*
- EGRS430 - 4 ______*
- EGRS435 - 3 ______*

General Technical Electives

- ** ______ - __ ______
- ** ______ - __ ______
- ** ______ - __ ______
- ** ______ - __ ______

Sustainable Energy Concentration

Complete all of the following:

- EGNR261 - 3 ______*
- [1]EGNR361 - 1 ______*

And any two of the four below:

- [1]EGEE330 - 4 ______*
- [1]EGEE411 - 3 ______*
- EGEE475 - 4 ______*
- [1]EGNR362 - 3 ______*

* (C or better is required for all courses within a concentration)

** CSCI281 or higher, EGEE310 or higher, EGME276 or higher, EGEM220, EGET310, EGRS385, EGRS460 or higher, MATH215 or higher, or any course from the concentrations.

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[1] Theses courses may be offered only every other year

School of Engineering and Technology

BS Degree in Electrical Engineering

(For Students Starting in the 2017-2018 Academic Year)

Student Name: ____ Advisor Approval: ____ Date: ____

Student ID: ____ ECE Coordinator Approval: ____ Date: ____

Intended Month of Graduation: ____ SET Chair Approval: ____ Date: ____

All information below should be from the student's most recent transcript and/or transfer evaluation.

GENERAL EDUCATION REQUIREMENTS

Communication (6 credits required)

ENGL110 - 3 ____
ENGL111 - 3 ____

Humanities (6 credits; different disciplines; see catalog)

Elective ____ - __ ____
Elective ____ - __ ____

Social Science (6 credits; different disciplines; see catalog)

Elective ____ - __ ____
Elective ____ - __ ____

Computational Literacy [Mathematics] (3 credits)

(fulfilled by departmental requirements)

Natural Sciences (7 credits)

(fulfilled by departmental requirements)

Diversity (3 credits; see catalog)

Elective ____ - __ ____

Communication Skills (3 credits)

COMM101, 201, or 225 COMM____ - __ ____

☐ **GEN-ED Requirements met by MTA or MACRAO**

Students must satisfy all of the following minimum requirements for graduation:

☐ 2.0 overall GPA
☐ 2.0 General Education GPA
☐ 2.0 departmental GPA
☐ 124 total credits (minimum)
☐ 32 credits from Mathematics (including EGNR340) and Natural Science
☐ 30 credits earned at LSSU
☐ 24 credits 300/400 level in major earned at LSSU

DEPARTMENT REQUIREMENTS

Complete the Electrical Engineering Core (82 credits required)

CHEM115 - 5 ____
EGEE125 - 4 ____
(C or better required)
EGEE210 - 4 ____
(C or better required)
EGEE250 - 4 ____
EGEE260 - 4 ____
(C or better required)
[1]EGEE310 - 4 ____
[1]EGEE330 - 4 ____
[1]EGEE345 - 3 ____

EGEE370 - 4 ____
EGEE475 - 4 ____
EGEM220 - 3 ____
EGNR101 - 2 ____
EGNR140 - 2 ____
EGNR265 - 3 ____
(C or better required)
EGNR340 - 1 ____
EGNR346 - 1 ____
EGRS460 - 4 ____

MATH151 - 4 ____
(C or better required)
MATH152 - 4 ____
(C or better required)
MATH251 - 4 ____
MATH308 - 3 ____
MATH310 - 3 ____
(C or better required)
PHYS231 - 4 ____
(C or better required)
PHYS232 - 4 ____

Complete One of the Senior Year Experiences (6-13 credits required)

Industrial Project	**Cooperative Project**	**Research Project**
EGNR491 - 3 ____	EGNR250 - 2 ____	EGNR260 - 2 ____
EGNR495 - 3 ____	EGNR450 - 4 ____	EGNR460 - 4 ____
	EGNR451 - 3 ____	EGNR461 - 2 ____
	EGNR491 - 3 ____	

Complete Technical Electives (13 minimum credits required)

Technical Elective** ____ - __ ____

Robotics & Automation Concentration

Complete the following:

EGRS385 - 4 ____*
EGRS430 - 4 ____*
EGRS435 - 3 ____*

Digital Systems Concentration

Complete all of the following:

[1]EGEE320 - 4 ____*
[1]EGEE355 - 4 ____*
[1]EGEE425 - 3 ____*

Sustainable Energy Concentration

Complete all of the following:

EGNR261 - 3 ____*
[1]EGNR361 - 1 ____*
[1]EGEE411 - 3 ____*

And any one of the two below:

[1]EGNR362 - 3 ____*
EGME337 - 4 ____*

General Technical Electives

** ____ - __ ____
** ____ - __ ____
** ____ - __ ____
** ____ - __ ____

* (C or better is required for all courses within a concentration)

** EGEE320 or higher, EGME225 or higher, MATH215 or higher, EGRS365, EGRS461, EGEM320, EGET310, or any course from the concentrations.

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[1] Theses courses may be offered only every other year

23-Jun-17

School of Engineering and Technology

BS Degree in Mechanical Engineering

(For Freshman Starting Fall 2017 or Earlier by Election)

Student Name: ______________________

Advisor Approval: ______________________ Date: ________

Student ID #: ______________________

ME Coordinator Approval: ______________________ Date: ________

Intended Month of Graduation: ______________________

SET Chair Approval: ______________________ Date: ________

All information recorded below should match the student's most recent transcript and/or transfer evaluation.

GENERAL EDUCATION REQUIREMENTS

Communications

ENGL110 - 3 (C or better required) ______

ENGL111 - 3 ______

Humanities (2 courses, different disciplines; see catalog)

Elective ______ - ____ ______

Elective ______ - ____ ______

Social Science (2 courses, different disciplines; see catalog)

Elective ______ - ____ ______

Elective ______ - ____ ______

Computational Literacy (formerly "Mathematics")

(fulfilled by departmental requirements)

Natural Sciences

(fulfilled by departmental requirements)

Diversity (3 credits minimum; see catalog)

Elective ______ - ____ ______

Communications

COMM101, 201, or 225 COMM- ____ ______

☐ GEN-ED REQUIREMENTS MET BY MTA or MACRAO

DEPARTMENTAL REQUIREMENTS

CHEM115 - (4,3) 5 ______

EGEE210 - (3,2) 4 ______

EGEM220 - (3,0) 3 ______
(C or better required)

EGEM320 - (3,0) 3 ______

EGME110 - (2,3) 3 ______

EGME141 - (2,2) 3 ______

EGME225 - (3,0) 3 ______

EGME275 - (3,0) 3 ______

EGME276 - (0,3) 1 ______

EGME337 - (4,0) 4 ______

EGME338 - (3,0) 3 ______

EGME350 - (3,3) 4 ______

EGME431 - (3,0) 3 ______

EGME432 - (1,3) 2 ______

EGNR101 - (1,2) 2 ______

EGNR140 - (1,3) 2 ______

EGNR265 - (3,0) 3 ______

EGNR340 - (0,2) 1 ______

EGRS460 - (3,3) 4 ______

MATH151 - (4,0) 4 ______
(C or better required)

MATH152 - (4,0) 4 ______
(C or better required)

MATH251 - (4,0) 4 ______

MATH308 - (3,0) 3 ______

MATH310 - (3,0) 3 ______

PHYS231 - (3,2) 4 ______
(C or better required)

PHYS232 - (3,2) 4 ______

SENIOR CAPSTONE EXPERIENCE

Industrial Project	Cooperative Project	Research Project
EGNR491 - 3______	EGNR450 - 4______	EGNR260 - 2______
EGNR495 - 3______	EGNR451 - 3______	EGNR460 - 4______
	EGNR491 - 3______	EGNR461 - 2______

TECHNICAL ELECTIVE CONCENTRATION

Vehicle Systems (VS)
(C or better required)

EGME240 - 3______

EGME310 - 2 ______

EGME415 - 2 ______

EGME425 - 4 ______

EGEE280 - 4 ______

EGNR362 - 3 ______

Robotics & Automation (RA)
(C or better required)

EGRS365 - 3 ______

EGRS385 - 4 ______

EGRS430 - 4 ______

EGRS435 - 3 ______

One of the following:

EGME240-3 *or* EGNR310-3

or EGMT216-3 *or* EGEE280-4

______ - ____ ______

General

EGME240-3 ______

9 credits for any courses listed in VS or RA options or EGNR261 or 361

______ - ____ ______, ______ - ____ ______

______ - ____ ______, ______ - ____ ______ (total cred: ____)

5 credits from any 400-level courses listed in the VS or RA options

______ - ____ ______, ______ - ____ ______ (total cred: ____)

Students must also satisfy the following for graduation:

- ☐ 2.0 Overall GPA, 2.0 Dept. GPA
- ☐ 32 credits Math (incl EGNR340)/Natural Science
- ☐ Residency (50% of 300/400 level credits in major = 24 cr.)
- ☐ 124 Total Credits (minimum)
- ☐ Residency (32 credits earned at LSSU)

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**School of Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**SET Load Distribution v6 – 2018-08-13**
This documentation is relevant to Question number:	**11**
Briefly summarize the content of the file and its value as evidence supporting program review:	**This is an extremely useful tool for forecasting loads of faculty and exploring "what if" scenarios when adjusting which faculty might teach particular courses over the course of a 2 year offering pattern.**

	ECE Faculty						ECE Adjuncts			Check for unknown instructor initials
	NH	DB	AJ	JM	PW	TBD_E	JK	ECE_A	ECE_B	
Fall 2018	[illegible]	[illegible]	[illegible]	15.62	[illegible]	0.00	[illegible]	0.00	0.00	[illegible]
Spring 2019	13.67	13.00	12.33	15.00	12.67	0.00	3.00	0.00	0.00	
Total	[illegible]	[illegible]	29.24	[illegible]	25.67	0.00	[illegible]	0.00	0.00	

	NH	DB	AJ	JM	PW	TBD_E	JK	ECE_A	ECE_B	
Fall 2019	12.33	12.00	[illegible]	[illegible]	15.00	0.00	2.00	0.00	0.00	[illegible]
Spring 2020	14.00	13.33	14.00	12.00	15.00	0.00	3.00	0.00	0.00	No issues
Total	26.33	25.33	[illegible]	29.62	[illegible]	0.00	5.00	0.00	0.00	

	ME Faculty						ME Adjuncts			Check for unknown instructor initials
	DL	RH	JD	MZ	ZM	TBD_M	JH	ME_A	ME_B	
Fall 2018	[illegible]	15.62	[illegible]	14.05	15.07	0.00	3.00	0.00	0.00	[illegible]
Spring 2019	14.00	[illegible]	14.00	[illegible]	[illegible]	0.00	[illegible]	0.00	0.00	
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00	8.00	0.00	0.00	

	DL	RH	JD	MZ	ZM	TBD_M	JH	ME_A	ME_B	
Fall 2019	14.33	[illegible]	15.83	12.05	15.07	0.00	3.00	0.00	0.00	[illegible]
Spring 2020	[illegible]	13.67	12.00	14.33	12.00	0.00	[illegible]	0.00	0.00	No issues
Total	[illegible]	[illegible]	27.83	26.38	27.07	0.00	11.00	0.00	0.00	

	Summary			Summary		
	Fall 2018	Spring 2019	Year Total	Fall 2019	Spring 2020	Year Total
ECE Totals	75.86	67.67	143.53	78.86	71.33	150.19
ME Totals	81.23	83.67	164.89	79.23	79.33	158.56
SET Totals	157.09	151.33	308.42	158.09	150.67	308.75
Avg. Load	15.71	15.13	30.84	15.81	15.07	30.88
FTE	13.09	12.61	12.85	13.17	12.56	12.86

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**School of Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**Major Equipment List (2018-2019)_2018-08-14**
This documentation is relevant to Question number:	**11**
Briefly summarize the content of the file and its value as evidence supporting program review:	**This Excel file was used to determine spending priorities for the program [and course under supplies, etc.] fees that students pay when taking EGNR prefixed courses.**

Dept	Priority	Resources	Description	Account/POPAL	Quantity	Cost per Unit	Total Cost	Running Cost	Lab	Responsible Person	Model # - (Ratings)
ME	XH	okay	Software Upgrade for Tinius Olsen	7061	1	[redacted]	$ 5,000	$ 5,000	CAS106A - Smash Lab	RH	
ME	XH	okay	Software Upgrade for Dynamometer	7061	1	[redacted]	$ 5,000	$ 10,000	CAS124 - Robotics Annex	RH	
ME	XH	okay	General Lab Supplies (metal, IC chips, etc.)	7004	1	$ 18,000	$ 18,000	$ 28,000	Various Labs	JK, JH	
SET	H	okay	~~Collaborative Robots~~	~~7960~~	1	$	$ -	$ 28,000	CAS125 - Robotics Lab	JD	
SET	H	okay	Mobile robot units/attachments	7960	1	$ 25,000	$ 25,000	$ 53,000	CAS??? - Mobile Robot Lab	AJ	
SET	H	okay	Senior Project Budget for Collaborative Robot	7960	1	$ 15,000	$ 15,000	$ 68,000	CAS125 - Robotics Lab	JD	
SET	H	okay	Senior Project Budget for Mobile Robot	7960	1	$ 10,000	$ 10,000	$ 78,000	CAS??? - Mobile Robot Lab	AJ	
SET	H	okay	Annual Service on 1200ES 3D Printer	7161	2	$ 3,500	$ 7,000	$ 85,000	TTX	BH	
SET	H	okay	~~Arago Flexi 1 Research + 26 Teaching~~	~~7061~~	1	$ -	$	$ 85,000	SET	RH	
ME	H	okay	Matlab General License	7061	1	$ 2,700	$ 2,700	$ 87,700	SET	JK	
ME	H	okay	Allen Bradley PLC Software	7061	1	$ 4,100	$ 4,100	$ 91,800	SET	JK	
ME	H	okay	CREO License	7061	1	$ 2,875	$ 2,875	$ 94,675	SET	DL	
ME	H	okay	CarSim	7061	1	$ 1,000	$ 1,000	$ 95,675	SET	RH	
SET	H	okay	MATLAB License for Research	7061	1	$ 500	$ 500	$ 96,175	SET	MB	
SET	H	okay	Wireless Mic and Speaker System	7070	1	$ 1,200	$ 1,200	$ 97,375	CAS125 - Robotics Lab	JD	
ECE	H	okay	Microcontroller Boards	7070	10	$ 300	$ 3,000	$ 100,375	CAS304 - Digital Lab	AJ	
ME	H	okay	COMSOL Software	7061	1	$ 10,000	$ 10,000	$ 110,375	[illegible]	ME	
ME	H	okay	Printer for Machine Shop	7065	1	$ 900	$ 900	$ 111,275	CAS120 - Machine Shop	JK	
ME	H	okay	Printer for CAS306	7065	1	$ 900	$ 900	$ 112,175	CAS306 - Circuits + Energy Lab	JK	
ME	XH	okay	Computer and Monitor for CAS-106A - IT covered	7065	1	$ 1,000	$ 1,000	$ 113,175	CAS106A - Smash Lab	RH	For Tinius-Olsen
ME	XH	okay	Computer and Monitor for CAS-124 - IT covered?	7065	1	$ 1,000	$ 1,000	$ 114,175	CAS124 - Robotics Annex	RH	For Dynamometer
ME	H	okay	Computer and Monitor for CAS-105 - IT covered?	7065	1	$ 1,000	$ 1,000	$ 115,175	CAS105 - Data Acquisition Lab	RH	
SET	H	okay	Computers and Monitors for Robotics Lab - IT cov	7065	8	$ 1,000	$ 8,000	$ 123,175	CAS125 - Robotics Lab	JD	
ME	M	okay	CNC Plasma Bossed Software (1 time purchase)	7061	1	$ 2,500	$ 2,500	$ 125,675	CAS120 - Machine Shop	DL	
ME	M	okay	Tool Holders for HAAS Machine	7960	1	$ 5,000	$ 5,000	$ 130,675	CAS120 - Machine Shop	DL	
ME	M	okay	Eddy Current Detector	7960	1	$ 5,000	$ 5,000	$ 135,675	??	??	
SET	M	okay	Chairs	7395	10	$ 800	$ 8,000	$ 143,675	CAS208 - SET Computer Lab	PW	
ME	M	okay	Printer for CAS304	7065	1	$ 900	$ 900	$ 144,575	CAS304 - Digital Lab	JK	
ME	M	okay	Printer for CAS309	7065	1	$ 900	$ 900	$ 145,475	CAS309 - Controls Lab	JK	
ME	M	okay	Printer for CAS125	7065	1	$ 900	$ 900	$ 146,375	CAS125 - Robotics Lab	JK	
ME	M	okay	Printer for CAS106B	151171	1	$ -	$	$ 146,375	CAS120 - Machine Shop	JK	
SET	M	okay	Lab Contingency	7395	1	$ 10,000	$ 10,000	$ 156,375		PW	
SET	M	okay	Computer and Monitor for CAS-208 - IT covered?	7065	2	$ 1,000	$ 2,000	$ 158,375	CAS208 - SET Computer Lab	JK	
SET	M	okay	Computer and Monitor for CAS-106B - IT covered	151171	7	$ -	$	$ 158,375	CAS106B - Senior Project Cubes	JK	
SET	M	okay	Computer and Monitor for CAS-311 - IT covered?	7065	9	$ 1,000	$ 9,000	$ 167,375	CAS311 - PLC Lab	JM	
ME	M	okay	Computers and Monitors for Machine Shop - IT c	7065	5	$ 1,000	$ 5,000	$ 172,375	CAS120 - Machine Shop	DL	
ME	M	okay	Doc Cam (CAS203) - IT/grant covered?	7065-->IT?	1		$	$ 172,375	CAS203 - Conference Room	JK	
ECE	M	okay	Doc Cam/projector (CAS306) - IT/grant covered?	7065-->IT?	1		$	$ 172,375	CAS306 - Circuits + Energy Lab	JM	
ECE	M	okay	Programmable loads ("high" power)	7070	7	$ 950	$ 6,647	$ 179,022		JM	BK Precision 8600 (120V, 30A, 150W
ECE	M	okay	Data Acquisition Module	7960	1	$ 8,000	$ 8,000	$ 187,022	CAS105 - Data Acquisition Lab	RH	Bruel & Kjaer Photon+
SET	M	needed	Additional mobile robot units/attachments		1	$ 25,000	$ 25,000	$ 212,022	CAS??? - Mobile Robot Lab	AJ	
ECE	M	okay	PLC hardware (buttons, etc.)		1	$ 4,000	$ 4,000	$ 216,022	CAS304 - Digital Lab	PW	DE1-SoC?
ECE	M	okay	FPGA		10	$ 400	$ 4,000	$ 220,022	CAS304 - Digital Lab	PW	DE1-SoC?
ECE	L	okay	Power Analyzer		1		$ -	$ 220,022		JM	Tektronix PA1000 (600V, 20A)
ECE	L	okay	IV Tracer (LabView addition?)		1		$	$ 220,022		PW	
ECE	L	okay	Small solar panels and wind turbines		2	$ 100	$ 200	$ 220,222		PW	Light sources
ME	L	okay	Tool Changers for HAAS Machine		4	$ 150	$ 600	$ 220,822		DL	
ECE	L	okay	Variable Frequency Drives (VFD)		3	$ 550	$ 1,650	$ 222,472		JM	
ECE	L	okay	Programmable AC Power Source		1	$ 2,000	$ 2,000	$ 224,472			BK Precision 9801 (300V, 3A, 45-500H
ECE	L	okay	Current Probe (for oscilloscope)		10	$ 650	$ 6,500	$ 230,972			Keysight 1146B (100 kHz/100 A)
ECE	L	okay	Differential Voltage Probe (for oscilloscope)		10	$ 650	$ 6,500	$ 237,472			Keysight N2791A (25 MHz/700 V)

- Dynamometer

Areas Items are Used

???

???

Various Labs

EGRS385, EGRS430, EGRN430

EGRS215, EGRS172, EGRS430, EGRN490

EGRS385, EGRS430, EGRN430

EGRS215, EGRS172, EGRS430, EGRN490

Note: Purchased in FY18 at a much lower cost than $90k with help from the Perkins grant

Note: No longer needed with [illegible]

Robotics Lab

EGEE-250-255

[illegible]

EGME-110

EGME-110

???

???

???

EGRS-385-481-285-430-435

EGME-276

EGME-276

SET

EGME-110

EGME-110

EGME-110

EGME-110

EGME-110

SET

SET

Note: Purchased from [illegible]

SET

EGME-110

???

EGEE-210-370-475, EGET-110-175, EGNR-361, EGRS-481

EGEE 330-370-475

EGEE 370-425-475, Research

EGRS-385-430, EGNR-265-491-493

EGEE-125-320-425

EGEE-125-320-425

EGEE-110-320-270-375, EGNR-361

EGEE 370, EGET-175

EGNR-481, EGEE -370-475

EGME 110

EGEE 330-475

EGEE 475

EGEE 330-370-475

EGEE 330-370-475

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	School of Engineering & Technology
Document Title (if attached) or Filename (if emailed):	**SET Course Teaching Qualification Categories_2018-03-19**
This documentation is relevant to Question number:	**11**
Briefly summarize the content of the file and its value as evidence supporting program review:	**This document is used to determine teaching qualifications based on the categories of courses and degrees within the School of Engineering & Technology.**

School of Engineering Technology   Adopted 27 April 2017 by a vote 8-Yes, 1-No, 0-Abstain, 2-Absent

Disciplinary Field/Subfield	Courses within this Field/Subfield	Minimal Faculty Qualifications	Desired Minimum Academic Credentials	[illegible] Tested Experience
Electrical Engineering	EGEE-250 Circuit Analysis EGEE-[illegible]35 Network Analysis EGEE-195 Electro-Mechanical Systems EGEE-345 Fundamentals of Electromagnetics EGEE-370 Electronic Devices EGEE-412 Power Distribution and Transmission EGEE-475 Power Electronics	One of the following: a) Master's degree (or higher) in, or appropriate to, the discipline or subfield being taught, or b) Master's degree with a minimum of 18 graduate semester credit hours appropriate to, or in, the discipline being taught, or c) tested experience	One of the following: a) Master's degree (or higher) in Electrical Engineering or closely related discipline, or b) Master's degree (or higher) in a STEM discipline with graduate coursework in an appropriate field of engineering	
Electrical/Computer Engineering	EGEE-125 Digital Fundamentals EGEE-[illegible] Microcontroller Fundamentals EGEE-280 Introduction to Signal Processing EGEE-320 Digital Design EGEE-355 Microcontroller Systems EGEE-435 Digital Signal Processing	One of the following: a) Master's degree (or higher) in, or appropriate to, the discipline or subfield being taught, or b) Master's degree with a minimum of 18 graduate semester credit hours appropriate to, or in, the discipline being taught, or c) tested experience	One of the following: a) Master's degree (or higher) in Electrical Engineering, Computer Engineering, or closely related discipline, or b) Master's degree (or higher) in a STEM discipline with graduate coursework in an appropriate field of engineering	
Electrical Engineering Technology	EGET-110 Applied Electricity EGET-175 Applied Electronics EGET-310 Electronic Manufacturing Processes	One of the following: a) Master's degree (or higher) in, or appropriate to, the discipline or subfield being taught, or b) Master's degree with a minimum of 18 graduate semester credit hours appropriate to, or in, the discipline being taught, or c) tested experience	One of the following: a) Master's degree (or higher) in Electrical Engineering, Electrical Engineering Technology, or closely related discipline, or b) Master's degree (or higher) in a STEM discipline with graduate coursework in an appropriate field of engineering	Bachelor's degree in Electrical Engineering, Electrical Engineering Technology, or closely related discipline plus three (3) years industrial or academic experience in subject matter
Mechanical Engineering	EGEM-220 Statics EGEM-[illegible] Dynamics EGME-225 Mechanics of Materials EGME-175 Engineering Materials EGME-226 Strength of Materials Lab EGME-310 Vehicle Development and Testing EGME-327 Thermodynamics EGME-338 Fluid Mechanics EGME-350 Machine Design EGME-425 Vehicle Dynamics EGME-428 Vibration and Noise Control EGME-431 Heat Transfer EGME-432 Thermal and Fluids Lab	One of the following: a) Master's degree (or higher) in, or appropriate to, the discipline or subfield being taught, or b) Master's degree with a minimum of 18 graduate semester credit hours appropriate to, or in, the discipline being taught, or c) tested experience	One of the following: a) Master's degree (or higher) in Mechanical Engineering or closely related discipline, or b) Master's degree (or higher) in a STEM discipline with graduate coursework in an appropriate field of engineering	
Manufacturing Engineering Technology	EGMT-110 Manufacturing Processes EGME-191 Solid Modeling EGME-280 Assembly Modeling and GD&T EGMT-182 Overview of Solid Modeling Techniques EGMT-214 CAM with CNC Applications EGMT-225 Statics and Strength of Materials	One of the following: a) Master's degree (or higher) in, or appropriate to, the discipline or subfield being taught, or b) Master's degree with a minimum of 18 graduate semester credit hours appropriate to, or in, the discipline being taught, or c) tested experience	One of the following: a) Master's degree (or higher) in Mechanical Engineering, Manufacturing Engineering Technology, or closely related discipline, or b) Master's degree (or higher) in a STEM discipline with graduate coursework in an appropriate field of engineering	Bachelor's degree in Mechanical Engineering, Mechanical Engineering Technology, or closely related discipline plus three (3) years industrial or academic experience in subject matter
History of Engineering	EGNR-101 Concepts of History in Engineering EGNR-103 Engineering Orientation	One of the following: a) Master's degree (or higher) in, or appropriate to, the discipline or subfield being taught, or b) Master's degree with a minimum of 18 graduate semester credit hours appropriate to, or in, the discipline being taught, or c) tested experience	One of the following: a) Master's degree (or higher) in any engineering discipline, or b) Master's degree (or higher) in a STEM discipline with graduate coursework in an appropriate field of engineering	Bachelor's degree in any STEM discipline plus three (3) years relevant experience

General Engineering	EGNR-101 Introduction to Engineering EGNR-140 Linear Algebra and Numerical Apps EGNR-245 Calculus Applications for Technology EGNR-280 Engineering Research Methods EGNR-265 Energy Systems and Sustainability EGNR-269 C Programming EGNR-310 Quality Engineering EGNR-340 Numerical Methods EGNR-348 Probability and Statistics Lab for Engineers EGNR-381 Energy Systems and Sustainability Lab EGNR-382 Vehicle Energy Systems EGNR-480 Engineering Research Project I EGNR-481 Engineering Research Project II EGNR-490 Research Projects in Engineering EGRS-[illegible] Control Systems EGRS-[illegible] Design of Control Systems	One of the following: a) Master's degree (or higher) in, or appropriate to, the discipline or subfield being taught, or b) Master's degree with a minimum of 18 graduate semester credit hours appropriate to, or in, the discipline being taught, or c) tested experience	One of the following: a) Master's degree (or higher) in any engineering discipline, or b) Master's degree (or higher) in a STEM discipline with graduate coursework in an appropriate field of engineering	
Engineering Practice	EGNR-250 Cooperative Education EGNR-470 Cooperative Education Project I EGNR-471 Cooperative Education Project II EGNR-491 Engineering Design Projects I EGNR-492 Engineering Design Projects II EGNR-496 Senior Directed Project	One of the following: a) Master's degree (or higher) in, or appropriate to, the discipline or subfield being taught, or b) Master's degree with a minimum of 18 graduate semester credit hours appropriate to, or in, the discipline being taught, or c) tested experience	One of the following: a) Master's degree (or higher) in any engineering discipline, or b) Master's degree (or higher) in a STEM discipline with graduate coursework in an appropriate field of engineering	Bachelor's degree in any Engineering or closely related discipline plus three (3) years relevant industrial or academic experience
Robotics Engineering	EGRS-180 Robotics Engineering EGRS-420 System Integration and Machine Vision EGRS-432 Automated Manufacturing Systems	One of the following: a) Master's degree (or higher) in, or appropriate to, the discipline or subfield being taught, or b) Master's degree with a minimum of 18 graduate semester credit hours appropriate to, or in, the discipline being taught, or c) tested experience	One of the following: a) Master's degree (or higher) in Computer Engineering, Electrical Engineering, Mechanical Engineering, Robotics Engineering, or any closely related discipline, or b) Master's degree (or higher) in a STEM discipline with graduate coursework in an appropriate field of engineering	
Robotics and Automation Technology	[illegible] Introduction to Robotics [illegible] Programmable Logic Controllers [illegible] Programmable Logic Controllers [illegible] Robotics Technology [illegible] Robotics Technology Lab [illegible] Introduction to Robotics Programming [illegible] Manufacturing Automation [illegible] Manufacturing Automation Lab [illegible] Automation and Simulation Lab	One of the following: a) Master's degree (or higher) in, or appropriate to, the discipline or subfield being taught, or b) Master's degree with a minimum of 18 graduate semester credit hours appropriate to, or in, the discipline being taught, or c) tested experience	One of the following: a) Master's degree (or higher) in Computer Engineering, Electrical Engineering, Mechanical Engineering, Robotics Engineering, Computer Engineering Technology, Electrical Engineering Technology, Mechanical Engineering Technology, Robotics Engineering Technology, or any closely related discipline, or b) Master's degree (or higher) in a STEM discipline with graduate coursework in an appropriate field of engineering	Bachelor's degree in Computer Engineering, Electrical Engineering, Robotics Engineering, Computer Engineering Technology, Electrical Engineering Technology, Mechanical Engineering Technology, Robotics Engineering Technology, or any closely related discipline plus three (3) years industrial experience

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PART 2: Degree-Level Review

Degree Program: B.S. Computer Engineering

Explain how the program works to address each of the following questions. For each question, respond with a narrative and supporting evidence.

Assessment (CC 4.B and CC 4.C)

13. Provide evidence that the degree-level program outcomes are clearly stated and are effectively assessed, including the "use of results." Attach the 4-Column Program Assessment Report.

All program outcomes are publicly posted at: https://www.lssu.edu/school-of-engineering-and-technology/accreditation-outcome-reporting/

Refer to Sections 3 (Student Outcomes) and 4 (Continuous Improvement) of the Computer Engineering ABET Self-Study Report. Also, refer to the 4-column report from Summer 2018.

14. Explain how results from degree assessments were used to improve the degree program. Include specific examples.

Refer to Section 4 (Continuous Improvement) of the Computer Engineering ABET Self-Study Report.

Quality, Resources and Support (CC 3.A)

15. Explain how the program ensures that degree program-level and course-level learning outcomes are at an appropriate level. Attach evidence, including a degree audit for the program.

Program-level outcomes are Student Outcomes A-K specified by ABET. Refer to Sections 3 (Student Outcomes) and 5 (Curriculum) of the Computer Engineering ABET Self-Study Report. A degree audit is also attached.

The Lumina Foundation's Degree Qualification Profile (DQP) is suggested as a resource for answering the questions about what students should know and be able to do at each degree level:
http://degreeprofile.org/wp-content/uploads/2017/03/DQP-grid-download-reference-points-FINAL.pdf

Intellectual Inquiry (CC 3.B).

16. Explain what the program does to engage students in collecting, analyzing, and communicating information; mastering modes of inquiry or creative work; developing skills integral to the degree program. Attach examples of undergraduate research, projects, and creative work.

    Refer to 5-A.6 (Major Design Experience) of the Computer Engineering ABET Self-Study Report; this section is written such that it is applicable to all SET bachelor's degrees. Binders with the Senior Project work can be found in the CAS203 cabinets in the 2nd cabinet from the right on the north wall.

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Academic Program Review

Appendix Cover Sheet

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**School of Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**ABET CE Report - Final**
This documentation is relevant to Question number:	**CE-related reports (multiple questions)**
Briefly summarize the content of the file and its value as evidence supporting program review:	**This file contains the self-study report for the ABET ETAC Fall 2018 visit, including a variety of information that is useful for the assessment of the CE program.**

ABET

Self-Study Report

for the

Bachelor of Science in Computer Engineering

at

Lake Superior State University

Sault Sainte Marie, Michigan

June 30, 2018

CONFIDENTIAL

TABLE OF CONTENTS

Criterion 0 BACKGROUND INFORMATION

0-A Contact Information

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0-B Program History

The Bachelor of Science in Computer Engineering is administered by the Department of Electrical and Computer Engineering, which is part of the School of Engineering & Technology. A brief historical background of the University, the School, and the Computer Engineering program follows.

0-B.1 Lake Superior State University

To address the needs of returning World War II veterans and to provide opportunities to the people of the Eastern Upper Peninsula of Michigan, Lake Superior State University was originally founded as a branch of Michigan Technology University (MTU) in 1946. The campus gained autonomy from MTU in 1969 and was renamed Lake Superior State College. University status was granted in 1987 and the institution was finally named Lake Superior State University (LSSU).

LSSU is the smallest 4-year public institution of higher learning in the state of Michigan. LSSU grants Bachelor of Science and Bachelor of Arts degrees in forty-nine areas, and Associate degrees in twenty-four areas. The enrollment as of fall 2017 was approximately 2,100 students (head count; ~1,900 full-time equivalent), of which about 88% were from the state of Michigan and about 7% were from the province of Ontario. The number of full-time faculty in the 2017-2018 academic year was 97. LSSU is accredited by the Higher Learning Commission of the North Central Association of Colleges and Schools.

0-B.2 School of Engineering & Technology

After gaining autonomy from MTU in 1969, three Bachelor of Science degrees in Engineering Technology were eventually introduced. The Mechanical Engineering Technology (MET) program was introduced in 1977, the Electrical Engineering Technology (EET) program was introduced in 1981, and Manufacturing Engineering Technology (MfgET) program was introduced in 1987. The EET and MET programs received continuous TAC of ABET accreditation until their discontinuation in 1999.

In 1994, the engineering technology faculty and constituents (alumni, employers of graduates, Industrial Advisory Board, and area educators) reviewed the three engineering technology programs and reached the decision to discontinue the EET and MET degrees in favor of Electrical Engineering (EE) and Mechanical Engineering (ME) degrees. The decision was based on better serving a larger audience of Michigan's industry and public and on input from alumni. In 2000, a Computer Engineering (CE) degree was added.

The LSSU School of Engineering & Technology now offers Bachelor of Science degrees in Computer Engineering, Electrical Engineering, Mechanical Engineering, Electrical Engineering Technology, and Manufacturing Engineering Technology. The School of Engineering & Technology has developed a reputation for high quality graduates and for its ability to provide an excellent undergraduate education in the area of robotics. In that respect, the School will be offering a new Bachelor of Science degree in Robotics Engineering starting fall 2018 which was formally approved this summer.

0-B.3 Computer Engineering Program

A plan to convert the EET degree program to a EE degree program was created in 1995 and implementation of the plan began in 1996. Beginning with the 1996 academic year, no EET freshmen were admitted and only EE freshmen were admitted. In subsequent years (sophomore, junior, senior), new engineering curriculum was put into place as the EET curriculum was phased out. By 1999, the completed EE degree program was in place, and the first graduates of the new EE degree program occurred in the 2000 academic year. During the conversion process, the Department of Electrical and Computer Engineering was formed.

Responding to the need for a computer engineering curriculum, the CE degree program was initiated in 2000. The first graduates of the new CE degree program occurred in the spring of 2004. Initial accreditation of the Computer Engineering program occurred in 2006. Subsequently reaccreditation was awarded most recently in 2013, effective until September 30, 2019.

Major revisions to the Computer Engineering program since the last site visit in Fall 2012 include the following:

1. Removed CSCI-122 Programming Tools and Techniques and increased the credits for CSCI-121 Principles of Programming from 3 to 4 (Fall 2014). This change was initiated by the Math and Computer Science department; the engineering faculty did not have any control over this change.
2. Removed EGEE-345 Electromagnetics from the core of the program in order to enable students to take a free technical elective, offering more student choice and flexibility.
3. Created a Sustainable Energy concentration, replacing the Control Systems concentration. This was mentioned in the previous self-study report as it was developed before the last visit, but was not approved until after the visit. This required the creation of the following courses:
    a. EGNR-261 Energy Systems and Sustainability
    b. EGNR-361 Energy Systems and Sustainability Lab
    c. EGNR-362 Vehicle Energy Systems (modification from an existing course)
    d. EGEE-411 Power Distribution and Transmission
4. Extended the length of the laboratory from 2 hours to 3 hours for EGEE-210 *Circuit Analysis* in order to provide more troubleshooting opportunities for the students.
5. Retirement of faculty member Prof. David McDonald (Summer 2017).
6. Removed, Spring 2013, EGEE280 lab and increased lecture hours from 3 to 4 (3 hours lab and 3 hours lecture became 4 hours lecture, weekly).

7. Increased, Spring 2013, credit count in EGNR450 from 2 credits to 4 credits, and in EGNR451 from 2 to 3 credits (these courses appear in the Cooperative Project alternative of the Senior Sequence block).
8. Replaced the four "program outcome objectives" (employability, societal awareness, professionalism, and fundamental technical skills), as described in the 2012 self-study, with the eleven Student Outcomes A – K, exactly corresponding to the ABET student outcomes.
9. Split, Spring 2014, the third Program Educational Objective into two (now the third and fourth). The third concerns professional growth and development and the fourth concerns societally-beneficial activity (see Criterion 3 for complete statements).

0-C Options

The Computer Engineering program may be completed, following any of the following technical elective concentrations:

- Robotics & Automation: Robotics Engineering (EGRS-385), Systems Integration & Machine Vision (EGRS-430), and Automated Manufacturing Systems (EGRS-435). A grade of "C" or better is required in all of the above courses.
- Sustainable Energy: Energy Systems and Sustainability (EGNR-261), Energy Systems and Sustainability Lab (EGNR-361), and two of the following: Electro-Mechanical Systems (EGEE-330), Power Distribution and Transmission (EGEE-411), Power Electronics (EGEE-475), or Vehicle Energy Systems (EGNR-362). A grade of "C" or better is required in all of the above courses that are taken.
- General: CSCI-281 or higher, EGEE-310 or higher, EGME-275 or higher, EGEM-220, MATH-215 or higher, EGRS-365, EGRS-460 or higher, EGET-310, or any course from the other concentrations.

0-D Program Delivery Modes

Courses in the Computer Engineering program are offered during daytime and evening hours, on regular weekdays only, and using a traditional lecture/laboratory format (the vast majority of it is unavailable at off-campus sites, or through web-based or distance education avenues; presently, only General Education courses, are available on-line). A small cooperative education component can be used, at the student's option, however, to satisfy a portion of the senior capstone course; that, of course, largely takes place at an employer site.

0-E Program Locations

The program is available, exclusively, at the main campus of Lake Superior State University, in Sault Ste. Marie, Michigan.

0-F Public Disclosure

For the Computer Engineering program, the Program Education Objectives (PEOs), Student Outcomes (SOs), annual student enrollment and graduation data is available at the URL:

https://www.lssu.edu/school-of-engineering-and-technology/accreditation-outcome-reporting/

0-G Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them

The ABET final statement subsequent to the visit of Fall 2012 resulted in the following citations remaining unresolved:

> "Criterion 8. Institutional Support This criterion requires that the resources available to the program be sufficient to attract, retain and provide for the continued professional development of a qualified faculty. Since the last accreditation visit, the program has experienced a significant turnover in the faculty. If the resources available to the program are not adequate for the retention and continued professional development of the faculty, there is the potential that future compliance with this criterion could be jeopardized."
>
> Due Process Response: The EAC acknowledges receipt of documentation showing that a proposal for additional funding for faculty to attend workshops/conferences and provide summer stipends for scholarly endeavors, and to support other professional development activities was approved by the LSSU Board of Trustees. However, additional professional development funding alone might not be enough to retain qualified faculty.
>
> The concern remains unresolved.

The 30-day response from LSSU to ABET was more detailed than as paraphrased above, concerning the promised professional development ("PD")/stipend support, reading:

> "Specifically, LSSU Engineering program fees will be raised from \$60/semester to \$70/semester, with 75% of these program fees being returned to Engineering versus the current 50% return. These modifications to the Engineering program fees scheme will generate ~\$52,000/yr to be used for professional development activities (~\$21,000/yr) and summer stipends (~\$25,000/yr). A small portion of the generated funds (~\$6,000/yr) will be used to reimburse the LSSU General Fund for Engineering Program Coordinators being at two release hours per semester versus the standard one release hour. This increase of course load release will provide additional time to complete administrative duties, particularly those related to maintaining ABET accreditation. (1 extra hour/coordinator x 3 coordinators/semester x 2 semesters/yr x \$890/hour = ~\$6,000/yr).
>
> "With ten faculty distributed amongst the three accredited engineering programs at LSSU, the new funds will provide ~\$5,000/yr per faculty member for professional development and scholarship."

The ABET finding cites high faculty loads and lack of professional development opportunities as background to the turnover problem. The latter will be discussed in terms of the PD funding program that sought to address it, below. Concerning the former, faculty load, see Criterion 6-B of this report, in which it is noted that high loads have continued (and are, in fact, higher now than 6 years ago).

The latter circumstance, lack of professional development opportunities, may best be discussed in terms of the status of the action plan to which reference was made in the final statement from 2012. The funding history of that professional development and stipend program, cited in the due process response as a mechanism to abate the turnover problem, is provided in Table 0-1, below.

Table 0-1: Funding History of PD / Stipend Funding in Response to 2012 Criterion 8 Weakness

				Fiscal Year		
Acct Code	Description	2013-14	2014-15	2015-16	2016-17	2017-18*
	Compensation					
6170	Salary	19,486.00	32,637.00			
6710	FICA	1,467.08	2,467.19			
6722	TIAA Retirement	2,338.32	3,916.44			
	subtotal	23,291.40	39,020.63			
	Supplies and expenses					
7002	Reference Books		670.61	179.92		
7020	Supplies	576.35		255.47	57.25	
7061	Software Licenses	2,994.00				
7070	Non-capital Equipment	6,146.56			87.49	
7340	Memberships			99.00		
	subtotal	9,716.91	670.61	534.39	144.74	
	Travel, conference fees					
7101	Travel In State				502.58	227.60
7102	Travel Out of State			480.70	1,386.15	2,032.60
7112	Conferences	1,150.00		2,000.00	400.00	4,290.00
7365	Professional Development		1,928.50	5,447.00	2,620.00	
	subtotal	1,150.00	1,928.50	7,927.70	4,908.73	6,550.20
	Grand totals	**34,158.31**	**41,619.74**	**8,462.09**	**5,053.47**	**6,550.20**

*as of 6-15-18 Banner query

As the table shows, the program was substantially active for the first two years at levels only somewhat short of the commitment, *after which* the program declined dramatically, as explained below.

The maximum annual funding peaked at about 80% of the promised ($52 k) figure, during the 2nd year only, the 1st year being somewhat close as well, at about two-thirds of the promised level. Most faculty in the School of Engineering & Technology (SET) participated during that time, and stipends were granted on the order of a few thousand dollars per recipient, as well as reimbursements of various other PD-related expenses.

Thereafter, the Dean stipulated new eligibility requirements for participation, namely that there should be *direct* student benefits from any approved activity, but that there should *not* be a direct connection to any specific course. This change ruled out the faculty specialty-area research projects (whereas faculty, widely in academia, would tend to understand the "scholarly endeavors" of the 2012 due process response to include individual faculty research within specialization areas, and not as necessarily implying student participation), effectively confining the awards to pedagogy-type research and degree-advancement (tuition/travel/fees expenses towards an MS degree); it also ruled out any of the lab-upgrade types of projects, as those were regarded as tied to specific courses. It has generally proven too difficult to find projects that fall between these two limitations, explaining the lack of projects (and therefore the lack of funding) since, as can be seen in the far lower funding totals for the last 3 years.

Furthermore, the CFO, at the same time (after 2 years) and since, disallowed any use of the funding for stipends or pay of any kind (even though stipends were part of the language of the original commitment), which has made participation significantly less attractive for faculty to pursue, even if projects could somehow be found that fit the now very narrow definition of eligibility. Accordingly, the program has remained largely inactive, with little to no participation in recent years, and funding at levels well below the $52k promised.

Returning, finally, to the EAC statement, it notes "Additionally, there is a lack of opportunity for teaching and/or research during the Summer…". As the research aspects have already been addressed, so it remains to describe the situation concerning teaching opportunities. The only "coursework" offered in Engineering for most Summers has been the Coop-program, with between 1 and 3 students enrolled per Summer. There has been no classroom-type coursework however. In Technology, two Summer courses (EGRS382 and EGRS482) were offered in 2014, taught by the same faculty member to two students, and one Technology course in Summer 2016 (EGRS381) for three students (same faculty member again). In summary, summertime instruction has been an extremely marginal phenomenon, and it can therefore still be said that Summer teaching opportunities, practically, do not exist.

Criterion 1 STUDENTS

1-A Student Admissions

Most students enrolled in the Computer Engineering program are adequately prepared to perform well in the demanding curriculum. The average ACT/SAT score of all students enrolled in the program is shown below in Table 1-1. In 2015, the state of Michigan selected to use SAT scores instead of the ACT scores as in previous years as a standard for high school juniors to take. That change took effect in spring of 2016, hence the reason for illustrating both ACT and SAT. As a comparison, the average ACT/SAT score of all students enrolled in any degree program at LSSU is also shown in Table 1-1.

Table 1-1: ACT/SAT Scores of Students by Academic Year

Year	ACT Scores of CE Students	SAT Scores of CE Students	ACT Scores of LSSU Students	SAT Scores of LSSU Students
2012-2013	23.9	N/A	22.4	1034
2013-2014	25.5	N/A	22.3	1076
2014-2015	24.0	N/A	22.2	971
2015-2016	26.8	N/A	22.2	1012
2016-2017	26.3	N/A	22.6	1093
2017-2018	25.0	1280	22.5	1092

1-A.1 Admission of First-Time-in-College Freshmen

LSSU considers any applicant with 19 credits (19 semester hours, or 29 quarter hours) or less of university or college coursework to be a freshman. The following policy applies to them. Those applicants with more than 19 credits of university or college coursework are considered to be transfer students.

The academic background of the applicant must demonstrate an ability to meet the requirements of an engineering program at LSSU. For those students entering directly from high school, admission to the engineering programs is based on high school grade point average and ACT/SAT scores. Admissions standards for admittance into Computer Engineering have changed over the past six years. Prior to 2017, the standard was a high school GPA of 2.75 or above, an ACT composite score of 24 or above, or SAT score of at least 1110. Starting in the fall of 2017, the current admission standards for the admittance into the program are the following criteria (all need to be satisfied):

1. Acceptance into LSSU.
2. Placement into MATH-111 (College Algebra) or higher. Currently an ACT Math minimum score of 23 or a SAT Math minimum score of 540.

Applicants not meeting the above criteria but meeting admission requirements for the University will be admitted into AS-General Studies-Engineering major, essentially a place-holder major for those aspiring to Engineering, but not yet qualified to take most early courses in the program; these students receive advising from a liberal arts advisor, as most of their course selections are General Education, so long as they remain in this major.

1-A.2 Transfer from AS-General Studies-Engineering to Computer Engineering (If Necessary)

In order for a first-time-in-college freshman who is in the AS-General Studies-Engineering major (see above) to move into the Computer Engineering program, that student must make good academic progress and be prepared to enter Calculus I (MATH151). Specifically, to be admitted to the program, the student must attain a C or better in College Algebra (MATH111) and a C or better in College Trigonometry (MATH131), and earn an overall GPA of 2.0 or higher.

1-B Evaluating Student Performance

Student performance in a course is evaluated by the course instructor, who assigns, at the completion of the course, a grade on an A-F scale, where F is a failing grade. There are no courses in the program graded on a pass-fail basis. The GPA is monitored by the University on a semesterly basis in order to insure the student is in good academic standing.

1-B.1 Grading

Pursuant to concepts of academic freedom, which are affirmed by the faculty-LSSU collective bargaining agreement, the School of Engineering & Technology (SET) does not mandate any methodology by which instructors are to arrive at grades, nor any distribution of grades, etc. Instead, grading policies are left to the judgment of the individual faculty member; the assurance of quality and consistency in grading is therefore *not directly* enforced by virtue of common policies, but rather *indirectly* attained by virtue of the care taken in the process of making faculty appointments to ensure that the faculty candidate has a mastery of his/her field and is a person of judgment. Please Refer to Criterion 6 for discussion of this process. Moreover, the dean prepares performance evaluations of faculty members, as discussed in Criterion 6, and issues of fairness and accuracy of grades could be addressed, and feedback given, if necessary.

The student can appeal to the instructor of a course for a grade change, but the instructor's grade cannot be overruled by the dean, provost, or even president.

1-B.2 Monitoring of Grades

To satisfy any course requirement in the Computer Engineering program, or for a course to serve as a prerequisite, the student must obtain a passing grade in that course. Additionally, certain fundamental courses require a grade of C or better. Furthermore, maintaining an adequate GPA (2.0 or better) is a condition for continued enrollment in the program.

All efforts are made to monitor student performance *during*, and not merely after, a course in order to be in a position to take corrective action, i.e., to encourage better study habits and learning approaches, when appropriate. Thus, instructors are encouraged to submit midterm grades, which not only apprise a student of his/her performance midway through a course, but also alerts the academic advisor and academic support units of the University when that student is not performing well. The IPASS (Individual Plan for Student Success) program, in particular, can provide an academic intervention in such a scenario.

1-B.3 Academic Standing

For a student to remain in good academic standing at the University, he/she must maintain a cumulative GPA of at least 2.0. A student who does not meet this requirement will be placed on probation. Any student who is on probation for two consecutive semesters or a student who has more than 19 credits and has a GPA of less than 1.6 will be dismissed from the University.

Upon dismissal from the University, the student must wait two semesters (summer may be counted for one semester) to elapse before re-enrollment or may petition the Scholastic Standards Committee for immediate readmission should extenuating circumstances exist.

1-B.4 Prerequisites

Each engineering course has prerequisites—usually a list of courses—identifying the necessary background a student must have to be successful in said course. The School of Engineering & Technology employs two methods to guarantee that student meet the prerequisites. The first method results from working diligently with the Registrar's office so that a student will not be able to register for a class in the on-line process if they have not satisfied the prerequisites. Additionally, after grades for the current semester are verified, if a student failed to satisfy any of the prerequisites for an enrolled course, the student is automatically notified and deregistered from the course for that future semester. The second method is the prerequisite compliance form. At the start of the semester each student completes a prerequisite compliance form for each SET course. Samples of these forms are located in Appendix K. The instructor for the course then reviews these submissions. Starting in fall 2017, some engineering classes piloted a new prerequisite compliance form that not only identifies the prerequisite courses but also the specific topics that are needed. Two of these new forms are also found in Appendix K.

A student may communicate to the instructor of a course and request for an override of a course's prerequisite. This occurs many times with transfer students or students that have taken classes at other institutions and the credits have not yet transferred. In any case, it is up to the instructor's discretion to either allow the student to register by providing an override in the on-line registration process or deny the override. If an override is granted, it is up to the student to register for the course. Additionally, at the start of the semester, the student must complete the prerequisite compliance form. If the reason for the override has not yet been resolved, the reason will be recorded on the form. Based on a student not satisfying the prerequisite, the instructor may further discuss the issue with the student and arrive at a solution where either the student would prove their understanding of previous topics or the student would be unenrolled from the course. The new, piloted prerequisite compliance forms provide a means and space specifically to record that solution.

1-C Transfer Students and Transfer Courses

Ideally, a student who plans to transfer into the Computer Engineering program at LSSU should contact the coordinator of the program. The coordinator assists the student in selecting courses that transfer directly into the program (specific courses from specific institutions with a precious evaluation history). The coordinator evaluates the courses that potentially transfer and processes the paperwork necessary to admit the student into the degree program.

1-C.1 Admission of Transfer Students

LSSU classifies any applicant as a transfer student if that student has enrolled in a postsecondary institution any time after the summer following his/her high school graduation. The following policy applies to them.

Official university or college transcript(s) should be sent to the Registrar's Office. The results of any advanced placement or aptitude tests taken in high school or college should also be sent to the Admissions office.

The academic background of the applicant must demonstrate an ability to meet the requirements of an engineering program at LSSU. A minimum GPA of 2.0 on all college level coursework and eligibility to return to the former college are required for admittance into the Computer Engineering program. Students with grade point averages of less than 2.0 will be admitted into the AS-General Studies-Engineering major.

1-C.2 Transfer from AS-General Studies-Engineering to Computer Engineering (If Necessary)

In order for a transfer student who is in the AS-General Studies-Engineering major due to not meeting initial admission requirements for the Electrical Engineering program, that student must make good academic progress (GPA 2.0 or higher) and be prepared to enter College Algebra (MATH111).

1-C.3 Transfer of Courses

For repeated courses, the grade for the most recent course will be used. Generally, a chemistry course, English composition courses, a computer course with "C" as the preferred language, and some elective courses in social sciences and humanities transfer into the engineering programs. Mathematics courses in differential and integral calculus, differential equations, probability and statistics, along with calculus-based general physics also transfer into the engineering programs. Sophomore engineering courses may transfer directly into engineering programs if they have similar content and prerequisites as LSSU engineering courses. The appropriate chair, or dean, determines if a course is transferable into an engineering program. Engineering program coordinators will be furnished a copy of the student's transcripts. The chair or academic advisor may elect to waive the need for a student to take EGNR101, "Introduction to Engineering", if he/she has transferred in any 200-level or higher engineering listed coursework, and who are at the sophomore-level or higher, by credits.

1-C.4 MACRAO/MTA Agreement between Michigan Colleges and Universities

An agreement regarding the transfer of General Education credit exists between participating Michigan colleges and universities called the Michigan Transfer Agreement (MTA). Prior to the MTA's implementation in the summer of 2015, there was a similar mechanism called the MACRAO transfer agreement. Since LSSU participated fully and without provision in the MACRAO transfer agreement, any transfer student who had completed the General Education requirements at any participating institution automatically met all General Education requirements at LSSU. This is also the case for the MTA. The details of this agreement are given below.

A minimum of 30 semester hours of coursework must be taken at one of Michigan's participating institutions. The courses needed to satisfy the MTA requirements are as follows:

- One course in English composition
- A second course in English composition or one course in communication
- One course in mathematics

- Two courses in social sciences (from two disciplines)
- Two courses in humanities and fine arts (from two disciplines excluding studio and performance classes)
- Two courses in natural sciences including at least one with laboratory experience (from two disciplines)

Additionally, the student must earn a minimum grade point of 2.0 in each of these courses for the MTA to be approved.

1-D Advising and Career Guidance

The purpose of academic advisement is to provide guidance for students to succeed in their academic pursuits. This includes:

a. Advising students on the sequence of courses that should be completed to finish their degree in a timely manner.
b. Providing information on academic support services available on campus such as counseling, preparing résumés, and seeking job opportunities.
c. Interpreting LSSU's policies on issues such as dropping courses, taking an "I" grade, transferring courses from other institutions, waiving courses, and substituting courses.
d. Fostering a sense of joint responsibility towards lifelong learning.
e. Providing resources for students in various appeal processes such as an extension of probation or financial-aid programs.
f. Supplying recommendation letters for future student employment, scholarships, graduate school, etc.

The following sections describe the role of engineering faculty in advising and ensuring that students remain in good academic standing as they pursue their degree.

1-D.1 Assignment of Students to Faculty Advisors

All students admitted into the Computer Engineering program are assigned a faculty advisor who teaches courses in their major. The program coordinator or the school chair advises all incoming freshmen and all transfer students during their first year. The students are re-assigned a new faculty advisor for the remainder of their time. The dean's office maintains updated advisee lists and posts them outside the School of Engineering & Technology office. Students may request a change of academic advisor, but the coordinator of the program is responsible for the approval of all advisor changes.

New faculty members receive training as part of their orientation allowing them to effectively advise their assigned students. Within the School of Engineering & Technology (SET), new faculty members are mentored by other experienced SET faculty members in the areas of degree audits, substitution waiver form, and advising methodologies. Additionally, staff at LSSU provides occasional training of the University's web-based Banner system, transfer evaluations, placement tests, financial-aid appeals, and other policies and procedures relevant to student advising.

The faculty receives a list of their advisees and written documents related to the students' academic background. Faculty members also have access to the University's web based Banner system (Anchor Access) to review the academic records of their advisees.

1-D.2 Faculty Advising

A student and his/her faculty advisor meet a minimum of once per semester. Furthermore:

a. The faculty advisor and student review the student's success toward meeting program requirements and review student progress toward the degree. A degree audit sheet is updated every semester. Midterm grades of courses in progress can also be reviewed.
b. The faculty advisor and student plan the student's courses for the next semester. The faculty advisor ascertains that the student has completed prerequisites and is in good scholastic standing before allowing the student to schedule any new courses for the next semester. Electronic removal of an advising hold, preventing registration prior to advising, serves as the formal mechanism to ensure that.
c. Both the faculty advisor and the SET chair approve all course waivers or substitutions.

1-E Work in Lieu of Courses

Besides regular course work, four types of experiences—Dual Enrollment, Departmental Examination, Advanced Placement, and College Level Examination Program—may count toward a degree in any LSSU program, including the Computer Engineering program.

1-E.1 Dual Enrollment

High school juniors and seniors may take classes at Lake Superior State University through the High School Dual Enrollment Program. These courses may count toward the Computer Engineering program either as a core class (typically MATH-151 Calculus I, MATH-152 Calculus II, ENGR-101 Introduction to Engineering, or CHEM-115 General Chemistry I) or as a General Education course. Attendance as a High School Dual Enrollee does not constitute admission into any four-year degree program at the University.

Only students who have received endorsements in Mathematics, Science, Reading, and Writing are eligible to take courses in those areas. All students are eligible to take courses in other areas. Grade point average is not a determining factor in eligibility to enroll.

1-E.2 Departmental Examination

A policy exists for students to "test out" of a course by taking a Departmental Examination. The department is free to administer its own examination for any course that it offers. The student must have the written approval of the School of Engineering & Technology chair to take the examination. The student must receive a grade of C or better on the examination in order to receive credit for the course, in which case the credit earned by exam is recorded as transfer credit on the student's transcript.

Although the policy for Departmental Exams exists, there has not been a single instance of its usage for an Computer Engineering program core or elective course in the past six years.

1-E.3 Advanced Placement (AP)

Course credit is awarded to students who receive a score of 3, 4, or 5 on any Advanced Placement exam listed in Table 1-2 below. The student will receive credit for the specified courses on the chart after being granted unconditional admission to Lake Superior State

University. Note that Table 1-2 is not a complete list and only includes those courses which may count toward credit in the Computer Engineering program.

Table 1-2: AP Courses for Computer Engineering Program

Advanced Placement Exam	LSSU Course Equivalent	Type of Course in CE Curriculum
Art – History of Art	ARTS -250, ARTS-251	General Education – Humanities
Biology	BIOL131, BIOL132	General Education – Natural Sciences
Calculus AB	MATH-151	Engineering Core
Calculus BC	MATH-151, MATH-152	Engineering Core
Chemistry	CHEM-115	Engineering Core
Computer Science A	CSCI-319	Computer Engineering Elective
English – Language & Composition	ENGL-110, ENGL-111	General Education – Communications
English – Literature & Composition	ENGL-110, ENGL-111	General Education – Communications
European History	HIST-102	General Education – Social Science
French Literature	FREN-355, FREN-356	General Education – Humanities
French Language	FREN-351, FREN-352	General Education – Humanities
German Language	GRMN-241, GERM-242	General Education – Humanities
Human Geography	GEOG-201	General Education – Social Science
Macroeconomics	ECON-201	General Education – Social Science
Microeconomics	ECON-202	General Education – Social Science
Music – Listening & Literature	MUSC-220	General Education – Humanities
Physics C: Mechanics	PHYS-231	Engineering Core
Physics C: Electricity and Magnetism	PHYS-232	Engineering Core
Physics C	PHYS-231, PHYS-232	Engineering Core
Psychology	PSYC-101	General Education – Social Science
Spanish Language	SPAN-261, SPAN-262	General Education – Humanities
Spanish Literature	SPAN-380, SPAN-381	General Education – Humanities
United States Government & Politics	POLI-110	General Education – Social Science
United States History	HIST-131, HIST-132	General Education – Social Science
World History	HIST-101, HIST-102	General Education – Social Science

1-E.4 College Level Examination Program (CLEP)

Course credit is also awarded to students who receive a passing score on any College Level Examination Program (CLEP) subject exam listed in Table 1-3 below. The student will receive credit for the specified courses on the chart after being granted unconditional admission to Lake Superior State University. These credits are not awarded grades and do not apply towards the student's GPA. Note that Table 1-3 is not a complete list and only includes those courses which may count toward credit in the Computer Engineering program.

Table 1-3: CLEP Courses for Computer Engineering Program

CLEP Exam – Passing Score	LSSU Course Equivalent	Type of Course in CE Curriculum
American Government – 50	POLI-110	General Education – Social Science
Biology – 50	BIOL-131, BIOL-132	General Education – Natural Sciences
Calculus – 50	MATH-151	Engineering Core
Chemistry – 50	CHEM115	Engineering Core

College Composition – 50	ENGL-110	General Education – Communications
French Language – 58	FREN-251	General Education – Humanities
French Language – 66	FREN-251, FREN-252	General Education – Humanities
History of the US I – 50	HIST-131	General Education – Social Science
History of the US II – 50	HIST-132	General Education – Social Science
Introductory Psychology – 50	PSYC-101	General Education – Social Science
Introductory Sociology – 50	SOCY-101	General Education – Social Science
Principals of Macroeconomics	ECON-201	General Education – Social Science
Principals of Microeconomics	ECON-202	General Education – Social Science
Spanish Language – 58	SPAN-261	General Education – Humanities
Spanish Language – 66	SPAN-261, SPAN-262	General Education – Humanities
Western Civilization I – 50	HIST-101	General Education – Social Science
Western Civilization II – 50	HIST-102	General Education – Social Science

1-F Graduation Requirements

The name of the degree awarded through successful completion of the Computer Engineering program is Bachelor of Science in Computer Engineering.

Two semesters before the student plans to complete degree requirements and graduate, he/she submits a *Degree Audit* form and a *Declaration of Candidacy for Degree* form to the Registrar's office. The *Degree Audit* denotes all previous coursework and lists the courses to be taken during the final two semesters. The faculty advisor, program coordinator, and school chair must approve the *Degree Audit*. The Registrar determines the University requirements remaining for graduation, and the student is informed in writing of the remaining requirements. Any degree requirements not denoted on the *Degree Audit* are immediately brought to the attention of the school chair, program coordinator, and faculty advisor.

The *Degree Audit*, which is shown in the Curriculum section (Criterion 5), contains all the requirements for the B.S. Computer Engineering degree. However, those requirements are summarized in Table 1-4 below.

Table 1-4: Summary of Requirements for the B.S. Computer Engineering Degree

Course Requirements	
General Education	24 credits
Computer Engineering Core	82 credits
Engineering Capstone and Technical Electives	19 credits
	125 credits
Other Requirements	
General Education GPA	2.0
Engineering GPA	2.0
Overall GPA	2.0
Minimum Credits at LSSU	30 credits
Minimum 300/400 Credits at LSSU	24 credits

1-G Transcripts of Recent Graduates

There have been 21 graduates of the Computer Engineering program over the past six years. A list of these students is shown in Table 1-5 below. At LSSU, "program options" are noted as "program concentrations." Each student's "concentration" is listed on his/her transcript. The three possible concentrations available for a student in Computer Engineering are "Robotics and Automation," "Sustainable Energy," and "General." Transcripts for any of these students can be provided upon request.

Table 1-5: Graduates of the past six years

Student	LSSU ID	Graduation
[redacted]	[redacted]	Fall 2012
[redacted]	[redacted]	Spring 2013
[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	Summer 2014
[redacted]	[redacted]	Spring 2015
[redacted]	[redacted]	Spring 2015
[redacted]	[redacted]	Spring 2016
[redacted]	[redacted]	Spring 2016
[redacted]	[redacted]	Spring 2016
[redacted]	[redacted]	Spring 2016
[redacted]	[redacted]	Spring 2016
[redacted]	[redacted]	Spring 2016
[redacted]	[redacted]	Fall 2016
[redacted]	[redacted]	Spring 2017
[redacted]	[redacted]	Spring 2017
[redacted]	[redacted]	Spring 2017
[redacted]	[redacted]	Spring 2018
[redacted]	[redacted]	Spring 2018
[redacted]	[redacted]	Spring 2018

Criterion 2 PROGRAM EDUCATIONAL OBJECTIVES

2-A Mission Statement

The University-level mission statement reads:

> *"We equip our graduates with the knowledge, practical skills and inner strength to craft a life of meaningful employment, personal fulfillment, and generosity of self, all while enhancing the quality of life of the Upper Great Lakes region."*

This mission statement is published in the LSSU Catalog and on the University's web-site at the following URL:

https://www.lssu.edu/president/mission-vision/

The School of Engineering & Technology, as well, has maintained a Mission Statement since 1996 when the School was formed. The School has reviewed and modified the Mission Statement periodically, most recently in Spring 2014, so that it now reads:

> *"To produce sought-after engineers and technologists by providing a rigorous undergraduate learning experience characterized by close student-faculty interaction."*

This mission statement is published at the School's web page on the following URL:

https://www.lssu.edu/school-of-engineering-and-technology/accreditation-outcome-reporting/

It is apparent by comparing the two mission statements that the mission of the School is supportive of that of the University as a whole, and not conflicting in any fashion.

LSSU's statement dictates that we "equip our graduates... to craft a life of meaningful employment, personal fulfillment, ...", and the School of Engineering & Technology responds by committing itself to a "produces sought after engineers"; evidently, the "meaningful employment" is attainable by those who are (by employers) "sought after", after which "personal fulfillment" is within reach of those well-enough prepared, by virtue of "a rigorous undergraduate learning experience".

The School's mission is, moreover, further clarified by a set of appended School goals (also periodically revised, most recently in Spring 2014 as well) as follows:

A. Deliver an undergraduate education that is current and provides knowledge and skills to be successful in professional careers or graduate school.
B. Provide programs that focus on the applications of fundamental principles of engineering, technology, mathematics, science, and computing to benefit society.
C. Provide courses which incorporate and develop skills in communication, design, ethics, teamwork, technology, and capstone experiences relevant to the students' degrees.
D. Provide an education and opportunities for students with diverse abilities to enhance their professional growth and capacity for life-long learning.
E. Engage in continuous improvement activities through ongoing external and internal reviews
F. Enable faculty, staff, and students to apply engineering solutions that support regional economic growth and develop intellectual property.

G. Maintain the School's viability, productivity, and effectiveness by supporting enrollment, retention, and placement initiatives.
H. Provide a supportive environment in which faculty, staff, and students are recognized as essential in the realization of the mission

Again, these clarifications to the School mission are aligned with the LSSU mission. Certainly, A through D can be seen as building the students future prospects for "meaningful employment, personal fulfillment, and generosity of self". Moreover, where LSSU endeavors to be "enhancing the quality of life of the Upper Great Lakes region", the School, correspondingly, through goal F, tries to "apply engineering solutions that support regional economic growth". Thus, the School's mission, and its goals, are highly complementary to that of LSSU as a whole.

These goals also serve as a link between the School's Mission Statement and the Program Educational Objectives (PEOs) to be discussed in the following section.

2-B Program Educational Objectives

The Department of Electrical and Computer Engineering has the responsibility, in accordance with the School's mission and goals, to educate and prepare its students for meaningful and productive careers in engineering. To provide measures of how well this responsibility is met, the faculty have developed four Program Educational Objectives (PEOs).

Program Educational Objectives define the skills and qualities that practicing engineers should have after some period of employment. These are based on the needs of our graduates, and of employers of our graduates; input from our Industrial Advisory Board (IAB), graduates, and employers, as well as the judgment of the faculty applied to the review of such input, guide the gradual evolution of these objectives. They specify the expected knowledge, abilities, skills, and qualifications of experienced Computer Engineering graduates, i.e., graduates with approximately three years of professional experience. The Program Educational Objectives are applicable either to working graduates or to graduates pursuing advanced degrees.

The PEOs for the Computer Engineering program are, moreover, common to the Electrical and Mechanical Engineering programs as well. They are published on the website on the following URL,

https://www.lssu.edu/school-of-engineering-and-technology/accreditation-outcome-reporting/

and reads as follows:

Graduates of the Computer Engineering, Electrical Engineering, and Mechanical Engineering programs having three or more years of experience:

I. will have applied engineering knowledge and skills to solve problems in their professions.
II. will have demonstrated application of design and/or research principles subject to technical, practical, ethical, and other societal constraints.
III. will have set professional goals, experienced professional growth, engaged in ongoing professional development and learning activities.
IV. will be capable self-learners and make meaningful contributions to society.

2-C Consistency of the Program Educational Objectives with the Mission of the Institution

The critical focus of the Computer Engineering program is to afford undergraduates of varying backgrounds and abilities every opportunity for achieving success as practicing Computer Engineers or in their graduate programs. Specific emphasis in the program is given to professional and industrial-related engineering practice. The relation between the Program Educational Objectives and the School Goals is shown in Figure 2-1 below.

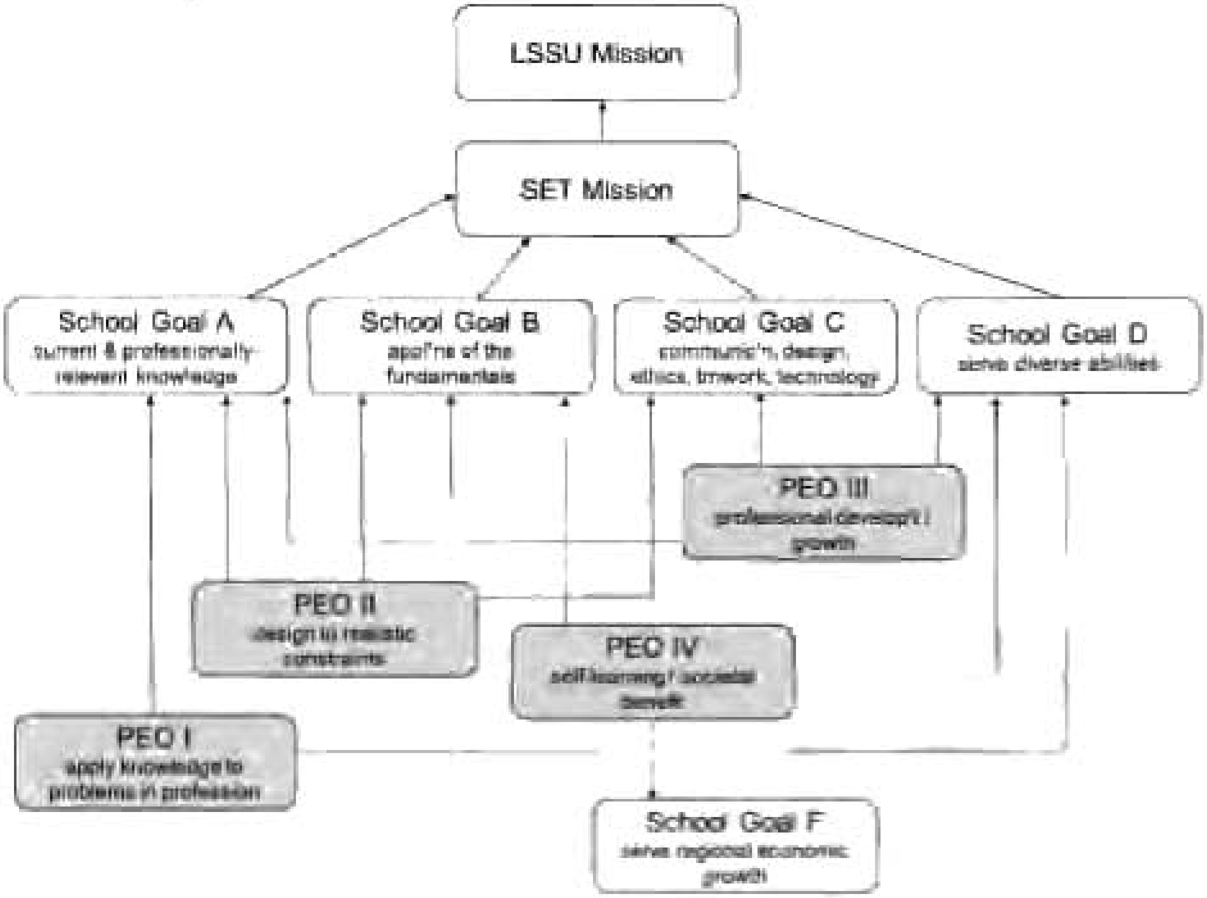


Figure 2-1: Relationship of Program Educational Objectives (in brief paraphrase) to the Mission, through the School Goals (paraphrased)

The Program Educational Objectives directly support the first four School Goals (A through D) which are focused upon student skills and abilities. The goals are the link to the mission statement for the School (and thence to that of LSSU). The last three School Goals (E through G) are only more indirectly relevant to the Program Educational Objectives, since they focus on faculty and institutional activities rather than the delivery of the program. Indeed, Goal E relates to the assessment process whereby feedback is obtained that redirects some of the ways the program is delivered. Goals F and G relate to the School's economic development and other activities that make for a healthy environment in which the program is delivered. However, the mapping acknowledges that societal benefit could be towards the regional economy in the case of some alumni.

2-D Program Constituencies

The School of Engineering & Technology recognizes as its principal constituents, all of the following:

- Current Students
- Alumni
- Faculty/Staff
- Employers of graduates
- Industrial Advisory Board (IAB)

This is not an exhaustive list that precludes other, perhaps more situational, interest groups; for instance, the economic development roles of the College, which the School supports, would suggest including entrepreneurial and industrial customers of the Product Development Center, and even the wider population of the Eastern Upper Peninsula – Northern Lower Peninsula region, which can be regarded as a beneficiary of the economic growth objectives of the School. Nevertheless, given the *primary* mission of the School to focus on offering quality academic programs, the list does identify the primary constituents.

The Industrial Advisory Board (IAB), in particular, was formed in 1985 and currently consists of approximately 30 members. IAB members possess a variety of professional experiences in the engineering and technology fields. The Board meets twice per year, once at a central Michigan location, and once on campus for program review and critique.

Notice that the PEOs define the attributes expected of alumni, a few years into their careers. Accordingly, the *alumni*'s needs are met, and *students*' needs on track to be met, by the PEOs by virtue of their being the recipients of the positive, self-beneficial attributes defined. It is evident, after all, that these are traits one widely considers desirable to attain; these stakeholders benefit by attaining them (in the present for alumni, and in the future for students).

The *employers*, as a stakeholder, have the need for engineers with adequate capabilities; the PEOs defined here imply those kinds of capabilities. The *IAB* stakeholder group is largely a subset of the employers, so that its needs are met by the PEOs in the same fashion.

2-E Process for Review of the Program Educational Objectives

It is evident that PEOs represent a goal for the product of a slow process, i.e., an engineering professional developed first by a 4-year curriculum and then further by the first few years of a professional career. Hence, it is not desirable to make rapid or frequent changes to how the PEOs are defined. The PEOs are best seen as the foundation of a long-term plan for which stability is desirable, and are therefore reviewed for currency on a several-year cycle.

The constituents listed in section D, above, all have, by various mechanisms, a voice in the process of establishing and evaluating the continued relevance and attainment of Program Educational Objectives. Alumni and their employers have a voice through surveys collected from them, or by unsolicited feedback they may provide on other occasions. Students have a voice through individual course feedback questionnaires and, finally, through graduate exit interviews. The IAB is periodically solicited for feedback on the occasion of its biannual meetings; its feedback may either focus upon the relevance of the objectives themselves, or upon their degree of accomplishment.

Upon review by the faculty every several years, occasion is also provided to redefine the PEOs themselves, if necessary. Such redefinition could be motivated by comments obtained from any of the constituents mentioned above. It could also be motivated by trends the faculty observe in the needs of industry, to which the School is well-attuned thanks to its economic development activities, as well as its regular meetings with its Industrial Advisory Board and its involvement with senior project sponsoring industries. The faculty of the School, by majority vote, have complete discretion over the PEOs.

Criterion 3 STUDENT OUTCOMES

3-A Student Outcomes

The student outcomes for the LSSU Computer Engineering program are the same as those in ABET Criterion 3 (A) through (K). These student outcomes are listed below:

A. an ability to apply knowledge of mathematics, science, and engineering.
B. an ability to design and conduct experiments, as well as to analyze and interpret data.
C. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
D. an ability to function on multidisciplinary teams.
E. an ability to identify, formulate, and solve engineering problems.
F. an understanding of professional and ethical responsibility.
G. an ability to communicate effectively.
H. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
I. a recognition of the need for, and an ability to engage in life-long learning.
J. a knowledge of contemporary issues.
K. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The student outcomes are documented, along with School mission statement, School goals, and program educational objectives, on the LSSU web site at the following URL:

https://www.lssu.edu/school-of-engineering-and-technology/accreditation-outcome-reporting/

3-B Relationship of Student Outcomes to Program Educational Objectives

The program education objectives for the program are listed below.

Graduates of the Computer Engineering, Electrical Engineering, and Mechanical Engineering programs having three or more years of experience:

I. will have applied engineering knowledge and skills to solve problems in their professions.
II. will have demonstrated application of design and/or research principles subject to technical, practical, ethical, and other societal constraints.
III. will have set professional goals, experienced professional growth, engaged in ongoing professional development and learning activities.
IV. will be capable self-learners and make meaningful contributions to society.

The eleven student outcomes (A-K) prepare students to attain, later as alumni, the four program educational objectives (I, II, III, and IV) through the course work as outlined in Criterion 5. A mapping of the student outcomes to each program educational objective is found in Table 3-1. The table lists each of the student outcomes and to what degree it supports each of the program educational objectives.

Table 3-1: Mapping of Student Outcomes to Program Educational Objectives

Student Outcome	PEO - I Apply Knowledge to Problems in Profession	PEO - II Design to Realistic Constraints	PEO - III Professional Development / Growth	PEO - IV Self Learning / Societal Benefit
(A) Math, Sci., Eng.	High	Moderate	N/A	Moderate
(B) Experiment	Moderate	High	N/A	Moderate
(C) Design	High	High	N/A	High
(D) Teams	Low	Low	High	Moderate
(E) Problem Solving	High	High	N/A	Moderate
(F) Ethics	Low	High	High	High
(G) Communication	Moderate	Low	Moderate	High
(H) Broader Impacts	Low	High	Moderate	High
(I) Life-Long Learning	N/A	N/A	High	High
(J) Contemporary Issues	Moderate	Moderate	High	Moderate
(K) Modern Tools	High	Moderate	Moderate	Moderate

3-B.1 Program Educational Objective I

Graduates of the Computer Engineering program having three or more years of experience will have applied engineering knowledge and skills to solve problems in their professions.

This objective is supported primarily by student outcomes a, c, e, and k. These outcomes are about applying knowledge and skills, designing systems, and solve problems all of which are directly needed for graduates to fulfill this objective. There are other outcomes that are not directly required but can help students to solve problems in their profession.

3-B.2 Program Educational Objective II

Graduates of the Computer Engineering program having three or more years of experience will have demonstrated application of design and/or research principles subject to technical, practical, ethical, and other societal constraints.

This objective is supported primarily by student outcomes B, C, E, F, and H. These outcomes are about understanding impacts of engineering and ethical responsibilities, interpreting data, solving problems, and designing systems within constraints all of which are directly needed for graduates to meet this objective. There are other outcomes that are not directly required but can help students to design systems given various constraints.

3-B.3 Program Educational Objective III

Graduates of the Computer Engineering program having three or more years of experience will have set professional goals, experienced professional growth, engaged in ongoing professional development and learning activities.

This objective is supported primarily by student outcomes D, F, I, and J. These outcomes are about working on teams, understanding ethical responsibilities, knowledge of contemporary issues, and recognizing the need for life-long learning all of which are directly needed for graduates to meet this objective. There are other outcomes that are not directly required but can help students to experience professional growth.

3-B.4 Program Educational Objective IV

Graduates of the Computer Engineering program having three or more years of experience will be capable self-learners and make meaningful contributions to society.

This objective is supported primarily by student outcomes C, F, G, H, and I. These outcomes are about understanding ethical responsibilities and the impact of engineering solutions, recognizing the need for life-long learning, as well as the ability to design a system and communicate effectively all of which are directly needed for graduates to meet this objective. There are other outcomes that are not directly required but can help students to make meaningful contributions to society.

Criterion 4 CONTINUOUS IMPROVEMENT

4-A Student Outcomes

The process for continuous improvement of the program is primarily a combination of student outcome and course assessment/evaluation. Assessment and evaluation of the student outcomes provides a means of improving the program while course assessment improves each individual course.

4-A.1 Overview of the Continuous Improvement Process

The block diagram shown in Figure 4-1 provides an overview of the continuous improvement process. The process starts with the ABET-EAC criteria as well as the missions and goals of the University, College, and School. From the criteria and missions the program educational objectives (PEOs) and the student outcomes are developed. The program educational objectives, in addition to input from the industrial advisory board and employers of our graduates are used to inform in determining the program curriculum. From the program curriculum courses and individual course objectives are designed. An essential component in this process is regularly measuring student performance in both the student outcomes and course objectives.

In addition to measuring student performance, constituent feedback is a vital part of our assessment process. Given our small student population, the sample size for student work is rarely statistically significant. The small size can also cause student performance to fluctuate as the academic ability of a particularly class varies. This can make it challenging to make definitive conclusions about changes made to a course and/or the program. As a result more qualitative mechanisms are used in conjunction with student performance.

Student feedback is an essential component in our assessment. The small student population allows the faculty to get to know the students which makes them more comfortable with providing meaningful feedback. This includes formal feedback in the form of written and verbal from course assessment as well as senior exit surveys and interviews. In addition, informal feedback such as conversations with students also plays an important role but is difficult to document. Faculty are also in contact with alumni and employers who provide valuable feedback to improve courses and the program.

Faculty regularly evaluate the student performance and constituent feedback. After thorough deliberation, recommendations for changes to courses or programs are developed. For minor changes, these recommendations are then implemented by course instructors. Larger changes may require approval from the University-wide curriculum committee and the Provost. These changes are usually initiated by the school chair or program coordinator.

The process, so described, takes place at the School level (SET) in the case of courses common to the Engineering programs (EE, CE, and ME). If the course is specific to the program, then the process described takes place at the Department level instead.

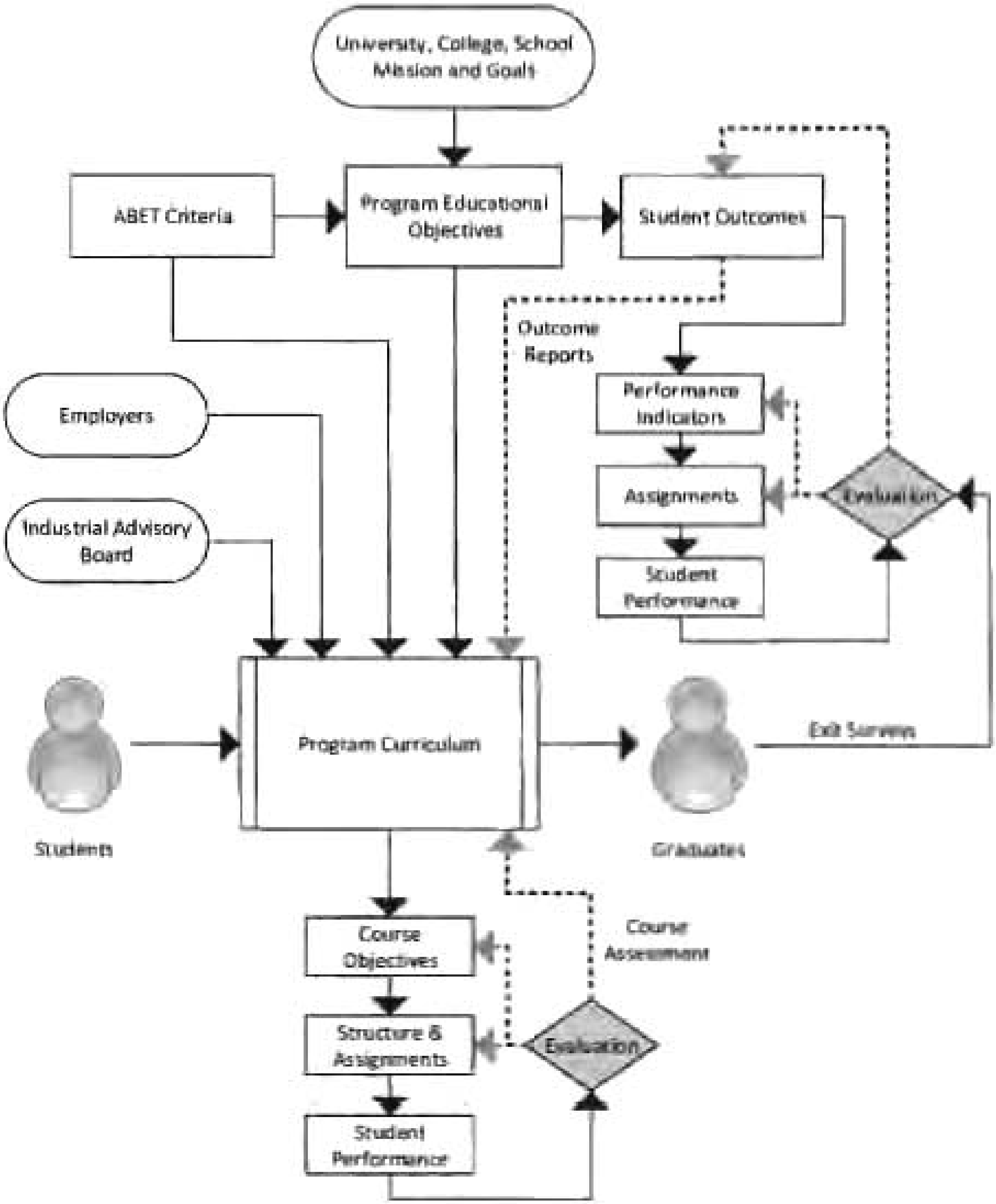


Figure 4-1: Overview of the Continuous Improvement Process

4-A.2 Student Outcome Evaluation

In order to evaluate student performance for each student outcome (A-K), one, two, or three performance indicators were established by the department or school. Each performance

indicator is associated with a specific assignment/activity in one of the upper-level core courses in the curriculum. Student attainment of the performance indicator is evaluated by the instructor and, in some cases when practical, another knowledgeable faculty member. Additionally, seniors are surveyed regarding their attainment of each student outcome at the end of their final semester. Upon completion of the survey the program coordinator conducts an interview with each graduate. To determine the attainment of the student outcomes, and hence the efficacy of the program, the performance indicators and the senior survey results are evaluated on a three-year cycle.

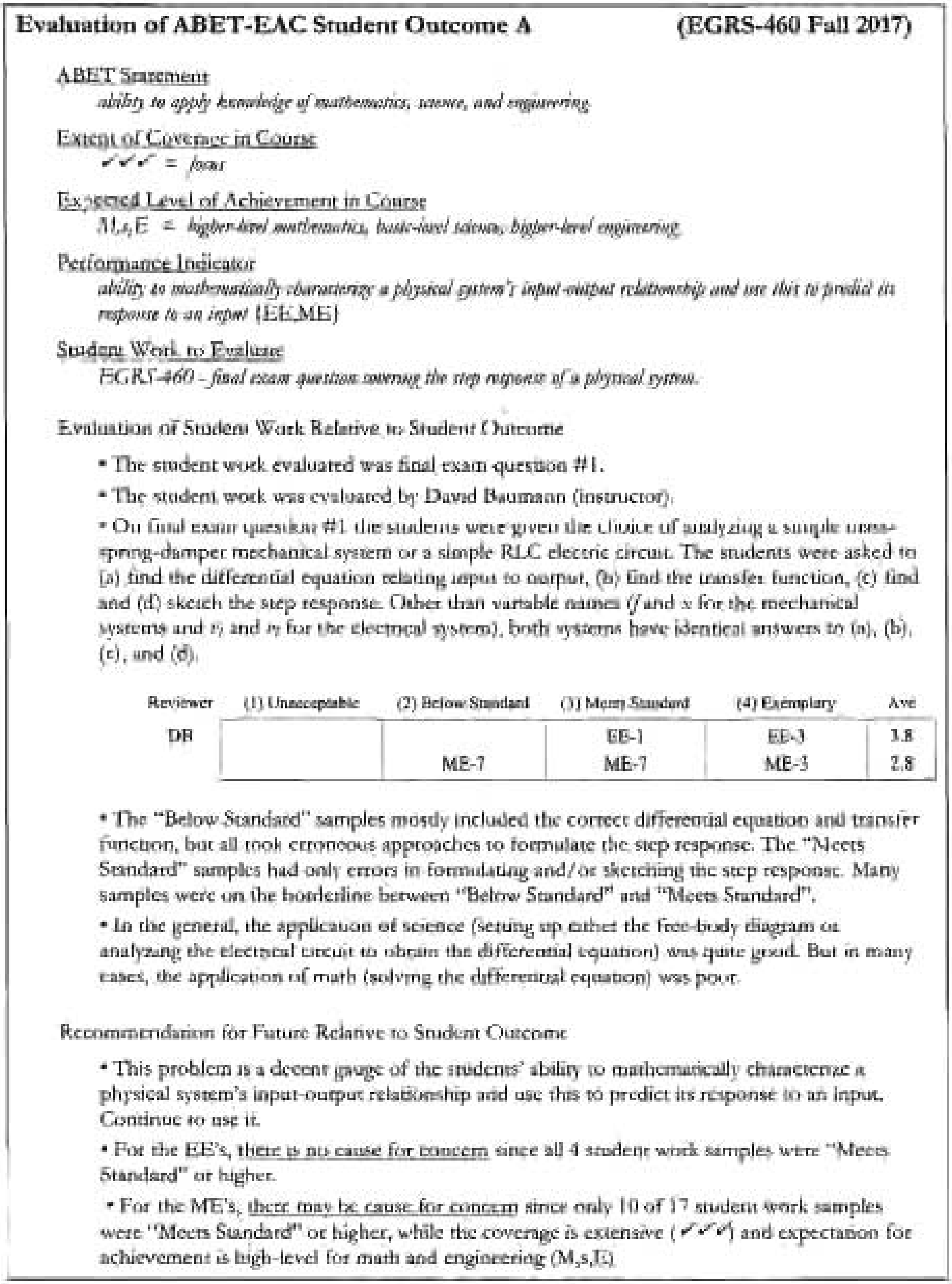
To develop the performance indicators for each student outcome, an appropriate course to sample student work must be selected. Thus for each engineering course in the curriculum, the faculty of the School of Engineering & Technology determined the extent of coverage and expected level of attainment for each student outcome. Then upper-level courses with a relatively high-level of expected attainment were selected to ensure a summative assessment. Due to the relatively small number of students, some of the performance indicators include activities from courses that encompass students from the other engineering programs. Next, for each of the selected courses, the performance indicators for the selected outcomes were developed. These performance indicators are designed to be a specific illustration of the outcome as it relates to the selected course. Finally, the specific assignment within the course is selected to assess student performance. These assignments are usually final exams or other summative items.

The performance indicators are evaluated every time a course containing the associated assignment is offered. The performance of each student (or for large classes a sample; for lab exercises and term projects, these may be from each group rather than each student) on the selected assignment is evaluated solely for the capability denoted by the performance indicator. Each sample of student work receives a score of 1, 2, 3, or 4 depending on how well the student meets the expected capability defined by the performance indicator. The meaning of the score is listed in Table 4-1 below and ranges from unacceptable to exemplary. The evaluation is performed by the instructor(s) responsible for teaching the course and, when possible, an additional reviewer with expertise in the area. For some student outcomes the industrial advisory board (IAB), employers, and alumni score student work. An example of this is outcome G (communications) where many IAB members as well as employers and alumni attend the senior capstone presentations.

Table 4-1: Scoring of Student Work for Performance Indicators

Score	Meaning
1	Unacceptable
2	Below Standard
3	Meets Standard
4	Exemplary

After individually scoring the student work, the reviewer(s) discuss the results and develop recommendations if needed. The results recommendations are reported in the *course assessment summary* report that is written at the conclusion of each course. A sample of an evaluation summary can be seen in Figure 4-2. The summary starts with a description of the student outcome, the extent of coverage and level of achievement, as well as the performance indicator and selected assignment. Next, the student scores and a brief explanation are given. Finally, the recommendations for future changes are listed.



Evaluation of ABET-EAC Student Outcome A (EGRS-460 Fall 2017)

ABET Statement

ability to apply knowledge of mathematics, science, and engineering

Extent of Coverage in Course

✓✓✓ = *focus*

Expected Level of Achievement in Course

M,s,E = *higher-level mathematics, basic-level science, higher-level engineering*

Performance Indicator

ability to mathematically characterize a physical system's input-output relationship and use this to predict its response to an input {EE,ME}

Student Work to Evaluate

EGRS-460 – *final exam question covering the step response of a physical system.*

Evaluation of Student Work Relative to Student Outcome

- The student work evaluated was final exam question #1.
- The student work was evaluated by David Baumann (instructor).
- On final exam question #1 the students were given the choice of analyzing a simple mass-spring-damper mechanical system or a simple RLC electric circuit. The students were asked to (a) find the differential equation relating input to output, (b) find the transfer function, (c) find and (d) sketch the step response. Other than variable names (*f* and *x* for the mechanical systems and v_i and v_o for the electrical system), both systems have identical answers to (a), (b), (c), and (d).

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
DB			EE-1	EE-3	3.8
		ME-7	ME-7	ME-3	2.8

- The "Below Standard" samples mostly included the correct differential equation and transfer function, but all took erroneous approaches to formulate the step response. The "Meets Standard" samples had only errors in formulating and/or sketching the step response. Many samples were on the borderline between "Below Standard" and "Meets Standard".
- In the general, the application of science (setting up either the free-body diagram or analyzing the electrical circuit to obtain the differential equation) was quite good. But in many cases, the application of math (solving the differential equation) was poor.

Recommendation for Future Relative to Student Outcome

- This problem is a decent gauge of the students' ability to mathematically characterize a physical system's input-output relationship and use this to predict its response to an input. Continue to use it.
- For the EE's, there is no cause for concern since all 4 student work samples were "Meets Standard" or higher.
- For the ME's, there may be cause for concern since only 10 of 17 student work samples were "Meets Standard" or higher, while the coverage is extensive (✓✓✓) and expectation for achievement is high-level for math and engineering (M,s,E).

Figure 4-2: Sample Student Outcome Evaluation

Copies of student work and evaluation summary sheet are placed in the appropriate student outcome binder (A-K). Then once every three years the department evaluates each student outcome by considering the results of each performance indicator and the results of the *senior exit surveys* (Appendix H) over the previous years. Each objective is examined, and discussed in detail if there is cause for concern. The reviewers discuss their findings and recommendations. Faculty members share their experiences and brainstorm ideas to help improve the student performance. These results and any approved changes are then recorded in the *student outcome evaluation* report (sample of which can be seen in Appendix G). Small changes are implemented by the instructor(s) of the appropriate course(s), while larger changes are implemented by the department or school (with input from the industrial advisory board and approval from the curriculum committee where appropriate). The efficacy of these changes are then discussed during the next evaluation of the outcome.

4-A.3 Summary Results of Student Outcome Evaluation

A summary of the student outcome evaluation results is provided below. The detailed results can be found in the *student outcome evaluation* report in Appendix G. For the sake of completeness and clarity, each student outcome is stated below followed by the associated performance indicators. Next, the selected course and assignment of student work to be evaluated is given. After that, the level of exposure and the expected level performance for the selected assignment are listed. Then, the average score of the student work for the most recent assignment is given. Finally, a brief summary of the analysis and recommendations (if any) of the outcome are included.

4-A.3.1 Student Outcome (A)

an ability to apply knowledge of mathematics, science, and engineering

Performance Indicator (A1)

the ability to solve a partial differential equation (PDE) numerically
EGNR-340 – final exam question on PDE's
(✓✓ = stress, Me = advanced-level math, basic-level engineering)
2.7 average of student work from Spring 2018

Performance Indicator (A2)

the ability to apply complex mathematics to transform from the discrete time domain to the frequency domain
EGEE-425 – final exam problem on discrete Fourier transform
(✓✓✓= focus, Me = advanced-level math, basic-level engineering)
3.2 average of student work from Spring 2017

Performance Indicator (A3)

the ability to mathematically characterize a digital system's input-output relationship and use it to predict its response to an input
EGEE-320 – final exam question on circuit timing
(✓✓= stress, me = basic-level math, basic-level engineering)
2.3 average of student work from Fall 2016

Analysis and recommendations

There is a concern that student performance in this outcome is not at the expected level. Examples of issues students had meeting this outcome include:

- Many students have difficulties approaching a problem and only attempt to do so on a surface level.
- There is a general weakness amongst students while working with complex numbers.

It was recommended that a common procedure for analyzing and solving problems along with support material be developed and used across all engineering courses. This common procedure will help reinforce the process of solving problems to students. A further recommendation is to add additional material on complex numbers to EGNR140. This additional exposure to complex numbers will help students gain more experience and become more comfortable using them.

4-A.3.2 Student Outcome (B)

an ability to design and conduct experiments, as well as to analyze and interpret data

Performance Indicator (B1)

the ability to develop a valid and reliable experimental procedure that will validate a product
EGNR-495 – design review on final product testing
(✓✓ = stress, ** = developed)
2.8 average of student work from Spring 2016

Performance Indicator (B2)

the ability to produce control charts and use them to monitor an on-going manufacturing process
EGNR-346 – control charts report
(✓✓ = stress, ** = developed)
3.0 average of student work from Fall 2017

Analysis and recommendations

There is currently no concern regarding this outcome. However, because of the small number of samples in EGNR346, this performance indicator should be monitored.

4-A.3.3 Student Outcome (C)

an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

Performance Indicator (C1)

the ability to reformulate implied customer needs as specifications and produce an acceptable design solution
EGNR-491 – product design review
(✓✓✓= focus, *** = high)
2.8 average of student work from Fall 2015

Performance Indicator (C2)

the ability to design a combined software and hardware solution that satisfies specific constraints
EGEE-355 – final design project report
(✓✓ = stress, ** = developed)
3.7 average of student work from Spring 2018

Analysis and recommendations

There is currently no concern regarding this outcome. More design projects and design reviews have been integrated into courses at the junior year, namely EGEE320 and EGEE355. This has taken time and effort to do but it seems that the students have benefited from this; some have noted this verbally in feedback sessions in Senior Projects (EGNR491-495).

4-A.3.4 Student Outcome (D)

an ability to function on multidisciplinary teams

Performance Indicator (D1)

the ability to provide constructive criticism of team members
EGNR-495 – peer evaluations
(✓✓✓ = focus, *** = high)
3.6 average of student work from Spring 2018

Analysis and recommendations

There is currently no concern regarding this outcome.

4-A.3.5 Student Outcome (E)

an ability to identify, formulate, and solve engineering problems

Performance Indicator (E1)

the ability to identify a human need and translate it into technical specifications
EGEE-425 – final design project – identifying a need and proposing a solution
(✓✓✓= focus, ** = developed)
2.5 average of student work from Spring 2017

Analysis and recommendations

There is no concern with this outcome. However, it is clear from examining the student work that phase response needs to be better emphasized in EGEE425 earlier on.

4-A.3.6 Student Outcome (F)

an understanding of professional and ethical responsibility

Performance Indicator (F1)

the ability to apply perspectives from established ethical philosophies in the analysis of a case study
EGNR-495 – ethics essay

(✓✓✓ = focus, ** = developed)
2.8 average of student work from Spring 2016

Analysis and recommendations

There is no cause for concern.

4-A.3.7 Student Outcome (G)

an ability to communicate effectively

Performance Indicator (G1)

the ability to make formal engineering presentations
EGNR-495 – final project presentations
(✓✓✓ = focus, *** = high)
3.0 average of student work from Spring 2016

Performance Indicator (G2)

the ability to write an engineering report
EGEE-355 – final project report
(✓= exposure, * = foundational)
2.7 average of student work from Spring 2018

Analysis and recommendations

There is no concern, even with the most recent results from EGEE-355 since it is reinforced in EGNR-495. It is however recommended that the grading form for G1 be modified to better separate the IAB's rating for the team's ability to communicate and that of the project outcome.

4-A.3.8 Student Outcome (H)

the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

Performance Indicator (H1)

the ability to describe the sustainability of a particular design
EGEE-320 – Sustainability discussion within a videocast about the final project
(✓= exposure, * = foundational)
1.8 average of student work from Fall 2016

Analysis and recommendations

It is very concerning that two teams omitted answers to the sustainability questions altogether. Looking ahead to the changing ABET-EAC criteria, F, H, and J will be combined into Outcome 4. This new outcome could be appropriately addressed in the corresponding sections of the Project Definition and Plan (PDP) document that all Senior Project teams are required to write. While not necessary under the new criteria, the current assignment from EGEE320 could be maintained. If it is kept, it might be useful to consider implementing the podcast in the form of a pass/fail grade based on whether the students cover all topics to ensure that they do not ignore this portion of the project.

4-A.3.9 Student Outcome (I)

a recognition of the need for, and an ability to engage in life-long learning

Performance Indicator (I1)

the ability to define and clarify customer needs through technical investigation
EGNR495 – faculty subjective evaluation for each individual on their respective team
(✓✓= stress, ** = developed)
3.0 average of student work from Spring 2018

Analysis and recommendations

There are no concerns.

4-A.3.10 Student Outcome (J)

a knowledge of contemporary issues

Performance Indicator (J1)

the ability to use examples from a realistic case study in making arguments
EGNR-495 - ethics essay
(✓= exposure, * = foundational)
3.2 average of student work from Spring 2016

Analysis and recommendations

There is no concern.

4-A.3.11 Student Outcome (K)

an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Performance Indicator (K1)

the ability to solve a recursive problem by writing a program in a structured programming language, implementing the recursion in an iterative loop
EGNR-340 – exam question on Newton-Raphson root search or on Euler's method for solving an ordinary differential equation (ODE)
(✓✓✓= focus, ** = developed)
2.7 average of student work from Spring 2018

Performance Indicator (K2)

the ability to apply modern engineering software and techniques to produce and evaluate a solution
EGEE-355 - final design project report – using flowcharts, cross compiler
(✓✓= stress, ** = developed)
3.7 average of student work from Spring 2018

Analysis and recommendations

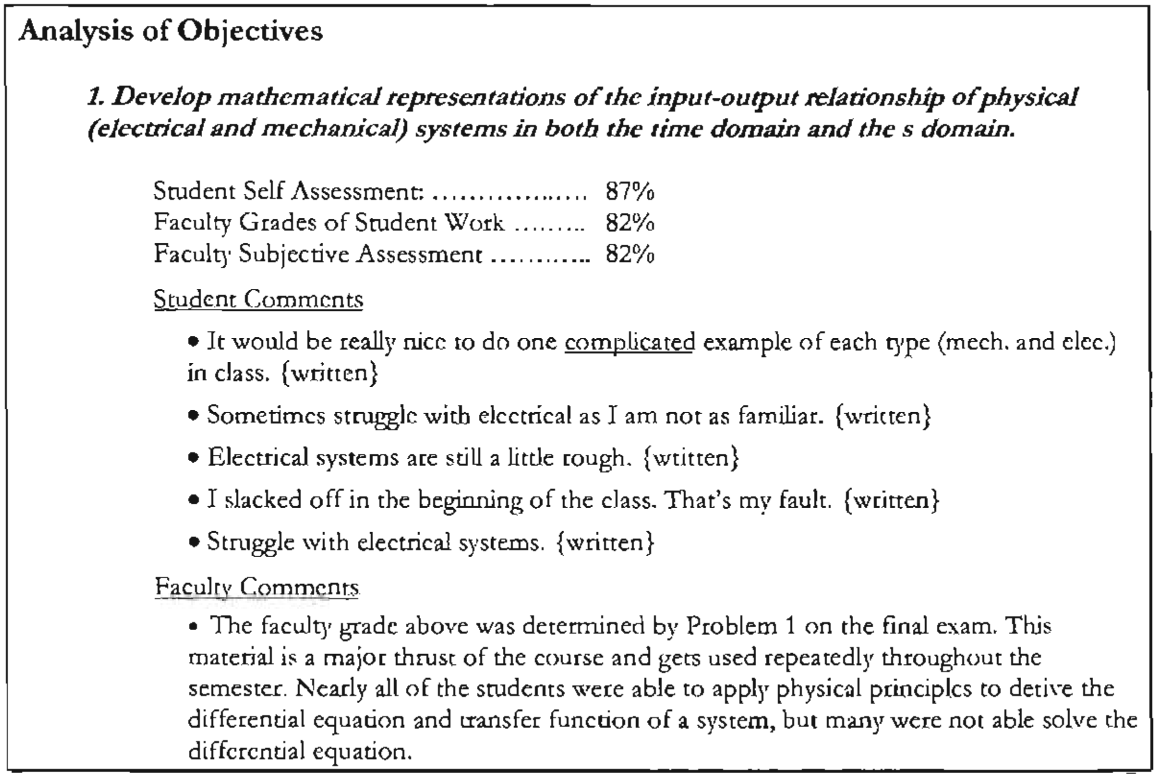
There is no concern.

4-A.4 Course Assessment

Course assessment is another important component of the continuous improvement process. At the completion of every engineering course offering, the instructor assesses the course objectives as well as student feedback and produces a *course assessment summary* report (samples of which can be seen in Appendix J). The report includes student comments, an analysis of student attainment in the course objectives, and an action plan for the next offering.

During the final two weeks of the semester, students are asked to complete a survey in each of their engineering courses. This survey has them rate (1-10) and comment on their abilities in each of the course objectives as well as the necessity of prerequisite courses. In addition, faculty can include additional questions to obtain specific feedback about the course. Faculty also facilitate a discussion with the class to obtain more feedback about objectives and the course.

Upon completion of the course, the instructor generates a course assessment summary report summarizing that course offering. For each course objective, the report includes the instructor's subjective score, student's self-rated score, grades of student work, and student comments. The instructor then provides a narrative on the performance and comments from students for each objective. An example of the objectives section of a report from EGRS-460 can be seen in Figure 4-3. Next, the summary report provides a brief analysis on the prerequisite courses, which can be seen in Figure 4-4. This includes the students rating (1-10) on how well the prerequisite prepared them for this class as well as any comments by students. Then the instructor provides their comments related to the prerequisite. If the course is used to evaluate any of the student outcomes it will contain a summary of the evolution of student work as previously seen in Figure 4-2. The summary report also provides a list of action plans. This includes a brief analysis of the efficacy of the most recent course improvements as seen in Figure 4-5 which shows a portion of the previous offerings section of the EGEE-125 report. Finally, a list of the recommended change for the next course is included in the summary report. An example of this list can be seen in Figure 4-6 which is a portion of the EGEE-125 report.



Analysis of Objectives

1. Develop mathematical representations of the input-output relationship of physical (electrical and mechanical) systems in both the time domain and the s domain.

Student Self Assessment: 87%
Faculty Grades of Student Work 82%
Faculty Subjective Assessment 82%

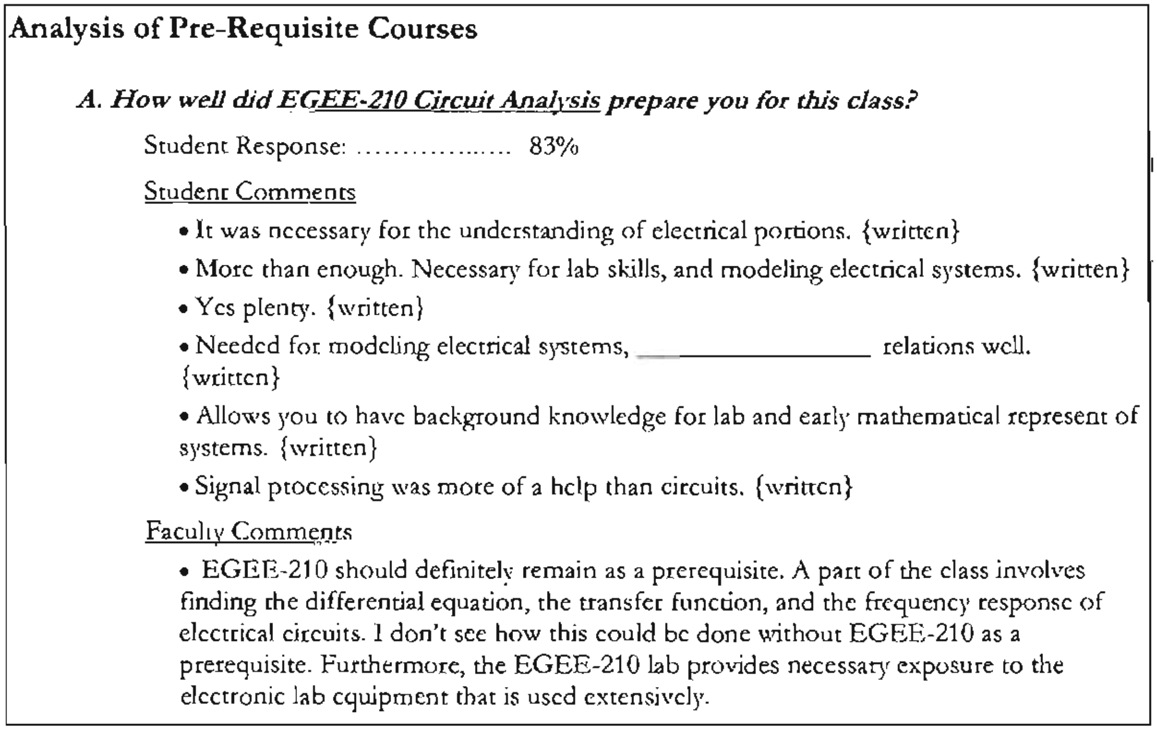
Student Comments

- It would be really nice to do one complicated example of each type (mech. and elec.) in class. {written}
- Sometimes struggle with electrical as I am not as familiar. {written}
- Electrical systems are still a little rough. {written}
- I slacked off in the beginning of the class. That's my fault. {written}
- Struggle with electrical systems. {written}

Faculty Comments

- The faculty grade above was determined by Problem 1 on the final exam. This material is a major thrust of the course and gets used repeatedly throughout the semester. Nearly all of the students were able to apply physical principles to derive the differential equation and transfer function of a system, but many were not able solve the differential equation.

Figure 4-3: Objectives Section of the EGRS-460 Course Assessment Summary Report



Analysis of Pre-Requisite Courses

A. How well did EGEE-210 Circuit Analysis prepare you for this class?

Student Response: 83%

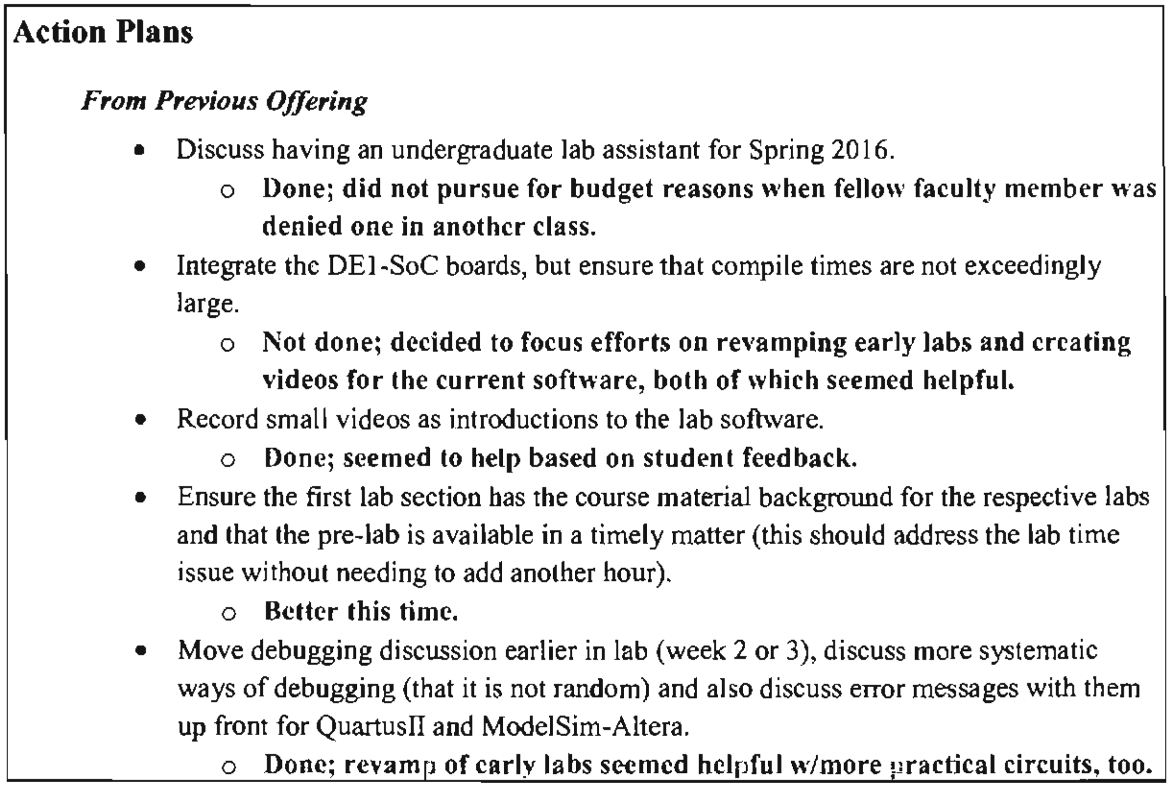
Student Comments

- It was necessary for the understanding of electrical portions. {written}
- More than enough. Necessary for lab skills, and modeling electrical systems. {written}
- Yes plenty. {written}
- Needed for modeling electrical systems, ____________________ relations well. {written}
- Allows you to have background knowledge for lab and early mathematical represent of systems. {written}
- Signal processing was more of a help than circuits. {written}

Faculty Comments

- EGEE-210 should definitely remain as a prerequisite. A part of the class involves finding the differential equation, the transfer function, and the frequency response of electrical circuits. I don't see how this could be done without EGEE-210 as a prerequisite. Furthermore, the EGEE-210 lab provides necessary exposure to the electronic lab equipment that is used extensively.

Figure 4-4: Prerequisite Section of the EGRS-460 Course Assessment Summary Report

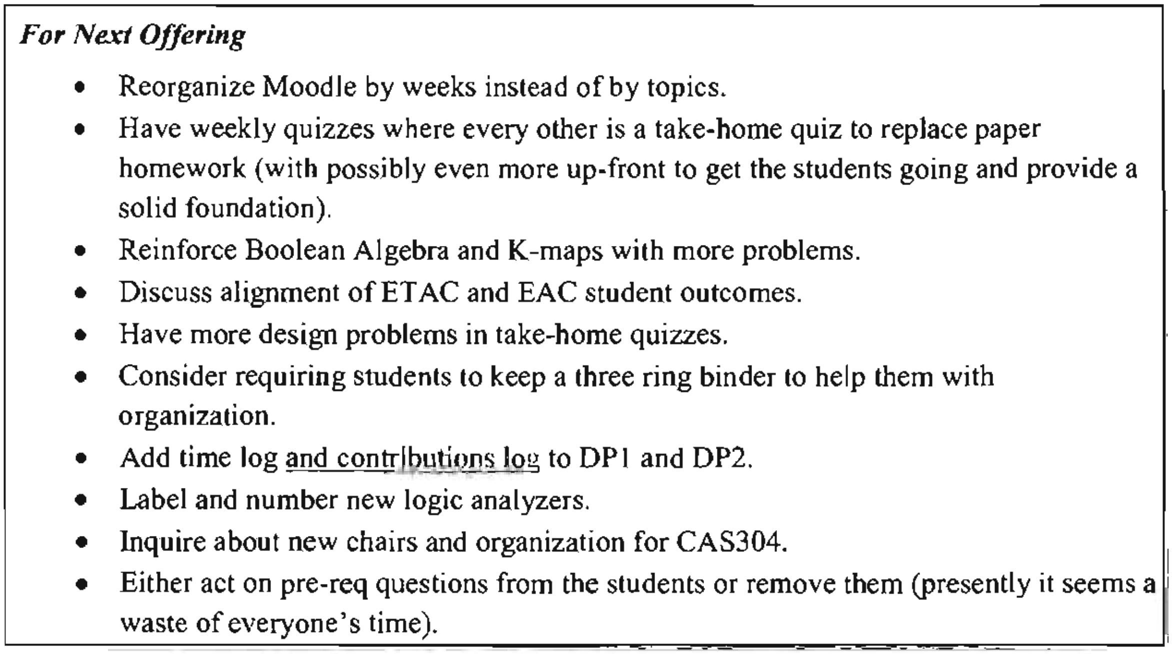


Action Plans

From Previous Offering

- Discuss having an undergraduate lab assistant for Spring 2016.
    - **Done; did not pursue for budget reasons when fellow faculty member was denied one in another class.**
- Integrate the DE1-SoC boards, but ensure that compile times are not exceedingly large.
    - **Not done; decided to focus efforts on revamping early labs and creating videos for the current software, both of which seemed helpful.**
- Record small videos as introductions to the lab software.
    - **Done; seemed to help based on student feedback.**
- Ensure the first lab section has the course material background for the respective labs and that the pre-lab is available in a timely matter (this should address the lab time issue without needing to add another hour).
    - **Better this time.**
- Move debugging discussion earlier in lab (week 2 or 3), discuss more systematic ways of debugging (that it is not random) and also discuss error messages with them up front for QuartusII and ModelSim-Altera.
    - **Done; revamp of early labs seemed helpful w/more practical circuits, too.**

Figure 4-5: Previous Offering Section of the EGEE-125 Course Assessment Summary Report



For Next Offering

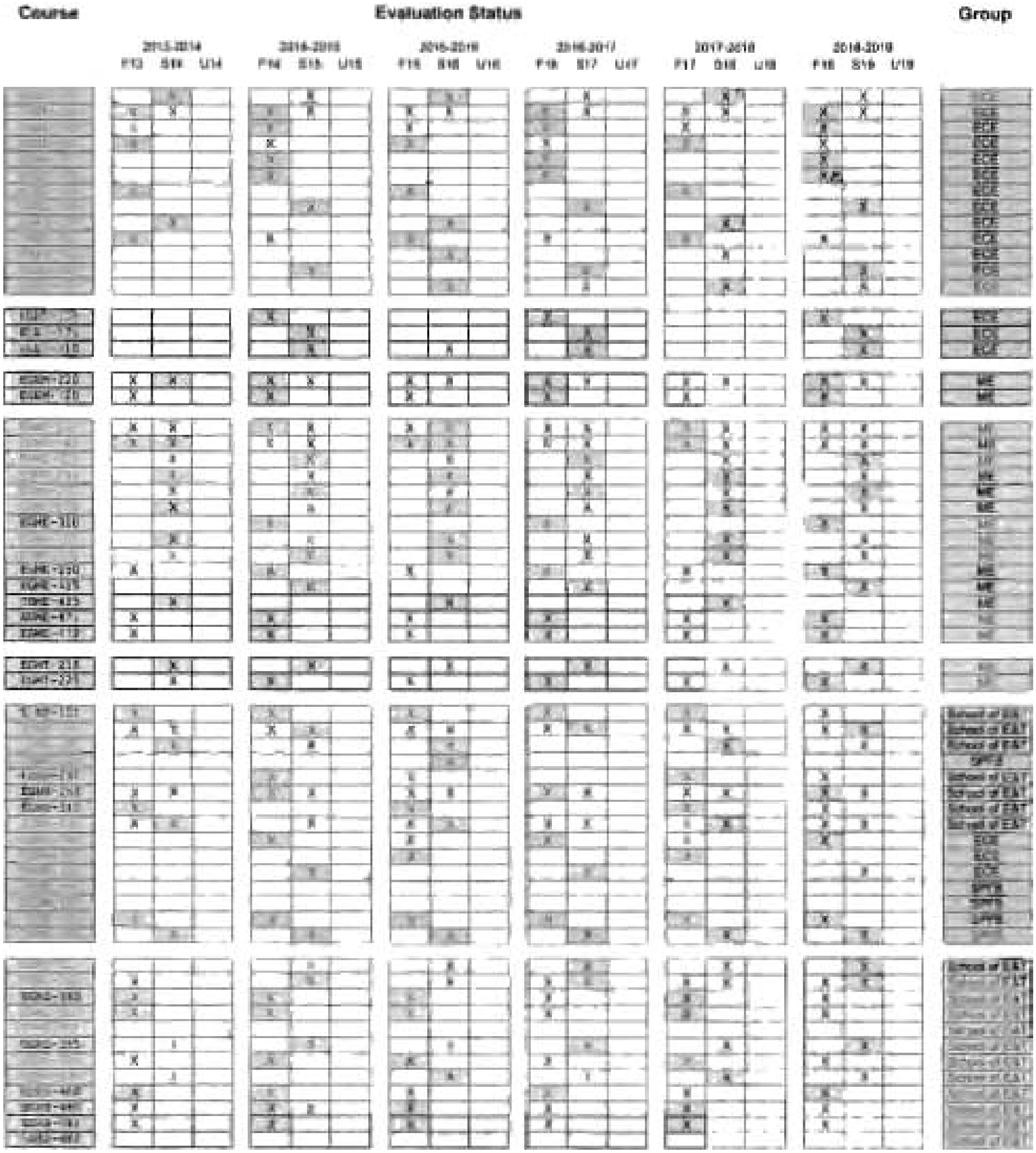
- Reorganize Moodle by weeks instead of by topics.
- Have weekly quizzes where every other is a take-home quiz to replace paper homework (with possibly even more up-front to get the students going and provide a solid foundation).
- Reinforce Boolean Algebra and K-maps with more problems.
- Discuss alignment of ETAC and EAC student outcomes.
- Have more design problems in take-home quizzes.
- Consider requiring students to keep a three ring binder to help them with organization.
- Add time log and contributions log to DP1 and DP2.
- Label and number new logic analyzers.
- Inquire about new chairs and organization for CAS304.
- Either act on pre-req questions from the students or remove them (presently it seems a waste of everyone's time).

Figure 4-6: Next Offering Section of the EGEE-125 Course Assessment Summary Report

Each engineering course is then evaluated within the appropriate venue at least once every two years. The department evaluates the courses that appear solely in the programs core. Other "cross-disciplinary" courses that are also contained in the other engineering program cores are evaluated by the school. The senior capstone sequence (EGNR-491&495) is evaluated by the senior project faculty board, which because of our small size constitutes the majority of the faculty. The schedule for course evaluation is shown below in Table 4-2 and includes the venue in which it is evaluated. This schedule includes all courses offered by the School of Engineering & Technology (SET), and is intended to illustrate the regular pattern of course offerings and subsequent evaluation. The courses listed for spring of 2018 (S18) and later are the future assessment plan as courses are assessed during the subsequent semester at the earliest.

During evaluation the instructor leads a discussion about the student performance and student feedback. Each objective is examined, and discussed in detail if there is cause for concern. This provides an opportunity for faculty members to share their experiences and brainstorm ideas to help improve the student performance. If additional changes are recommended by the department or school they are recorded in the meeting minutes and the *course assessment summary* report. The instructor then implements the changes during the next offering of the course (or if needed, initiates a curricular change proposal). The efficacy of these changes are then discussed during the next evaluation of the course.

Table 4-2: Course Evaluation Schedule



Course

Evaluation Status

Group

2013-2014 F13 S14 U14

2014-2015 F14 S15 U15

2015-2016 F15 S16 U16

2016-2017 F16 S17 U17

2017-2018 F17 S18 U18

2018-2019 F18 S19 U19

☐	Not Offered
X	Offered
▨ X	Scheduled to be Evaluated
▨ X	Evaluated by School of E&T
▨ X	Evaluated by Department of ECE
▨ X	Evaluated by Department of ME
▨ X	Evaluated by Senior Projects Faculty Board

4-A.5 Summary of the Improvement Process

In summary curricular improvements (at both the course and program level) are made by the School of Engineering & Technology faculty using a combination of student outcome and course evaluations. While student performance provides the most important indicator of achievement, given our small size, constituent (student, IAB, and employer) feedback is also a vital part of continuous improvement. All curricular changes are made by the School of Engineering & Technology faculty based on the results of these evaluations. Ultimately, the program is improved by small changes to courses (course layout, syllabi, grading structure, extent of coverage, *etc.*), changes to content in courses (alteration of objectives, topical content, *etc.*), and large curricular changes (course deletion, course addition, shifting material from one course to another, adding new material to the curriculum, *etc.*). The smaller changes tend to be made at the time of course evaluation while the more significant changes tend to be made at the time of student outcome evaluation.

4-B Continuous Improvement

Continuous improvement is an important part of maintaining a quality program. As such assessment is an important part of the School of Engineering & Technology. Below are a few examples of changes made within the Computer Engineering program.

4-B.1 Improvement Example for Student Outcome F

In the last ABET report (2012) it was mentioned that students indicated that they thought ethics (student outcome F) should be removed from senior projects (EGNR-495). The recommended action was to create a new General Education course that would cover ethics, economics, and sustainability as it applies to the design and use of technology. This course would then allow for the removal of that material from senior projects giving student more time to focus on their project.

For a number of reasons, the creation of this class was not possible. However, based on faculty discussions and student feedback it was decided to bring in an expert in ethics. Thus, Dr. Jason Swedene—a Professor in Department of Humanities & Philosophy who specializes in ethics—began teaching the ethics portion of senior projects in the spring of 2017.

From the latest student outcome evaluation, there is no concern for outcome F. Student feedback regarding the ethics portion has overall been very positive, with students enjoying Dr. Swedene's lectures. Some students indicated that they would prefer that ethics be moved to the fall semester of senior projects (EGNR-491). The possibility of moving this topic is currently being explored and may occur in the future. Overall, it seems that bringing in Dr. Swedene was beneficial to the program.

4-B.2 Improvement Example for Student Outcome C

Feedback from electrical and computer engineering students in the senior capstone sequence (EGNR-491&495) indicated that they felt underprepared for design reviews as compared to mechanical engineering students. ME students take EGME-350 *Machine Design* in their junior year which has them do a design review.

To help correct this it was recommended that a design review be added to a core course ensuring that all CE students have that experience. It was later determined that the design review be added to EGEE-320 *Digital Design* and EGEE-355 *Microcontroller Systems* as they already had a substantial final design project.

In the latest evaluation of student outcome C it was found that there is no cause for concern in this area. Verbal feedback from senior project students indicated that the design reviews in EGEE-320 and EGEE-355 were beneficial. Although it is nearly impossible to say conclusively that the addition of the design review improved student performance in outcome C; it is thought to be a benefit to the students and will continue as a part of these courses.

4-B.3 Recommendations for Student Outcome A

During last evaluation of student outcome A, it was determined that there is a slight concern regarding students' mathematical ability. Upon further examination of student work, some students have difficulties with how to even approach a problem. These students seem to search for equations in the book and try to apply it to the problem even if they are unrelated. One could describe the issue as often, but not always, a tendency to approach problem-solving very superficially. In these cases, the student approaches the situation with a goal of trying to reduce almost all problems to the simplistic model of applying whichever equation happens to be readily available, with too little concern for its relevance or validity in the circumstances, and always expecting to apply it in the fashion of determining an output based on known inputs. Understanding of the underlying principles, cognizance of approximating assumptions made, and actual meaning of the physical quantities involved, is given little value in this way of thinking.

This is a complicated issue that will take significant time and effort to address. As a first step, the faculty will develop a common procedure for students to use in analyzing and solving problems. This procedure, along with supporting material, will be used for all ECE courses (and possibly all engineering courses in general). It is thought that repeatedly using the same steps in analyzing and solving problems will help students understand how to approach and solve problems that they are not familiar with. This common procedure will be developed in the upcoming academic year (2018-2019). This outcome will continue to be monitored and additional changes will be made to further improve student performance.

4-B.4 Future Improvements to the Process

As discussed, there is a continuous improvement process in place and being used to improve both the courses (course assessment) and the program (student outcome evaluation). However, the adherence to this process needs to be improved moving forward. There is a very strong history of using course assessment as the primary means for improvement of the program (up until the last ABET accreditation). As a result programmatic changes are often discussed during these course assessment meetings especially for summative courses such as the senior capstone sequence (EGNR-491&495). This itself is not an issue. However, the recommendations and rationale were not always properly documented and included in the student outcome evaluation reports. Thus these reports have not necessarily contained the complete summary. Moving forward, the department and school must be more diligent in documenting the assessment and evaluation of the student outcomes. This should be easier with the experience gained from going through the student outcome evaluation process.

4-C Additional Information

Additional information regarding assessment and the student outcomes can be found in:

- *Course Assessment Summary* reports (Appendix J)
- *Student Outcome Evaluation* report (Appendix G)

Criterion 5 CURRICULUM

5-A Program Curriculum

5-A.1 Plan-of-Study

For the purpose of planning and evaluating the curriculum, as well as academic advising, the ECE department has summarized the full set of course requirements in two complementary formats. These are to be found in the Computer Engineering *Plan-of-Study* document, wherein the courses comprising the curriculum are arranged in a suggested temporal semester-by-semester sequence in which students could feasibly take them, and in the Computer Engineering *Degree Audit Sheet* document, wherein the arrangement is instead alphabetical by discipline; the latter serves at the University level, moreover, as a kind of check-off sheet for meeting program requirements. The most up-do-date versions of these documents (applicable to students starting in Fall 2018) are found in Appendix L and Appendix M; versions for earlier years will be available as part of the display materials at the visit.

Table 5-1 through Table 5-3, below, collects this information in terms of a list of courses (sequential, i.e., as in the first mentioned document, the "plan-of-study"), but also indicating to which curricular components they contribute, and providing recent enrollment information.

Courses are all semester-length where a semester consists of 15 weeks; 14 weeks of instruction and 1 week when final examinations and other summative activities occur.

Table 5-1: Curriculum: CE w/Robotics & Automation Conc.

Computer Engineering, Robotics & Automation Concentration 125 credit hours (minimum possible)

Course (Department, Number, Title) List all courses in the program by term starting with first term of first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective	Subject Area (Credit Hours)				Last Two Terms the Course was Offered	Maximum Section Enrollment for the Last Two Terms the Course was Offered
		Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other		
1st YEAR: FALL							
CHEM115 General Chemistry	R	5				F17/S18	75
CSCI105 Introduction to Computer Programming	R		3			F17/S18	34
EGNR101 Introduction to Engineering	R		2✓			F16/F17	54
ENGL110 First-Year Composition I	R			3		F17/S18	24
MATH151 Calculus I	R	4				F17/S18	29
1st YEAR: SPRING							
CSCI121 Principles of Programming	R		4			S17/S18	24
EGEE125 Digital Fundamentals	R		4			S17/S18	27
EGNR140 Linear Algebra & Numerical Appl'ns for Engineers	R		2			F17/S18	28
ENGL111 First-Year Composition II	R			3		F17/S18	24
MATH152 Calculus II	R	4				F17/S18	20
2nd YEAR: FALL							
CSCI2xx e.g. CSCI221 Computer Networks*	SE		3			S17/S18	20
EGEE250 Microcontroller Fundamentals	R		4			F16/F17	16
MATH251 Calculus III	R	4				F17/S18	27
PHYS231 Applied Physics for Engineers & Scientists I	R	4				F16/F17	49
2nd YEAR: SPRING							
COMM101 Fundamentals of Speech Communication	R			3		F17/S18	24
EGEE210 Circuit Analysis	R		4			F17/S18	22
MATH310 Differential Equations	R	3				F17/S18	24
PHYS232 Applied Physics for Engineers & Scientists II	R	4				S17/S18	40
Social Science Elective e.g. PSYC101 Intro. to Psychology*	SE			3		F17/S18	98

3rd YEAR: FALL							
CSCI341 Discrete Structures for Computer Science	R		4			F14/F16	24
EGEE280 Introduction to Signal Processing	R		4			F16/F17	23
EGEE370 Electronic Devices	R		4			F16/F17	10
EGNR340 Numerical Methods for Engineers	R	1				F17/S18	14
Other Tech Elective from List of Alternatives e.g., EGRS365 Programmable Logic Controllers*	SE		3			F17/S18	13
3rd YEAR: SPRING							
EGEE355 Microcontroller Systems	R		3			S16/S18	25
EGRS385 Robotics Engineering	SE		4			S17/S18	23
Humanities Elective e.g., HUMN251 Humanities I*	SE			3		F17/S18	61
Social Science Elective e.g., SOCY101 Intro. to Sociology*	SE			3		F17/S18	55
4th YEAR: FALL							
EGEE320 Digital Design	R		4✓			F14/F16	18
EGNR346 Probability & Statistics Lab for Engineers	R		1			F16/F17	8
EGNR491 Engineering Design Project I	R		3✓			F16/F17	39
EGRS430 System Integration & Machine Vision	SE		4			F16/F17	27
MATH308 Probability & Mathematical Statistics	R	3				F16/F17	28
4th YEAR: SPRING							
EGEE425 Digital Signal Processing	R		3			S15/S17	12
EGNR495 Engineering Design Project II	R		3✓			S17/S18	39
EGRS435 Automated Manufacturing Systems	SE		3			S17/S18	16
Cultural Diversity Elective e.g. SOCY 103 Cultural Diversity*	SE			3		F17/S18	48
Hum. Elec. e.g., HUMN255 World Mythology*	SE			3		S16/S18	93
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		32	69	24			
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM							
PERCENT OF TOTAL		26%	55%	19%			
Minimum Semester Credit Hours (Total must satisfy either credit hours or percentage)		**32 Hours**	**48 Hours**				
Minimum Percentage (Total must satisfy either credit hours or percentage)		25%	37.5 %				

*Example courses used for illustration.

Table 5-2: Curriculum: CE w/Sustainable Energy Conc.

Computer Engineering, Sustainable Energy Concentration 124 credit hours (minimum possible)

Course (Department, Number, Title) List all courses in the program by term starting with first term of first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective	Subject Area (Credit Hours)				Last Two Terms the Course was Offered	Maximum Section Enrollment for the Last Two Terms the Course was Offered
		Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other		
1st YEAR: FALL							
CHEM115 General Chemistry	R	5				F17/S18	75
CSCI105 Introduction to Computer Programming	R		3			F17/S18	34
EGNR101 Introduction to Engineering	R		2✓			F16/F17	54
ENGL110 First-Year Composition I	R			3		F17/S18	24
MATH151 Calculus I	R	4				F17/S18	29
1st YEAR: SPRING							
CSCI121 Principles of Programming	R		4			S17/S18	24
EGEE125 Digital Fundamentals	R		4			S17/S18	27
EGNR140 Linear Algebra & Numerical Appl'ns for Engineers	R		2			F17/S18	28
ENGL111 First-Year Composition II	R			3		F17/S18	24
MATH152 Calculus II	R	4				F17/S18	20
2nd YEAR: FALL							
CSCI2xx e.g. CSCI221 Computer Networks*	SE		3			S17/S18	20
EGEE250 Microcontroller Fundamentals	R		4			F16/F17	16
MATH251 Calculus III	R	4				F17/S18	27
PHYS231 Applied Physics for Engineers & Scientists I	R	4				F16/F17	49
2nd YEAR: SPRING							
COMM101 Fundamentals of Speech Communication	R			3		F17/S18	24
EGEE210 Circuit Analysis	R		4			F17/S18	22
MATH310 Differential Equations	R	3				F17/S18	24
PHYS232 Applied Physics for Engineers & Scientists II	R	4				S17/S18	40
Social Science Elective e.g. PSYC101 Intro. to Psychology*	SE			3		F17/S18	98

3rd YEAR: FALL							
CSCI341 Discrete Structures for Computer Science	R		4			F14/F16	24
EGEE280 Introduction to Signal Processing	R		4			F16/F17	23
EGEE370 Electronic Devices	R		4			F16/F17	10
EGNR340 Numerical Methods for Engineers	R	1				F17/S18	14
EGNR261 Energy Systems and Sustainability	SE		3			F15/F17	10
EGNR361 Energy Systems and Sustainability Lab	SE		1			F15/F17	4
3rd YEAR: SPRING							
EGEE355 Microcontroller Systems	R		3			S16/S18	25
Concentration Elective, e.g. EGEE 411 Power Distribution & Transmission*	SE		3			S16/S18	6
Humanities Elective e.g., HUMN251 Humanities I*	SE			3		F17/S18	61
Social Science Elective e.g., SOCY101 Intro. to Sociology*	SE			3		F17/S18	55
4th YEAR: FALL							
EGEE320 Digital Design	R		4✓			F14/F16	18
EGNR346 Probability & Statistics Lab for Engineers	R		1			F16/F17	8
EGNR491 Engineering Design Project I	R		3✓			F16/F17	39
Concentration Elective, e.g. EGEE330 Electro-Mechanical Systems*	SE		3			F15/F17	11
MATH308 Probability & Mathematical Statistics	R	3				F16/F17	28
4th YEAR: SPRING							
EGEE425 Digital Signal Processing	R		3			S15/S17	12
EGNR495 Engineering Design Project II	R		3✓			S17/S18	39
General Technical Elective, e.g. EGEM220 Statics*	SE		3			F17/S18	14
Cultural Diversity Elective e.g. SOCY 103 Cultural Diversity*	SE			3		F17/S18	48
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		32	68	24			
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM							
PERCENT OF TOTAL		26%	55%	19%			
Minimum Semester Credit Hours (Total must satisfy either credit hours or percentage)		**32 Hours**	**48 Hours**				
Minimum Percentage (Total must satisfy either credit hours or percentage)		25%	37.5 %				

*Example courses used for illustration.

Table 5-3: Curriculum: CE General

Computer Engineering: General (i.e., no named concentration) 124 credit hours (minimum possible)
(showing here, example technical elective choices that just minimally satisfy the required totals: 13 credits of {CSCI281 or higher} and/or {EGEE310 or higher} and/or EGEM220 and/or {EGME275 or higher} and/or EGET310 and/or {EGRS460 or higher} and/or {MATH215 or higher} and/or any course from concentrations)

Course (Department, Number, Title) List all courses in the program by term starting with first term of first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective	Subject Area (Credit Hours)				Last Two Terms the Course was Offered	Maximum Section Enrollment for the Last Two Terms the Course was Offered
		Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other		
1st YEAR: FALL							
CHEM115 General Chemistry	R	5				F17/S18	75
CSCI105 Introduction to Computer Programming	R		3			F17/S18	34
EGNR101 Introduction to Engineering	R		2✓			F16/F17	54
ENGL110 First-Year Composition I	R			3		F17/S18	24
MATH151 Calculus I	R	4				F17/S18	29
1st YEAR: SPRING							
CSCI121 Principles of Programming	R		4			S17/S18	24
EGEE125 Digital Fundamentals	R		4			S17/S18	27
EGNR140 Linear Algebra & Numerical Appl'ns for Engineers	R		2			F17/S18	28
ENGL111 First-Year Composition II	R			3		F17/S18	24
MATH152 Calculus II	R	4				F17/S18	20
2nd YEAR: FALL							
CSCI2xx e.g. CSCI221 Computer Networks*	SE		3			S17/S18	20
EGEE250 Microcontroller Fundamentals	R		4			F16/F17	16
MATH251 Calculus III	R	4				F17/S18	27
PHYS231 Applied Physics for Engineers & Scientists I	R	4				F16/F17	49
2nd YEAR: SPRING							
COMM101 Fundamentals of Speech Communication	R			3		F17/S18	24
EGEE210 Circuit Analysis	R		4			F17/S18	22
MATH310 Differential Equations	R	3				F17/S18	24
PHYS232 Applied Physics for Engineers & Scientists II	R	4				S17/S18	40
Social Science Elective e.g. PSYC101 Intro. to Psychology*	SE			3		F17/S18	98

3rd YEAR: FALL							
CSCI341 Discrete Structures for Computer Science	R		4			F14/F16	24
EGEE280 Introduction to Signal Processing	R		4			F16/F17	23
EGEE370 Electronic Devices	R		4			F16/F17	10
EGNR340 Numerical Methods for Engineers	R	1				F17/S18	14
General Technical Elective e.g., EGRS365 Programmable Logic Controllers*	SE		3			F17/S18	13
3rd YEAR: SPRING							
EGEE355 Microcontroller Systems	R		3			S16/S18	25
General Technical Elective, e.g. EGRS385 Robotics Engineering*	SE		4			S17/S18	23
Humanities Elective e.g., HUMN251 Humanities I*	SE			3		F17/S18	61
Social Science Elective e.g., SOCY101 Intro. to Sociology*	SE			3		F17/S18	55
4th YEAR: FALL							
EGEE320 Digital Design	R		4✓			F14/F16	18
EGNR346 Probability & Statistics Lab for Engineers	R		1			F16/F17	8
EGNR491 Engineering Design Project I	R		3✓			F16/F17	39
General Technical Elective, e.g. EGRS430 System Integration & Machine Vision*	SE		3			F16/F17	27
MATH308 Probability & Mathematical Statistics	R	3				F16/F17	28
4th YEAR: SPRING							
EGEE425 Digital Signal Processing	R		3			S15/S17	12
EGNR495 Engineering Design Project II	R		3✓			S17/S18	39
General Technical Elective, e.g. EGEE411 Power Distribution & Transmission*	SE		3			S16/S18	6
Cultural Diversity Elective e.g. SOCY 103 Cultural Diversity*	SE			3		F17/S18	48
Hum. Elec. e.g., HUMN255 World Mythology*	SE			3		S16/S18	93
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		32	68	24			
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM							
PERCENT OF TOTAL		26%	55%	19%			
Minimum Semester Credit Hours (Total must satisfy either credit hours or percentage)		**32 Hours**	**48 Hours**				
Minimum Percentage (Total must satisfy either credit hours or percentage)		25%	37.5 %				

*Example courses used for illustration.

5-A.2 Curriculum Alignment to PEOs

There are four stated educational objectives for the program; these are described in Criterion 2, above. The curriculum aligns with and supports these, as explained in the following.

5-A.2.1 Program Educational Objective I

The first PEO calls for alumni to *apply knowledge* from the discipline in solving *problems within the profession.* Most importantly, the curriculum is there to supply the knowledge base which is to be applied; secondarily, the curriculum practices problem-solving skills which are generalizable to the application of other knowledge that may be later obtained, as well as skills in design and software that are tools in professional problem solving.

The curriculum fulfills the primary function described, furnishing the knowledge base, by its development of breadth across the discipline and the engineering sciences. The development of problem solving skills, in parallel with subject knowledge, will be evidenced in the course-specific display materials at the time of the visit.

5-A.2.2 Program Educational Objective II

The second PEO requires the practice of design or research within realistic (economic, societal, etc.) constraints. The curriculum has a number of courses which impart design experience, constrained by realistic specifications; these are expected to develop an early-stage experience in the student which should facilitate the transition to design work in the profession. The courses checked in Table 5-1 through Table 5-3 have particularly significant design projects.

5-A.2.3 Program Educational Objective III

The third PEO says that alumni set goals, experience professional growth, and engage in on-going learning / professional-development. Accordingly, the curriculum is so constructed as to provide the *tools* and facilitate the development of the *attitude* necessary to engage in continued learning.

The primary *tool* is the coherence of knowledge, in the sense that advanced and/or applied knowledge (upper-level engineering sciences, and capstone/design experiences) is rooted in fundamentals and derived from first principles; the development of first principles (e.g., logic gates, Boolean algebra, and programming basics) into advanced principles (e.g., design of larger logic circuits, programming complex systems, and interfacing digital systems with analog systems) within the curriculum instills the ability to see the larger picture and interconnectedness within the discipline, and the ability to extrapolate and develop competencies that go beyond the knowledge obtained directly from the curriculum. The deep prerequisite structure of the curriculum, and also the structure and philosophy of individual courses, i.e., emphasizing the linkages of "first principles" to advanced results, develops this tool.

The *attitude* promoting life-long learning is instilled, especially, by exposure to experiences that are interdisciplinary, e.g., the senior (capstone) project and the Introduction to Engineering project. The interdisciplinairity is suggestive to the student of how the need can arise, in authentic engineering design and development scenarios, to synthesize knowledge beyond that obtained directly in the student's own coursework.

Concerning professional growth, the EGNR-101 Introduction to Engineering course introduces students to the LSSU student chapters of professional societies, notably the Institute of Electrical and Electronics Engineerings (IEEE) and the Society of Women Engineers (SWE) for CE students especially. Sustained extracurricular involvement in these societies is expected to be a factor promoting professional growth, particularly to the extent the association with the corresponding national organizations continues after graduation.

5-A.2.4 Program Educational Objective IV

The fourth PEO says that alumni will be, furthermore, societally-beneficial as individuals.

The curriculum contributes to this objective by providing competencies that are of use to society, most directly manifested by the various concentration courses which show industry-specific applications, to the energy and automation industries in particular (for the Sustainable Energy Systems and Robotics & Automation concentrations, respectively). But of course, the broader core of Computer Engineering is versatile in its applications to a great many industries, as well as to government, academia, and the non-profit sector.

5-A.3 Curriculum Support of Student Outcomes

There are eleven Student Outcomes established for the program; these are described in Criterion 3 above, and coincide exactly with the ABET (A) – (K) criteria. The courses comprising the core part of the curriculum support these, as illustrated by the mapping of Table 5-4.

The table, firstly, serves as a mapping, indicating which courses are intended to contribute in some way to attainment of which Student Outcomes, by virtue of cells being filled when that is the case at the intersection of the course-row with the objective-column. For instance, in the EGEE-355 row, the cell in column C is occupied and that in column F is not; accordingly, EGEE-355 can be expected to contribute something to outcome C (design of a system), but not by design (although perhaps incidentally, and inconsistently if so) to outcome F (ethics).

But the table also provides, secondly, an indication of the *degree* to which each course contributes. The number of check marks, from one to three, increases as contribution increases. As the legend below the table shows, a single check mark would suggest a fairly secondary contribution, mere “exposure” without any especial stress in the course; this might be the case if, for example, a single or few assignments, adding up to a small portion of the course grade and effort expended, were to exercise the student outcome concerned. Two checks indicate that the student outcome is, instead, *stressed* in the course, such as would be the case if it corresponded to a course objective. Three checks would suggest that the class is largely focused on contributing to that objective, for example if multiple course objectives contribute to it.

Table 5-4: Mapping of Courses to Student Outcomes

Course	Cores	A	B	C	D	E	F	G	H	I	J	K
EGEE-125	CE, EE	✓✓✓ M	✓ *	✓✓ *	✓ *	✓✓ *		✓✓ *	✓ *	✓ *	✓ *	✓✓✓ *
EGEE-210	CE, EE, ME	✓✓ m, S, E	✓ *	✓ *	✓ *	✓ *		✓ *				✓ *
EGEE-250	CE, EE	✓✓ M		✓ *	✓ *	✓✓ *		✓ *				✓✓ **
EGEE-280	CE, EE	✓✓ M				✓✓ *						✓✓ *
EGEE-320	CE	✓✓ m, e	✓ **	✓ **	✓✓✓ *	✓✓ **	✓ *	✓✓ *	✓ *	✓ *	✓ *	✓✓✓ **
EGEE-355	CE	✓✓ m, e	✓ **	✓✓ *	✓ *	✓✓ ***		✓ *		✓ *	✓ *	✓✓ **
EGEE-370	CE, EE	✓✓ m, s, e	✓ **		✓ *	✓✓ **		✓✓ *				✓✓ *
EGEE-425	CE	✓✓✓ M, e	✓ *	✓ *	✓ *	✓✓✓ **		✓✓ **	✓ *	✓ *	IP	✓✓✓ **
EGNR-101	CE, EE, ME	✓ e		✓✓ *	✓✓ *	✓ *	✓✓ *	✓✓ *	✓ *	✓ *	✓ *	✓✓✓ *
EGNR-140	CE, EE, ME	✓✓ m, e				✓✓ *		✓ *				✓✓✓ *
EGNR-340	CE, EE, ME	✓✓ m, e	✓ *			✓ **						✓✓✓ **
EGNR-346	CE, EE	✓✓ M, e	✓✓ **	✓ *				✓✓ **				✓✓ **
EGNR-491	CE, EE, ME	✓ E		✓✓✓ ***	✓✓✓ **	✓✓✓ **	✓✓ *	✓✓✓ ***	✓ *	✓✓ **		✓✓ ***
EGNR-495	CE, EE, ME	✓ E	✓✓ **	✓✓✓ ***	✓✓✓ ***	✓✓✓ **	✓✓✓ **	✓✓✓ ***	✓✓ **	✓✓ **	✓ *	✓✓ ***

	evaluated for CE
▨	evaluated for CE and EE
░	evaluated for CE, EE, and ME

✓	exposure (for instance, one graded assignment)
✓✓	stress (for instance, one course objective)
✓✓✓	focus (for instance, multiple objectives or course title)

*	foundational – ready for further development
**	developed – prepared for practical application
***	high – approaching that of a practicing engineer

IP	incorporation into course is "in progress"

m(M)	basic-level (advanced-level) mathematics
s(S)	basic-level (advanced-level) science
e(E)	basic-level (advanced-level) engineering

(A) an ability to apply knowledge of mathematics, science, and engineering
(B) an ability to design and conduct experiments, as well as to analyze and interpret data
(C) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(D) an ability to function on multidisciplinary teams
(E) an ability to identify, formulate, and solve engineering problems
(F) an understanding of professional and ethical responsibility
(G) an ability to communicate effectively
(H) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(I) a recognition of the need for, and an ability to engage in life-long learning
(J) a knowledge of contemporary issues
(K) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The table, thirdly, indicates the expected level of development, with regard to that outcome, to be displayed by students performing satisfactorily. The number of asterisks, for all outcomes except A, correlates to the level of development; for A in particular, the letters m, s, and e are instead used to distinguish the math, science, and engineering aspects, respectively, of the outcome, with the lower case – upper case distinction to indicate level of development (lower case implying lower development and upper case higher). Thus, a single asterisk in B – K means a *foundational* level, i.e., an outcome at the very initial stages of development; two asterisks implies some readiness for practice; and three a level comparable to a practicing professional. Lower case m indicates the application of basic mathematics (through univariate calculus), and upper case M a more advanced mathematics (e.g., multivariate calculus, differential equations); the s vs. S and e vs. E distinctions are analogous for application of natural sciences and engineering sciences, respectively.

Fourthly, and finally, the table indicates from which courses evidence is purposefully collected in order to assess the attainment of Student Outcomes via the curriculum, i.e., "program assessment" evidence. This is understood to be evidence that sheds light on the workings of the whole curriculum, not merely the course from which the evidence is extracted, towards the outcome concerned. Cells with color highlighting are those indicating an evidentiary source; the course corresponding to the cell's row provides evidence of attainment of the objective corresponding to the cell's column. The color chosen for highlighting furnishes the additional information as to whether any distinction is made, or not, between CE students and other Engineering students. Thus, yellow means Computer Engineering students exclusively, whereas light green implies grouping with Electrical Engineering students, and orange with *all* Engineering students (ME, EE, CE).

To return to the EGEE-355 example, the faculty had noted that the circumstance that column C was occupied implied some contribution of that course to outcome C (design of a system). In fact, the table also tells us, by two checks, that the design component is *stressed* in the course, and the two asterisks that the expectation for students is *prepared for practical application* in their design of a system in that course. Finally, the yellow highlighting means that the department collects and evaluates evidence from that course (one would have to consult the course or program assessment reports for specifics) for purposes of evaluating the program's attainment of outcome C, and that such evidence is (unlike that from, say, EGNR-495 for the same objective) not confounded with that of students from other Engineering disciplines.

Note that the technical electives of the concentrations (or general) also support the Student Outcomes, but to varying degrees and varying distribution; accordingly, these are *not* included in the table, but the respective course assessment reports may be consulted for the same kind of information for those technical electives as supplied here for the core courses.

5-A.4 Prerequisite Structure

Figure 5-1, below, shows direct prerequisite and co-requisite relationships between the core courses of the curriculum (omitted are the technical electives in the concentrations, as well as those elective general education courses typically requiring no prerequisites).

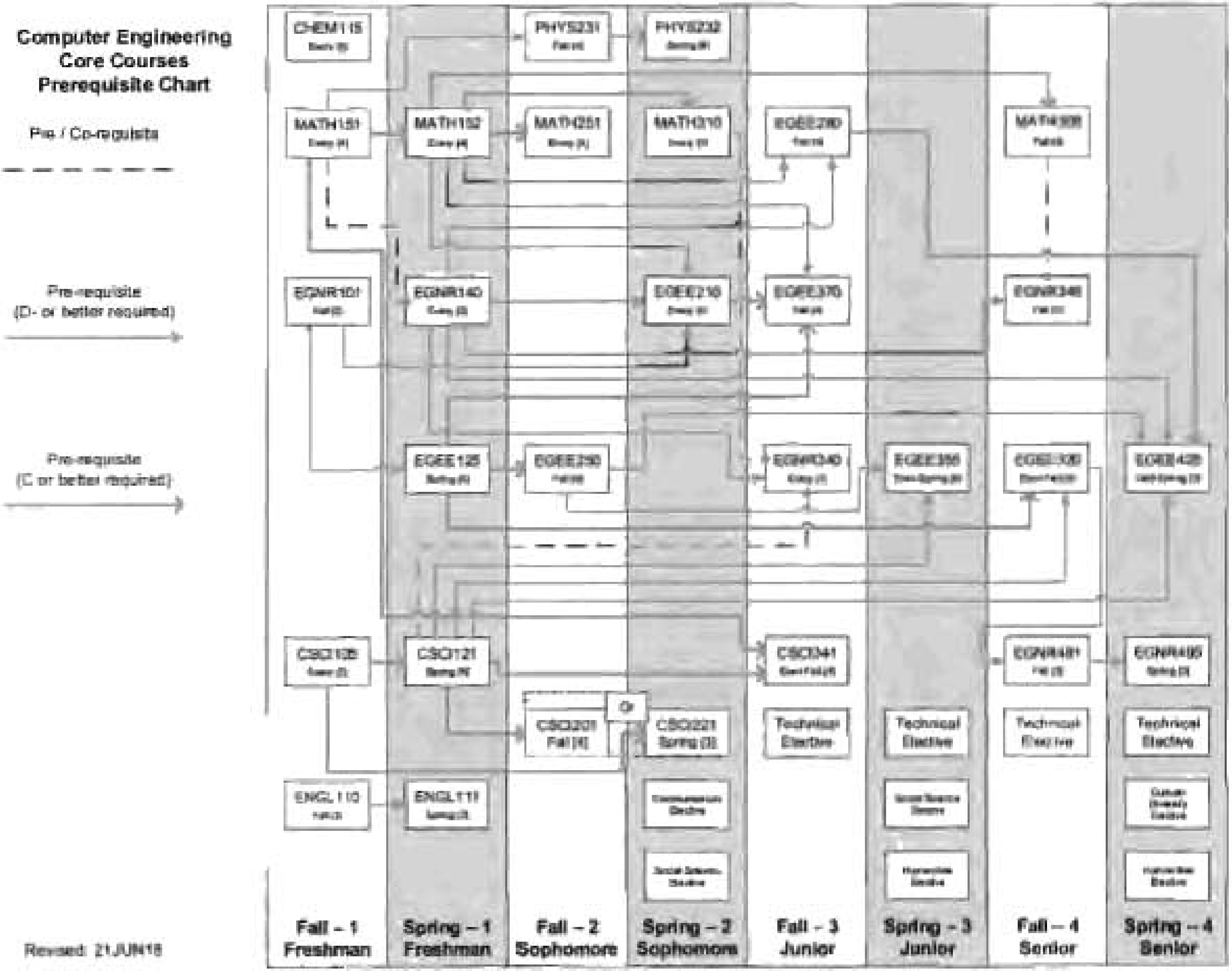


Figure 5-1: Prerequisite Structure for the Computer Engineering Curriculum

The prerequisite chart, as it is broken down at the course level, is useful to illustrate a few key features of the Computer Engineering program:

- There is a significant *depth* developed throughout the curriculum; the final capstone course, EGNR-495 *Senior Design Projects II*, is so much as *sixth* in a chain of prerequisites, and there are several courses that are four or five layers deep;
- Certain courses, such as MATH-152 *Calculus II* or CSCI-121 *Principles of Programming*, are the *knowledge base* of a large part of the subsequent core curriculum, as can be seen by the *divergence* of many lines from those courses to the right;
- Certain other courses, such as EGEE-425 *Digital Signal Processing*, *synthesize* knowledge obtained from across the discipline, as is evident by the *convergence* of many lines towards them from the left.

To enforce compliance with the prerequisite structure outlined above, the University's registration system is designed to disallow enrollment in courses for which students lack the prerequisites or have not already enrolled in co-requisites. In recent years, furthermore, the Registrar has also adopted the practice of flagging and dis-enrolling students who could preliminarily enroll in a course while in the process of completing a prerequisite course, but who then subsequently do not successfully complete that prerequisite requirement (by withdrawing, failing, or not attaining a C in cases that require such). To provide some redundancy in ensuring compliance, furthermore, students, at the beginning of any course, are also asked by the Engineering instructor to complete and sign a statement that testifies to their having satisfactorily completed any prerequisite courses, and having enrolled in (or already completed) any co-requisite courses. Waivers for prerequisites must be approved by the ECE Coordinator, and a departmental policy statement (Appendix F) exists to provide guidance for frequently-occurring cases, while not restricting the discretion of the advisor and coordinator. Appendix K also contains example prerequisite forms.

5-A.5 Depth in Subject Areas

As indicated in Table 5-5, the program consists of at least 125 credits; insofar as these are semester credits, this is in accordance with the standard for total semester credits of at least 124. The distribution of these credits by subject area is as follows:

Table 5-5: Component of Curriculum

Subject Area	Credits	
Mathematics	19	
Instructed by Math Department		18
Instructed by School of Engineering & Technology		1
Basic Sciences	13	
General Education	24	
Engineering Sciences (core courses)	50	
Senior Sequence (capstone)	6 min.	
Technical Electives	13 min.	
Total	**125 min.**	

These various components, and their relation to Criterion 5, will be discussed in detail in the following subsections.

5-A.5.1 Mathematics and Basic Sciences

Criterion 5 requires that the curriculum include a minimum of 32 credits of mathematics and basic sciences (or a quarter of the total credits). The program meets that requirement by virtue of the courses listed in Table 5-6 below.

Table 5-6: Mathematics & Basic Sciences Component of Curriculum

Course	Credits
CHEM-115 General Chemistry I	5
EGNR-340 Numerical Methods	1
MATH-151 Calculus I	4
MATH-152 Calculus II	4
MATH-251 Calculus III	4
MATH-308 Probability and Statistics for Engineers	3
MATH-310 Differential Equations	3
PHYS-231 Applied Physics for Engineers and Scientists I	4
PHYS-232 Applied Physics for Engineers and Scientists II	4
Total	**32**

Some students entering the Computer Engineering program do not possess a sufficient mathematical background to be placed in MATH-151 at the outset. These students are instead placed in lower level Mathematics courses, as appropriate to their initial preparation. Academic credit at the University is certainly received for such courses (except for any below the 100-level), and the grade point average does account for them, but they do not apply towards any degree requirements of the Computer Engineering program, and stand outside of the program's minimum 125 required credits.

The Engineering-instructed course EGNR-340 *Numerical Methods* is regarded, for present purposes, as essentially a mathematics course rather than an engineering science course. It not only introduces numerical methods related to mathematics concepts from other courses (e.g., numerical integration, eigenvalue analysis, etc.), but also original mathematics content (e.g., partial differential equations) not introduced in the MATH listed courses of the curriculum.

It is also noteworthy that the program criterion calls not merely for *inclusion* of the Mathematics in the curriculum, but also for its *application* ("…to apply… mathematics"). Accordingly, many of the Engineering courses do make application of the Mathematics content, all the way from lower mathematics through topics from multivariate calculus and differential equations as the criterion specifies. As examples from the core, EGNR-346 Probability and Statistics Lab makes use of probability and statistics. Technical elective courses such as EGRS-385 Robotics Engineering (using multivariate calculus for kinematic analyses) also contribute substantially to the application of mathematics.

The Mathematics portion of the curriculum, and its use to serve subsequent Engineering Sciences courses, is illustrated below in Figure 5-2. Grayed out courses are not formally parts of the program, but may be needed by some students before beginning Calculus I, if underprepared in mathematics. Note that for Figures 5-2 and 5-3, unlike in Figure 5-1, there is no distinction made between prerequisite courses and pre-/co-requisite courses.

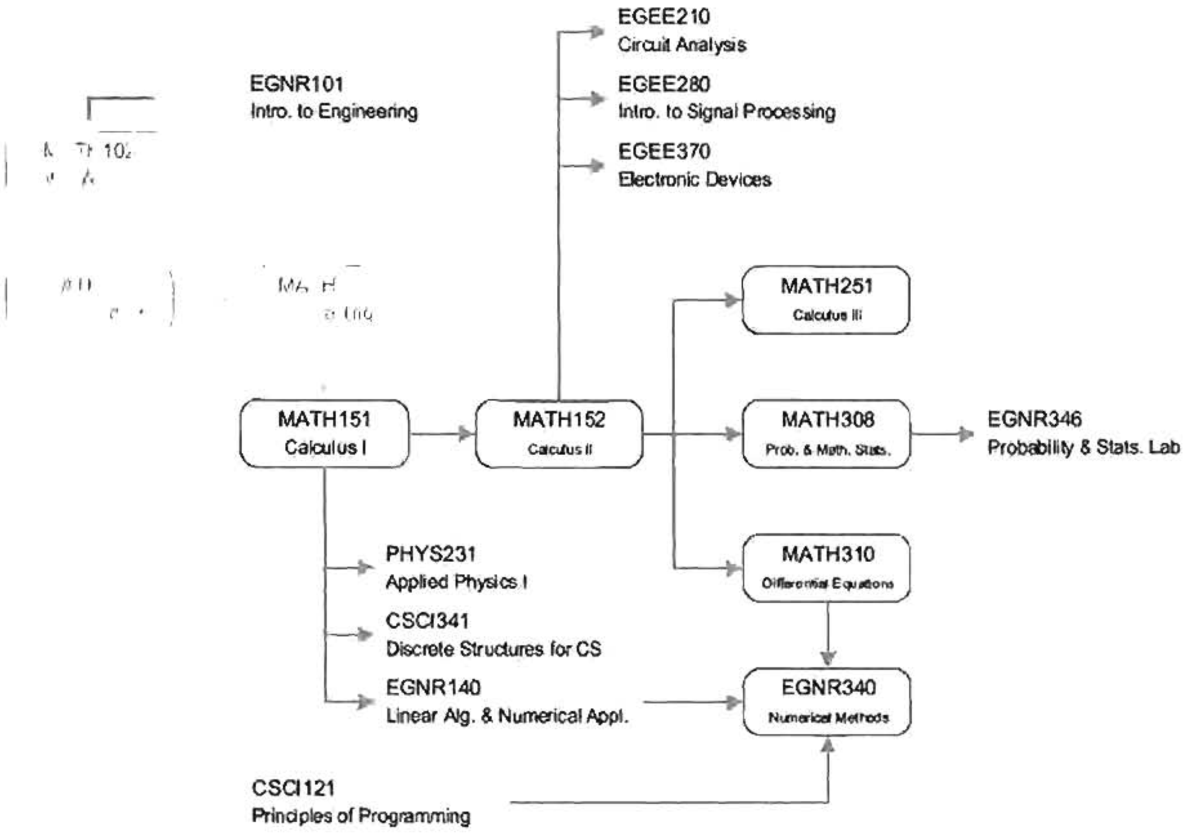


Figure 5-2: Mathematics Component as Related to Subsequent Courses

Consistent with the criterion 5 requirement that some basic science courses include experimental experiences, all three of the courses in natural sciences (CHEM-115, PHYS-231, and PHYS-232) have a laboratory component; these are 3 hours/week for CHEM-115, and 2 hours/week for each of PHYS-231 and PHYS-232.

The structure of the natural sciences portion of the curriculum and its mathematics prerequisites are shown below in Figure 5-3.

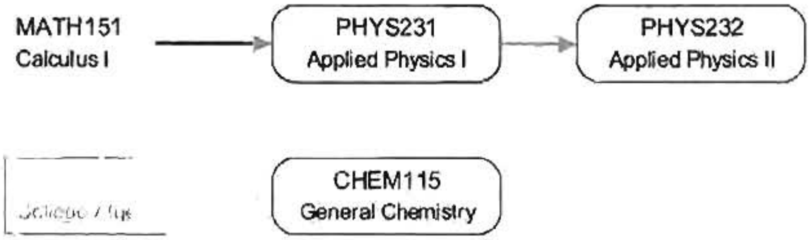


Figure 5-3: Science Component as Related to Subsequent Courses

5-A.5.2 *Engineering Courses*

Criterion 5 requires 48 credits (one-and-a-half years) of engineering topics, which are comprised of engineering science and engineering design. Indeed, the Computer Engineering program at

LSSU provides at least 56 such credits and typically 69 such credits when the technical electives are considered.

The core of the program provides 50 credits in engineering topics, as shown below in Table 5-7

Table 5-7: Engineering Core Component of Curriculum

Course	Credits
CSCI-105 Introduction to Computer Programming	3
CSCI-121 Principles of Programming	4
CSCI-122 Programming Tools and Techniques	3
CSCI-2XX Computer Science Core Elective	3
CSCI-341 Discrete Structures for Computer Science	4
EGEE-125 Digital Fundamentals	4
EGEE-210 Circuit Analysis	4
EGEE-250 Micro-Controller Fundamentals	4
EGEE-280 Introduction to Signal Processing	4
EGEE-320 Digital Design	4
EGEE-355 Microcontroller Systems	4
EGEE-370 Electronic Devices	4
EGEE-425 Digital Signal Processing	3
EGNR-101 Introduction to Engineering	2
EGNR-140 Linear Algebra and Num. Appl. for Engineers	2
EGNR-346 Probability and Statistics Lab for Engineers	1
Total	**50**

Additionally, 6-13 credits of engineering topics are provided through the senior-year capstone experience. Most students choose the EGNR-491&495 *Senior Design Projects* sequence, which has 6 credits of engineering topics, to satisfy the senior-year capstone experience. The other two routes are the EGNR-250-450-451-491 *Cooperative Education* sequence, which has 13 credits of engineering topics, and the EGNR-260-460-461 *Research Projects* sequence, which has 8 credits of engineering topics.

Additional credits of engineering topics are also provided in the options; however, a student may choose to take only advanced mathematics courses via the "General" option and earn only mathematics credits, although this has never occurred. The number of engineering topics credits available through technical electives is 0-13.

Thus, the total number of engineering topics credits in the program ranges from 56 to 69, depending upon which senior-year capstone experience is chosen and which technical electives are selected. This is summarized below in Table 5-8.

Table 5-8: Engineering Topics in the Curriculum

	Engineering Credits	
Curricular Component	Range	Typical
Engineering Core	50	50
Senior-Year Experience	6-13	6
Engineering Technical Electives	0-13	13
Total	**56-69**	**69**

The EAC criterion 5 notes that "The engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering practice on the other." It will be evident from a consideration of Figure 5-1 through Figure 5-3, showing prerequisite structure, that the Engineering Science courses are indeed based upon foundations in Mathematics and the basic Sciences. Finally, the Engineering sciences lead into practice, as is highlighted especially by the senior sequence courses (EGNR-491&495).

5-A.5.3 Advanced Mathematics

The EAC program criterion for degrees named Computer Engineering specifies, furthermore, that the program "must include discrete mathematics." Accordingly, the program contains substantial amounts of material in these areas, as tabulated below in Table 5-9. Furthermore, the prerequisite structure within these areas is well-developed, giving the depth needed for professional work, as illustrated in Figure 5-1.

Table 5-9: Advanced Mathematics in Engineering Core Curriculum

Course
MATH-310 Differential Equations • Laplace transform introduced
EGEE-210 Circuit Analysis • complex numbers used in phasor description of sinusoidal signals and complex power
EGEE-280 Introduction to Signal Processing • complex numbers used in phasor description of sinusoidal signals • discrete systems covered extensively • frequency response through Fourier transfer introduced
EGEE-425 Digital Signal Processing • DFT and FFT • implementation of FIR and IIR filters • impulse response and frequency response of FIR and IIR filters • design of FIR and IIR filters
EGNR-140 Linear Algebra and Numerical Applications for Engineers • linear algebra introduced
EGNR-340 Numerical Methods • numeric solutions found to differential equations
CSCI-341 Discrete Structures for Computer Science • recursion • parsing • Turing machines • adaptive algorithms

5-A.5.4 General Education

There is a general education component comprising 24 credits (minimum) that are not otherwise called out by the degree program. The General Education mission statement reads as follows:

> *"In a diverse and changing world, college graduates must be prepared for a lifetime of learning in a variety of fields. In order to meet this challenge, general education requirements*

foster the development of general skills and knowledge that are further developed throughout the curriculum."

Note that the LSSU University-level perspective is that the General Education component is actually 34 credits minimum, but that definition of "General Education" also includes Mathematics and Natural Sciences courses, which, for present purposes, are not included in what is referred to as "General Education" in this report (since they are fulfilled by specific program requirements). These are broken into 4 blocks:

- a *Communications* block, consisting of two English composition courses (ENGL-110, ENGL-111) and a speech course (almost always COMM-101, although alternatives are listed which tend to be impractical for Engineering students). The courses have the objective that students *analyze, develop, and produce rhetorically complex texts, and communicate competently in a variety of contexts.*
- a *Humanities* block, consisting of two course from different disciplines, including humanities, fine arts, or languages. These courses have the objective that students *analyze, evaluate, and explain human aesthetics and its historical development.*
- a *Social Sciences* block, consisting of two elective courses from areas such as history, sociology, psychology, geography, etc. These courses have the objective that students *think critically and analytically about the causes and consequences of human behavior.*
- a *Diversity* block, consisting of a single elective course. These courses have the objective that students *view the world from cultural perspectives other than their own.*

5-A.6 Major Design Experience

Design is an integral part of the program, and there are numerous courses in the curriculum that provide design experiences. Students begin experiencing design activity in their first engineering course, EGNR-101 *Introduction to Engineering*, and continue to experience it throughout each subsequent semester, culminating in a senior (capstone) sequence. Projects, as a rule, require proof-of-concept and not mere design, usually implying that a prototype be fabricated and tested.

There are three possible paths for students to follow for their senior year capstone experience: *Industrial-path, Coop-path,* and *Research-path*; all of these paths provide a realistic design experience in an academic environment. In recent years, most students have chosen the Industrial-path, with just a few opting for the Coop path. The research path, while remaining available in principle, had been entirely inactive; however, for the first time in many years, three students are now pursuing it, having just completed the initial course in the Spring 2018 semester.

The industrial-path consists of the senior design course sequence EGNR-491&495. The initial course, EGNR-491, has a strong emphasis on team and communication skills during the definition and proposal phase, and initial design phase, of a multi-disciplinary project. Then, in EGNR-495, students continue to work on multidisciplinary teams to implement and engineer, i.e., realize, a final design for an industrial customer.

Alternatively, the Cooperative Education path students may substitute an equivalent design experience during their Co-op internship for the EGNR-495 course (realization phase). They still take the EGNR-491 course for the benefit of its academic content, and also assist one of the full-year (industrial-based) project teams during that semester, in order to gain further project experience. While the Co-op internship is in progress, they take the courses EGNR-450&451,

with similar technical writing and oral presentation assignments to those of the industrial path courses.

Finally, the research-path students take, instead, a three-course sequence: EGNR260 – 460 – 461, of which the first (EGNR-260) is largely a literature study and introduction to basic research methodologies, taken in the 2nd-semester junior year; the 460 and 461 courses are largely coincident with the 491 – 495 courses of the industrial sequence, with the same lectures, and participation in the same team / communication skills activities, but the nature of the project differs, being rather an academically-oriented research project under the direction of a faculty member. Rather than a prototype necessarily, a scientific paper (perhaps complemented by a conference presentation or poster display) is the expected tangible outcome.

The Senior Year Experience for all of these paths requires the application of student knowledge and skills acquired in earlier course work to enhance their ability to accomplish required objectives. As described above, for most students (industrial path), the senior design experience at LSSU involves participating in an intensive design project that spans *two* semesters. Students work on multidisciplinary teams (i.e., typically a mix of students from the disciplines MfgET, ME, EE, EET, and CE (Computer Engineering), often 3-7 students depending on the scope. They ordinarily design and build a product or process prototype or proof-of-concept for an industrial customer; some projects, however, are supported directly by LSSU. Typical project budgets are $5,000 - $30,000, but have occasionally fallen out of that range on both ends. Examples descriptions of some projects from the past few years which have involved CE students are:

- The design, build, and automation of a prototype CNC milling machine. Team LSA upgraded an existing gantry mill which was originally manually operated. This machine was designed to work in a wide range of applications, could be mounted and operated while in any orientation, and was completely mobile.
- The design and build of an automated prescription dispensing machine designed to assist pharmacy employees. Building off the previous team's proof of concept workcell, Team CVS replaced the FANUC delta robot with a 3D gantry system they designed and built. Along with replacing the robot, Team CVS converted a majority of the control of the system from PLC (Programmable Logic Controller) to Raspberry Pi (mini-computer).
- Team WIS was tasked with researching and developing a system to automate the inspection of automotive rims. The system used an industrial camera and machine vision software to capture an image of a rim and analyze it.
- Team SAGA designed and built a system which utilizes laser measurements to achieve alignment between a robot arm and a steering column. The system replaced the previous manual method of robot alignment at Nexteer and increased the repeatability and accuracy of the testing procedure. The removable system used lasers mounted to the steering column and a target mounted to the robot arm. Together, the tools measured the robot's position and orientation in order to calculate and execute the required movements to achieve proper alignment.

- The design and build of a laser measuring system for Mactech, Inc., that had a vision of incorporating precision measurement tools alongside its on-site services. It was intended to be used to replace traditional dial indicators during the alignment process. The system overcame several obstacles frequently encountered with traditional mechanical indicators, such as visibility, physical manipulation, and size constraints. The device was also modular and wireless so that it could be attached to any machine desired by the operator, its linear adjustability made it compatible with cylindrical objects of a given diametrical range, and allowed Mactech to observe surface quality before and after machining.
- The design and implementation of a robotics workcell to simulate the dispensing of Spikefast, a wood filler product, into railroad ties. A Motoman robot, using custom end of arm tooling and a machine vision system, located the positions of spike holes on railroad ties as they moved by on a continuous conveyor. This project served as a proof-of-concept for future development of a wood product dispensing system in the railroad industry.
- The research-path group which has just completed EGNR-260 is working on a project using surface-wave seismic techniques for either obstacle detection, or for detecting oil spills under lake ice layers (of application to the regional problem of monitoring Great Lakes pipelines for winter leaks); the exact direction is still developing.

More information regarding senior design projects, including more extensive descriptions of specific projects, can be found on the School's web site at the URL:

https://www.lssu.edu/school-of-engineering-and-technology/senior-projects

The senior design courses are managed by a multidisciplinary team of faculty called the senior projects faculty board (SPFB). Figure 5-4 depicts the major activities associated with the senior design courses. The display materials available at the time of the visit will also contain portfolios of the design projects.

As is evident from the process illustrated, there are several identifiable phases that put a premium on non-technical skills: multiple presentations (scope, update, final) enhance oral communications skills; written documents such as the project proposal ("project definition & plan") develop technical writing skills; customer meetings, team meetings, design reviews, etc. develop skills in running effective meetings and recording useful minutes; timeline software tools, action items and responsibility charts develop skills in time and resource management; all of these things as well as the project's design and implementation aspects, and various team assignments, all encourage the development of teamwork skills.

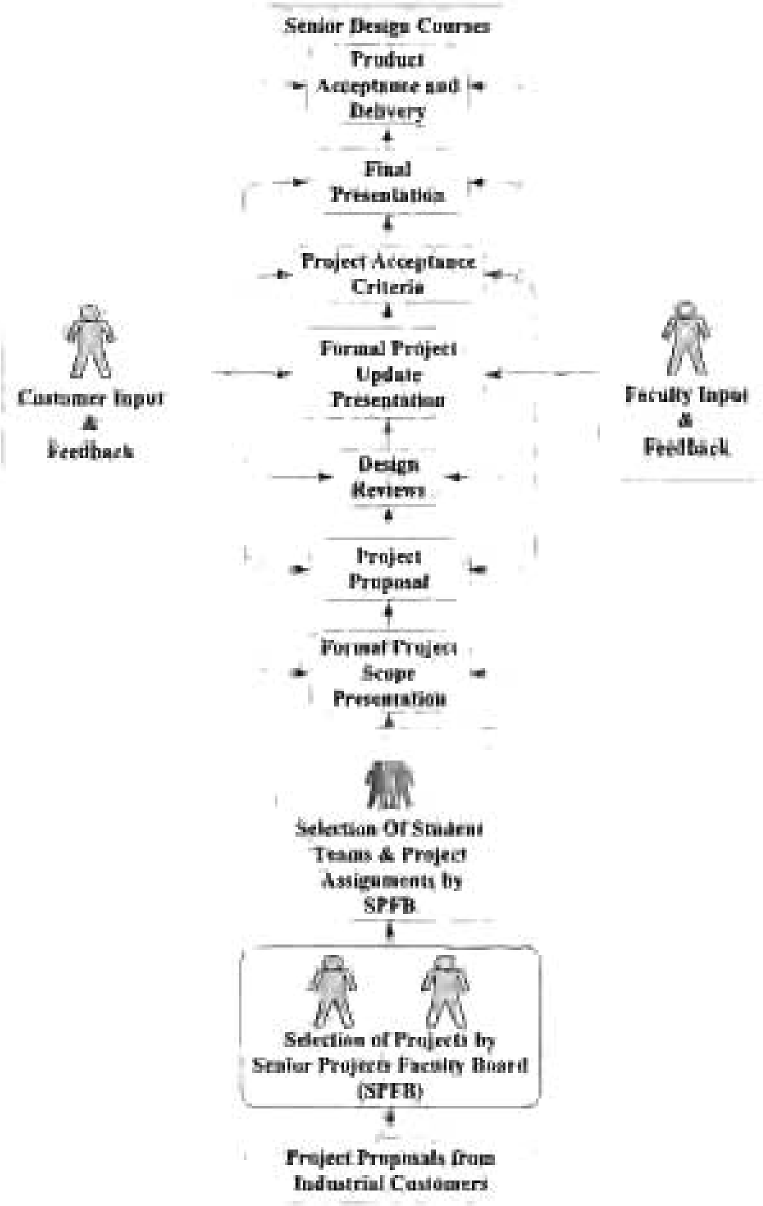


Figure 5-4: Overview of Senior Design Projects

Since the projects are technical in nature, they require the application of the engineering skills of the student throughout; the required design and implementation tasks are the primary avenues for making use of engineering skills.

Appendix J contains the detailed syllabi for the senior design experience courses EGNR-491 and EGNR-495, and attachments to these.

5-A.7 Cooperative Education

Cooperative education opportunities exist for the engineering and technology students at LSSU. Co-op is not a large part of the curriculum, but the students may use some co-op to replace the second course in the senior (capstone) sequence, as described above. The most basic co-op course (EGNR-250), which is 2 credit hours, requires that a student write a business report describing their work in the engineering field. They must also complete an evaluation of their work experience and submit an evaluation of their work performance from the supervisor.

Students may also elect to use two upper level co-op classes (EGNR-450 and 451, as discussed above with respect to the alternative capstone experience paths) to replace EGNR-495, the second semester of senior projects (as described above). In this co-op experience, the students must complete a project at the co-op site that requires at least 60% of their time over the course of two semesters. The content of the project is approved by the co-op coordinator and the Senior Projects Faculty Board (SPFB). The academic requirements for the projects are very similar to those of the projects completed by the students in the senior design experience on campus, including graded presentations and written reports. The SPFB reviews the major documents submitted by the student to fulfill the course requirement.

5-B Course Syllabi

For more detailed information on specific courses listed in Table 5-1 through Table 5-3, note that all courses have detailed syllabi. Examples of the detailed syllabi of *some* courses are collected, as examples, in Appendix I; such syllabi are updated with each course offering, and electronic copies are kept on the Engineering network (y:/-drive), so that such detailed syllabi, comprehensively for all Engineering courses going at least a dozen years back, are available.

More concise syllabi for *all* courses in the program are provided in Appendix A. Each of these syllabi contain the following elements:

- Course number and name
- Credits and contact hours
- Instructor's / course coordinator's name
- Text book, title, author, and year, and any other supplemental materials
- Specific course information
- Brief description of the content of the course (catalog description)
- Prerequisites and/or co-requisites
- Whether a required, elective, or selected elective course in the program
- Specific goals for the course
- Specific outcomes of instruction (course objectives)
- Which of the student outcomes are addressed by the course
- Brief list of topics to be covered

Criterion 6 FACULTY

The School of Engineering & Technology (SET) contains positions for ten full-time faculty, two laboratory engineers, and a consulting engineers (with one of the lab engineers serving part-time as a second consulting engineer). School and program leadership rests with key faculty members who perform these functions on a release time basis. The School faculty work very well together as a combined team on school-related items. For purposes of program direction and planning, the School faculty members also meet as two separate departments: 1) Department of Electrical and Computer Engineering (ECE), and 2) Department of Mechanical Engineering (ME). The Computer Engineering program is housed within the Department of Electrical and Computer Engineering, which is comprised of five full-time faculty members, one laboratory engineer, and one consulting engineer. It should be noted that due to the retirement of one of the ECE faculty members, the ECE department has been operating for the 2017-2018 academic year with only 4 full-time faculty members (and the School has been operating with only 9 full-time faculty members. A search is presently in progress to fill the open ECE faculty position.

Because of its small size, the School of Engineering & Technology offers engineering curricula that are significantly impacted by the other engineering disciplines in the School and also receive a significant amount of instruction from the faculty in the Department of Math and Computer Science. By the time they leave LSSU, Computer Engineering graduates, for example, will have taken classes taught (or team-taught) by most of the ten-person School of Engineering & Technology faculty. Furthermore, much of the continuous improvement process occurs at the School level, in which the entire School of Engineering & Technology faculty participate. Hence, the discussion provided on the faculty in this section will include all members of the School faculty; however, special attention will be paid to the Department of Electrical and Computer Engineering faculty which directly administers the Computer Engineering program. Additionally some information will be provided on the faculty members from the Department of Math and Computer Science that instruct the computer science courses which are a part of the Computer Engineering program.

LSSU is dedicated to its primary mission as a teaching institution by offering challenging undergraduate programs and services to students. In recognition of this mission, all members of the LSSU faculty are required by the University contract to devote 50-75% of their efforts during the academic year toward student learning activities and an additional 10-20% towards advising/student support activities. The remaining effort is directed towards scholarly and creative activities (5-20%) and service to the institution, profession, and/or general community (10-20%). The emphasis on teaching will come out in the subsequent sections, especially in Faculty Qualifications, Faculty Workload, and Authority and Responsibility of Faculty.

6-A Faculty Qualifications

The Computer Engineering program at LSSU, like the Electrical Engineering and Mechanical Engineering programs, can be characterized as one that emphasizes the fundamentals of engineering, traceability of theoretical results to first principles, applications of theory, and a heavy laboratory component that coordinates with the theoretical content. The faculty members instructing the program, consequently, generally share these philosophical precepts with regards to engineering education.

Consistent with the institution's primary mission of teaching, and the School's philosophy of maintaining an applied emphasis in its engineering and technology programs, the evaluation process employed in the hiring of new faculty accordingly places a greater emphasis on a candidate's philosophy of engineering education, promise as an instructor, and industrial experience, than it does on academic research credentials.

A candidate for the School of Engineering & Technology faculty is generally expected to have some teaching experience (either as faculty member or a teaching assistant) and to possess excellent communication skills. Each candidate is asked to give a sample lecture (on a topic specified by the hiring committee chair and generally kept the same for all visiting candidates) during the on-campus interview. This lecture is ordinarily given to both students and faculty. Feedback is thereafter solicited from those in attendance, and is given much weight in the subsequent hiring decision.

6-A.1 School of Engineering & Technology Faculty

As was noted before, the Computer Engineering graduates are affected by nearly all the faculty in the SET due to the small size of the School and the interwoven nature of the engineering disciplines. Some faculty primarily teach courses that are required for the program, while other faculty interact with students through their participation in project-based courses such as EGNR-101 Introduction to Engineering or the EGNR-491&495 Senior Design Projects I and II capstone sequence. Background information is therefore presented for all faculty members in the SET below in Table 6-1 with a special note to those that routinely participate in the ECE departmental meetings.

An overview of the nine full-time and four adjunct faculty members of the School of Engineering & Technology in Table 6-1 indicates the following:

- All faculty members have appropriate BS degrees in engineering or engineering technology
- All full-time faculty members have appropriate advanced degrees in CE, EE, or ME to teach courses in the respective programs
- An average of 5.6 years of government and industrial experience
- An average of 14.9 years of teaching experience
- 11% of full-time faculty members are licensed Professional Engineers
- A medium level of professional society involvement
- A medium-high level of professional development
- A medium-low level of consulting and other industrial involvement

Table 6-1: Faculty Qualifications

School of Engineering & Technology

					Years of Experience				Level of Activity[4] H, M, or L		
Faculty Name	Highest Degree Earned - Field and Year	Rank [1]	Type of Academic Appointment[2] T, TT, NTT	FT or PT[3]	Govt./Ind. Practice	Teaching	This Institution	Professional Registration/ Certification	Professional Organizations	Professional Development	Consulting/ summer work in industry
Baumann, David **(ECE)**	PhD, EE, 1992	P	T	FT	4	25	19	Michigan	L	L	L
Jones, Andrew **(ECE)**	PhD, ECE, 2002	ASC	T	FT	0	19	13		M	M	H
Moening, Joseph **(ECE)**	PhD, EE, 2010	ASC	T	FT	0	13	8		M	H	L
Weber, Paul **(ECE)**	PhD, EE (CE), 2006	ASC	T	FT	1	12	9		M	M	M
King, Jeff **(ECE)**	BS, EET, 1996	A	NTT	PT	4	20	20		L	M	L
Becks, Eric **(ECE)**	MS, EE, 1981	A	NTT	PT	37	8	10		M	M	H
Devaprasad, Jim	MS, ME, 1986	P	T	FT	1	32	32		H	H	M
Hildebrand, Robert	PhD, Acoustics, 2001	ASC	T	FT	4	19	13		M	M	L
Leach, David	MS, ME, 2018	I	TT	FT	18	7	7		L	M	H
Mahmud, Zakaria	PhD, ME, 2003	ASC	TT	FT	1	15	4		M	M	L
Zarepoor, Masoud	PhD, ME, 2016	AST	TT	FT	0	2	2		H	H	M
Huff, Jordan	BS, ME, 2017	A	NTT	PT	1	0.5	1		M	M	H
Finley, David (Dean, 2017-2018)	PhD, ChemE, 1996	P	NTT	FT	7	12	6	Indiana	H	H	L
Muller, Kimberly (Dean, Starting Fall 2018)	PhD, Mathematics, 2004	P	T	FT	0	24	14		M	H	L

1. Code. P = Professor ASC = Associate Professor AST = Assistant Professor I = Instructor A = Adjunct O = Other
2. Code: TT = Tenure Track T = Tenured NTT = Non Tenure Track
3. FT = Full Time Faculty or PT = Part Time Faculty, at the institution.
4. The level of activity, high, medium or low, should reflect an average over the three years prior to the visit.

6-A.2 Department of Electrical and Computer Engineering Faculty

As will be demonstrated in this section, the ECE faculty is, furthermore, mutually complementary in their mix of competencies, and, these span the Computer Engineering and Electrical Engineering discipline as traditionally understood. They bring a blend of educational and professional experience. Given below is a brief description of each member of the ECE faculty, including strengths and the faculty member's relationship to curricular areas.

6-A.2.1 Dr. David Baumann, P.E. (ECE Professor)

Dr. Baumann has BS, MS, and PhD degrees in Electrical Engineering and an MS degree in Statistics from the University Wisconsin. As a graduate student he worked under the direction of Dr. R. A. Greiner in the Electro-Acoustics Laboratory. His research involved acoustic monitoring of machinery condition and active attenuation of noise in air ducts. He has four summers of research experience at the Naval Surface Warfare Center involving active vibration control of submerged propellers. He taught for 6 years at Oral Roberts University and has now taught for 19 years at LSSU. He has expertise and teaches courses in the areas of Electromagnetics, Control Systems, Circuits and Signals, Probability and Statistics, and Power Distribution. He served several years as the coordinator of the Senior Projects Faculty Board and the coordinator of the Department of Electrical and Computer Engineering and served the past six years as the Chair of the School of Engineering & Technology.

6-A.2.2 Dr. Andrew Jones (ECE Professor)

Dr. Andrew Jones joined LSSU during the 2005-2006 academic year. He has degrees in Electrical Engineering (BS/MS) and in Computer Engineering (PhD). He previously taught at Purdue University for three years. Dr. Jones has research experience in digital and micro-controller systems as applicable to mobile robotics systems. He primarily teaches courses in robotics, software development, digital electronic and micro-controller areas and was awarded with the LSSU Distinguished Teacher Award in 2010. Dr. Jones has also engaged in applied research activities with entrepreneurs interested in developing electronic products as well as consultations for industrial companies. He is also involved with FIRST with coordinating local FLL (FIRST Lego League) tournaments and mentoring the local FRC (FIRST Robotics Competition) team. He is the advisor for the LSSU chapter of IEEE. Dr. Jones is the coordinator of the Department of Electrical and Computer Engineering.

6-A.2.3 Dr. Joseph Moening (ECE Professor)

Dr. Moening has been at LSSU since the start of the 2010-2011 academic year. He has BS, MS, and PhD degrees in Electrical Engineering from the University of Toledo. His areas of interest include power electronics, renewable energies, semiconductor devices, analog electronics and micro/nano-device fabrication. He primarily teaches courses related to these areas. He has research experience in laser-based micro-structuring of thin films as well as power processing systems. His is the co-advisor for the Engineering House.

6-A.2.4 Dr. Paul Weber (ECE Professor)

Dr. Weber has a BS in Computer Engineering, and MS and PhD degrees in Electrical Engineering from Michigan Technological University. While at Michigan Tech, his primary research was in the area of fault-tolerant distributed control algorithms for safety-critical systems (e.g. fly-by-wire aircraft control). After finishing graduate school, he taught for three years as a Visiting Assistant Professor at University of Minnesota Duluth. During his time there, he also developed research in the areas of energy and engineering education, which he has continued while at LSSU since joining the faculty in the fall of 2009. Dr. Weber's primary teaching expertise is in digital design and embedded systems. He is currently the coordinator for Senior Projects and began serving as the Chair for the School of Engineering & Technology during the Spring 2018 semester.

6-A.2.5 Mr. Eric Becks (ECE Consulting Engineer)

Mr. Becks earned his BS and MS in Electrical Engineering/System Science from Michigan State University. Prior to joining the LSSU Product Development Center (PDC), Eric Becks was involved in industrial and entrepreneurial activities. His work experience ranges from Engineering Manager in a multi-national company to President of a diagnostic equipment manufacturing firm. Mr. Becks was involved in the formation of real estate, retail, internet marketing and manufacturing businesses as well as negotiating a leveraged buy-out. He has designed numerous products including several that have received industry awards. Besides his duties at the PDC, Mr. Becks also serves as Director of Intellectual Property & Economic Development for LSSU and President & CEO of SSMartSM, Inc., the Sault Ste. Marie/LSSU SmartZone. He has also served as a school board member for 14 years; 12 as president.

6-A.2.6 Mr. Jeff King (ECE Lab Engineer)

Mr. King is a full-time laboratory engineer for the School of Engineering & Technology. He has a BS degree in Electrical Engineering Technology from LSSU, and is pursuing a BS degree in Mathematics from LSSU on a part-time basis. He has valuable professional engineering experience in industrial electrical controls and PLCs, and is responsible for the School's electronic and computer systems. He occasionally teaches as an adjunct in the areas of electrical circuits, electronics, and PLC's for the engineering technology programs in the School and has instructed sections of the digital fundamentals laboratory. He also assists significantly in the senior design projects on the PLC and electrical design and implementation aspects.

6-A.3 Faculty Composition in Light of Program Criteria

It will be evident from the descriptions above, that the faculty composition contributes to satisfaction of the curriculum aspects of the program criteria stated below:

A. The structure of the curriculum must provide both breadth and depth across the range of engineering topics implied by the title of the program.
B. The curriculum must include probability and statistics, including applications appropriate to the program name; mathematics through differential and integral calculus; sciences (defined as biological, chemical, or physical science); and engineering topics (including computer science) necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components.
C. The curriculum must include discrete mathematics.

There is extensive professional experience in each of these kinds of activities when the full set of ECE faculty is considered, and that is further complemented by experience from the Mechanical Engineering and Math and Computer Science faculty (see below).

6-A.4 Department of Mechanical Engineering Faculty

The following faculty members from the ME Department provide teaching and key ancillary support for the CE program:

6-A.4.1 Dr. Robert Hildebrand (ME Professor)

Dr. Hildebrand has research and publication background in the areas of noise and vibrations, vehicle dynamics, and soil dynamics. He has a good mix of industrial, consulting, research and teaching experience, often with a particular emphasis on editing and translating work. Accordingly, he strongly supports the program's emphasis on applications of fundamentals, on laboratory instruction, and on communications. He regularly teaches EGME-275 Engineering Materials, EGME-276 Strength of Materials Lab (co-taught), EGME-310 Vehicle Development & Testing, EGNR-310 Advanced Quality Engineering, EGEM-320 Dynamics, EGME-350 Machine Design, EGNR-340 Numerical Methods, EGME-415 Vehicle Dynamics, and EGME-425 Vibrations & Noise Control, regularly serves as a senior project faculty advisor, and has often team-taught MATH-310 Differential Equations. Dr. Hildebrand is the coordinator of the Department of Mechanical Engineering.

6-A.4.2 Prof. James Devaprasad (ME/MfgET Professor)

Prof. Devaprasad has been a professor in the School of Engineering & Technology at LSSU for 32 years. His areas of teaching emphasis include robotics and automation. He was the Coordinator or Chair of Manufacturing Engineering Technology for much of that time, and has also served as Chair of the School of Engineering & Technology for a time while the Dean position was vacant. He is currently the coordinator of General Engineering and Technology as well as the director of LSSU's Robotics Center.

Prof. Devaprasad has been the leader in developing the robotics laboratory through industrial donations and grants, and has been in key leadership roles nationally in the Society of Manufacturing Engineers (SME) and the Robotics Industries Association. He normally teaches several robotics courses in both the engineering and engineering technology curricula and often serves as the advisor or customer for robotics senior projects. He also supports the Robotics Technology minor available for the Engineering Technology students and Computer Science students. He is a recipient of the Outstanding Young Manufacturing Engineer award from SME and the distinguished faculty award from the Michigan Association of Governing Boards of universities. He serves as the director of the Women in Technology summer camps and the Robotics summer camps that he and his colleague founded over 27 years ago. He also led the successful initiative to create a B.S. in Robotics Engineering during the Spring 2018 semester.

6-A.4.3 Mr. David Leach (ME Instructor)

Mr. Leach started working for the LSSU Product Development Center in 2008, and became a full time faculty member in 2014. He has MS and BS Mechanical Engineering degrees from Michigan Technological University, and is currently enrolled in MTU's doctoral mechanical engineering program, with an expected start date of Spring 2019. Mr. Leach's areas of interest include CNC machining, manufacturing processes, product development, plastics design, lean manufacturing, quality systems, and manufacturing sustainability. David primarily teaches EGME-141 Solid Modeling, EGME-240 Assembly Modeling and GD&T, EGME-110 Manufacturing Processes, EGMT-216 CAM with CNC Applications, EGMT-225 Statics and

Strength of Materials, and EGNR-491/495 Senior Projects. He has automotive industry experience in product and quality engineering for Class A exterior plastic trim. Mr. Leach is our cooperative education coordinator and is responsible for our co-op sequence of courses: EGNR-250, EGNR-450, and EGNR-451. David is also the faculty advisor for Tau Kappa Epsilon (TKE), a service fraternity at LSSU.

6-A.4.4 Dr. Zakaria Mahmud (ME Professor)

Dr. Mahmud has a BS in Mechanical Engineering from Bangladesh University of Engineering and Technology (Dhaka, Bangladesh), MS in Sustainable Energy Engineering from The Royal Institute of Technology (Stockholm, Sweden), and PhD in Engineering Science and Mechanics from the University of Alabama (Tuscaloosa, Alabama). After graduation, he taught for one year in Aerospace Engineering Department at Texas A & M University (College Station, TX). He then led NASA SBIR phase II project as Principal Research Engineer at Techsburg Incorporated (Blacksburg, VA). Dr. Mahmud then taught in Mechanical Engineering Technology program at Georgia Southern University (Statesboro, GA). Before joining in LSSU since Fall 2014, he taught for seven years in Mechanical Engineering at North Dakota State University (Fargo, ND). His primary research interests are in the areas of experimental aerodynamics and micro-fluidics. He regularly teaches the following courses at LSSU: EGNR-101 Introduction to Engineering, EGNR-140 Linear Algebra and Numerical Applications, EGME-337 Thermodynamics, EGME-338 Fluid Mechanics, EGME-431 Heat Transfer, and EGME-432 Thermal Fluids Laboratory. Dr. Mahmud is serving as a co-advisor for Engineering house and advisor for the Society of Automotive Engineers (SAE).

6-A.4.5 Dr. Masoud Zarepoor (ME Professor)

Dr. Zarepoor received his BS in Mechanical Engineering from Shiraz University. He pursued his graduate studies by receiving MS and PhD degrees in Mechanical Engineering from Wright State University and Old Dominion University, respectively. His PhD research was focused in the areas of vibrations, nonlinear dynamics, bistable structures, and piezoelectric materials. He joined LSSU in 2016 as an Assistant Professor in Mechanical Engineering, where he teaches Statics, Mechanics of Materials, Vibrations, and Finite Element Analysis courses. He also continues his research works in the area of vibrations and piezoelectric actuation of bistable structures at LSSU and serves as the Faculty Advisor for the ASME student chapter at LSSU.

6-A.4.6 Mr. Jordan Huff (ME Lab Engineer)

Mr. Huff is a full-time mechanical laboratory engineer for the School of Engineering & Technology. He has a BS ME degree from LSSU and has experience in manufacturing as well as vehicle development and testing. Prior to earning his bachelor's degree he was self-employed and restored vehicles. He supports both mechanical and manufacturing aspects of the program and is active in professional groups such as SAE (Society of Automotive Engineers). Mr. Huff also provides mechanical engineering support for LSSU's Product Development Center and has also served as an adjunct lab instructor for the manufacturing and processes course.

6-A.5 School of Mathematics and Computer Science Faculty

As will be demonstrated in this section, the Computer Science faculty is qualified to offer instruction to support the Computer Engineering program. Given below is a brief description of those members of the Computer Science faculty who regularly teach or soon will be teaching the computer science courses which are in the Computer Engineering curriculum.

6-A.5.1 Dr. George Voutsadokis (Mathematics & Computer Science Professor)

Dr. Voutsadakis has been part of the Mathematics & Computer Science Faculty since 2002. He holds a BS in Computer Engineering & Informatics from the University of Patras (Greece), a MS and PhD in Mathematics from Iowa State University, and a PhD in Computer Science from Iowa State University. He has primarily taught math courses at LSSU, but will be teaching CSCI341—Discrete Structures for Computer Science in Fall 2018. His research interests include complexity theory, artificial intelligence, and Algebraic logic.

6-A.5.2 Dr. Evan Schemm (Computer Science Professor)

Dr. Schemm has been part of the Computer Science Faculty since 2000 and teaches programming, computer architecture and assembly language, computer graphics, programming languages, and UNIX. He holds a BS in Secondary Education and Computer Science, an MS in Computer Science, and a PhD in Computational Science and Engineering, all from Michigan Technical University. His professional interest and expertise are in the areas of compiler development, computer graphics, and computer security.

6-A.5.3 Dr. Christopher Smith (Computer Science Professor)

Dr. Smith has been a faculty in Computer Science since 2012. He holds a BS in Computer and Mathematical Sciences from LSSU, an MS in Computer Science and Engineering from the University of Michigan, and a PhD in Computer Science from the University of Minnesota. While at LSSU, he has taught CSCI105, CSCI121, CSCI201, and CSCI341. His areas of interest are computer vision/image processing, intelligent systems, data analysis, and wireless senor networks.

6-B Faculty Workload

The faculty member is understood to have duties in instruction (encompassing teaching, office hours, advising, and student support/mentoring), "professional development" (encompassing research and scholarly work), and service (to the University—including the School and the Department, to the Profession, and/or to the Community as outreach).

The instructional portion, specifically, is fulfilled by instructing coursework amounting to 24 contract hours per year (or an average of 12 per semester), where "contract hours" are defined below. Although faculty members are considered full time if they teach 24 contract hours per year (average of 12 contract hours per semester), professional development and scholarly work are duties that fall outside the 24 measured contract hours.

6-B.1 Definition of Contract Hours

Faculty time commitment is measured contractually in contract hours (also "load hours"), which are *not* identical to credit hours earned by a student. A student earns a *credit* hour for each hour of lecture per week, and an additional credit hour for a 1-3 hour lab. On the other hand, one *contract* or *load* hour is one hour of lecture or 1.5 hours of lab (i.e., the actual lab time is multiplied by 2/3 to generate contract hours).

The time distribution of the faculty member's workload (implied based on proportionality to the contractually allowable weights given in the supervisory evaluation of the faculty member) is 50-75% for the student learning activities (corresponding primarily to the 24 load hours per year), 10-20% "advising/student support activities," 5-20% scholarly and creative activities (including research), and 10-20% University/School/Departmental/Community service. In a few cases, such as very heavy advising loads and special lab/research director appointments, contract load may be given for activities besides courses.

6-B.2 Instructional Workload

The amount of time and energy that faculty are expected to provide to an engineering program greatly influences the general strength of the program. Typical indicators of workload include contract hours, and student-to-faculty ratios (reflective of typical class and lab enrollments). A detailed list of instructional duties of the individual ECE faculty members (the four current full-time ECE faculty members, one ECE laboratory engineer, and one ECE consulting engineer) is shown in Table 6-2 and Table 6-3. A broad overview of the instructional workload broken down by group (regular faculty, lab engineers, etc.) meanwhile is shown in Table 6-4.

Table 6-2: Faculty Workload Summary, Fall Semester

School of Engineering & Technology

Faculty Member	PT or FT[1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to Program[5]
			Teaching	Research or Scholarship	Other[4]	
Baumann, David (ECE)	FT	F2017: EGEE280 (4), EGNR346 (1), EGRS460 (4)	75%		25% SET Chair	75%
Jones, Andrew (ECE)	FT	F2017: EGEE250 (4), EGNR101 (2) Team, EGNR265 (3), EGRS380 (2)	92%		8% ECE Coordinator	100%
Moening, Joseph (ECE)	FT	F2017: EGEE210 (4) Lec, EGEE330 (4), EGEE370 (4) Lab, EGRS365 (3)	100%			100%
Weber, Paul (ECE)	FT	F2017: EGNR261 (3), EGNR361 (1), EGNR491 (3) Lec&Crd, EGRS430 (4)	100%			100%
Becks, Eric (ECE)	PT	F2017: EGNR491 (3) Adv&Lec, EGEE370 (4) Lec	15%		50% PDC Engineer 35% Assoc Dean	85%
King, Jeff (ECE)	PT	F2017: EGNR491 (3) Adv, EGEE210 (4) Lab	10%		90% Lab Engineer	100%
Devaprasad, Jim	FT	F2017: EGRS381 (1), EGRS480 (3), EGRS481 (1), EGRS496 (3), EGNR491 (3) Adv	62%		30% Robotics Center Coordinator 8% Eng. Tech. Coordinator	100%
Hildebrand, Robert	FT	F2017: EGNR340 (1), EGNR491 (3) Adv, EGEM320 (3), EGME350 (4) Team	80%	12% Scholarship	8% ME Coordinator	100%
Leach, David	FT	F2017: EGME110 (3), EGME141 (3), EGNR490 (4) Adv, EGNR491 (3) Adv	100%			100%
Mahmud, Zakaria	FT	F2017: EGNR101 (2) Team, EGNR140 (2), EGME431 (3), EGME432 (2)	100%			100%
Zarepoor, Masoud	FT	F2017: EGEM220 (3), EGME350 (4) Tm, EGMT225 (4), EGNR495 (3) Adv	75%	25%		100%
Huff, Jordan	PT	F2017: None	10%		70% Lab Engineer 20% PDC Engineer	100%
Finley, David (Dean, 2017-2018)	N/A	F2017: None	0%		100% Dean and Interim Provost	25%
Muller, Kimberly (Dean, Start: Fall 2018)	FT	F2017: MATH111 (3), MATH151 (4)	75%	5%	20% Math & CS Chair	0%

Key: Lec = Lecture Only; Lab = Lab Only; Crd = Coordinator; Tm = Team Taught, Adv = Project Advisor

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the Self-Study Report is being prepared
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.

Table 6-3: Faculty Workload Summary, Spring Semester

School of Engineering & Technology

Faculty Member	PT or FT[1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to Program[5]
			Teaching	Research or Scholarship	Other[4]	
Baumann, David (ECE)	FT	**S2018:** EGEE210 (4), EGEE411 (3), EGNR340 (1), EGNR490 (1)	87.5%		12.5% Faculty Senate	87.5%
Jones, Andrew (ECE)	FT	**S2018:** EGEE355 (4), EGNR265 (3), EGRS215 (2), EGRS385 (4) Lec	92%		8% ECE Coordinator	100%
Moening, Joseph (ECE)	FT	**S2018:** EGEE475 (4), EGRS365 (3)	100%			100%
Weber, Paul (ECE)	FT	**S2018:** EGEE125 (4), EGNR495 (3) Crd, EGRS385 (4)Lab	75%		25% SET Chair	75%
Becks, Eric (ECE)	PT	**S2018:** EGNR245 (3), EGNR495 (3) Adv	15%		50% PDC Engineer 35% Assoc Dean	85%
King, Jeff (ECE)	PT	**S2018:** EGNR495 (3) Adv	10%		90% Lab Engineer	100%
Devaprasad, Jim	FT	**S2018:** EGRS385 (3) Lab, EGRS435 (3), EGNR495 (3) Adv	62%		30% Robotics Center Coord. 8% Eng. Tech. Coordinator	100%
Hildebrand, Robert	FT	**S2018:** EGNR260 (2), EGNR490 (1), EGNR495 (3) Adv, EGME275 (3), EGME276 (1), EGME425 (4)—Team	80%	12% Scholarship	8% ME Coordinator	100%
Leach, David	FT	**S2018:** EGME110 (3), EGME240 (3), EGNR495 (3), EGMT216 (3)	100%			100%
Mahmud, Zakaria	FT	**S2018:** EGNR140 (2), EGME337 (4), EGME338 (3)	100%			100%
Zarepoor, Masoud	FT	**S2018:** EGEM220 (3), EGME225 (3), EGME425 (4) Tm, EGME276 (1), EGNR495 (3) Adv, EGME141 (3)	75%	25%		100%
Huff, Jordan	PT	**S2018:** EGME110 (3) Lab	10%		70% Lab Engineer 20% PDC Engineer	100%
Finley, David (Dean, 2017-2018)	N/A	**S2018:** None	0%		100% Dean and Interim Provost	25%
Muller, Kimberly (Dean, Start: Fall 2018)	PT	**S2018:** MATH152 (4), MATH207 (3)	75%	5%	20% Math & CS Chair	0%

Key: Lec = Lecture Only; Lab = Lab Only; Crd = Coordinator; Tm = Team Taught, Adv = Project Advisor

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the Self-Study Report is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.

Table 6-4: SET Faculty Workload Overview for 2017-2018

	Instruction Only		Instruction + Release	
Instructional Subgroup	**Load Hours**	**Percentage**	**Load Hours**	**Percentage**
Full-Time Faculty (active)	242.79	89.8%	271.64	90.5%
Full-Time Faculty (on sabbatical)	0	0%	0	0%
Lab Engineers	13.39	5.0%	14.14	4.7%
PDC Engineers	14.03	5.2%	14.43	4.8%
External Adjuncts	0	0%	0	0%
Total	270.21	100%	300.21	100%

Notice that, since most of the courses offered for the Computer Engineering program are included in the Electrical Engineering program, for the purposes of constructing Table 6-2 no attempt was made to parse faculty time between the two programs in the parenthetical ECE notes. Furthermore, due to the highly integrated nature of the School of Engineering & Technology the right-most column of Table 6-2 and Table 6-3 indicates the percentage of time that each faculty member devotes to the School.

For the regular faculty, a full-time teaching load is 12 contract hours (or sometimes "load hours") per semester, with the option to take on up to 6 additional load hours per semester with "overload" compensation at a reduced rate. A faculty member may fall under 12 for a given semester, if compensated in the same academic year by an overload in the other semester, such that 24 contract hours are performed per year. Single semester loads are limited to 18, and annual (excluding summer) loads to 32.

The average School-wide load for the full-time faculty during the 2017-2018 academic year was 15.1 load hours per semester (i.e., an average of 3.1 hours of overload), and about 90% of the instruction was provided by them. Note that the situation was unusual that year, however, because a faculty member retired and the position was not filled immediately (as of the time of this report, the search for a new faculty member is still on-going). In the 2015-2016 academic year, for comparison, the average load had been 13.4 load hours per semester. If the present year's load was divided by 10 full-time faculty members instead of 9, the average load per semester would be 13.6 load hours per semester. Furthermore, the student-faculty ratio for courses in the School of Engineering & Technology in the Spring 2018 semester was approximately 16:1. With faculty research commitments less than is traditional in academia, no supervision of graduate students, and reasonable limits on other non-instructional activities as outlined below, adequate faculty coverage for quality teaching and student interaction is thereby assured.

The teaching load limits, and the general goals of keeping faculty near to the nominal load of 12 hours per semester and of maintaining a healthy student-to-faculty ratio, are intended to allow faculty members time to participate in non-classroom, professional activities as well as provide for quality student interaction and class preparation. Thus, beyond the expectations for teaching, faculty are also expected to hold regular office hours, and to participate in academic advising, student group advising, service activities, and professional development.

6-B.3 Office Hours and Advising

All regular, full-time faculty keep 5 office hours per week, at which they are available to meet students; those teaching less than full-time (e.g., the lab and PDC engineers) have numbers of office hours that are pro-rated by their respective fractions of a full-time teaching load. These office hours permit students to interact with the faculty member to supplement in-class instruction. Some courses have recitation sections, for which faculty provide a one-hour recitation and are accordingly relieved of an hour of office hour burden. Thus, the standard is that the total of recitation hours and office hours add up to 5 per week (note that no faculty currently have so far had more than 1 recitation hour per semester, and exceeding 2 recitation hours per faculty member per semester will be discouraged should that situation ever arise, in order that the number of general office hours will remain adequate).

Academic advising, in its aspect as a service to students, is described above. Concerning, on the other hand, its aspect as a faculty activity and time burden, note that the approximately 180 students enrolled in the School are divided amongst the 9 fulltime faculty members as advisees, so that the average is about 20 advisees per faculty member. The advising duties of the faculty member are to meet with each advisee prior to registration, recommend courses for which to register, and discuss course selection alternatives from the perspectives of progress to degree completion, student interests, and career relevance. As a benchmark, 15 minute advising sessions are used for freshmen students in EGNR-101 *Introduction to Engineering* (for students in that course only, these are scheduled during a specific lab session). Thus, an estimate of 4-5 hours of ordinary advising burden per faculty member per semester is reasonable; there is also some additional burden on the program coordinators and the school chair, specifically, in handling supplemental advising related to course overrides, transfer credit evaluation, and waivers, but this phenomenon is compensated through the release time adjustments to the 12-hour full-time load.

Faculty members also advise senior project teams, which provide a substantial amount of additional interaction with students and their respective industrial sponsor contacts in a realistic professional setting. Certainly, advising of senior projects teams is another time-consuming activity for faculty that resembles some of the out-of-classroom student interaction activities described above, but in principle, since this activity is compensated by teaching load from the EGNR-491 and EGNR-495 courses, it is more properly seen as part of team-teaching those courses.

The office hour and academic advising burdens are implied extensions of the instructional component of the faculty members' duties; they do not generate additional contract hours with the exception of extreme cases where 50 or more advisees are assigned to a single adviser, but are rather understood to be a part of the duties inherent in fulfilling the 24 load hours.

6-B.4 Release Time Assignments

Certain leadership roles within the School or the Departments (school chair, program coordinators) or within team-taught courses (lab section coordinators, senior projects board chair) *do* provide "release time" contract hours which may be counted towards the 24 contract hour per year requirement. These assignments are described in detail in Criterion 6-E.

6-B.5 Non-Instructional Workload

The 24-load hour requirement, described above, may be understood to comprise (with the exception of release time appointments) the *instructional* part of the faculty member's duties, only. Outside of the 24 load hours fall the additional duties of service and scholarship. As noted previously, this may be up to 40% of the faculty member's workload (scholarship up to 20%, and service up to 20%). This is an adjustment from 6 years ago when 100% of a faculty member's time could be devoted to teaching for a given year, although there was always an expectation of accomplishment in both the service and the scholarship categories by the time of tenure and promotion decisions.

Professional development activities, by their nature, vary considerably in kind and scope from faculty member to faculty member; the reader is referred to the faculty CVs (Appendix B), for specifics.

Service activities also vary in kind and scope among faculty members, especially with regards to service to the general Community. However, many of the other service activities are School-coordinated to such an extent that a rough overview can be given. Faculty members within the School regularly serve on University-wide committees (e.g., curriculum, general-education, student retention, etc.), serve on School committees (e.g., Engineering scholarship awards committee), support the faculty association, and participate in assessment. Each faculty member has a unique, measurable, responsible role in the School's assessment program (e.g., assessing a performance indicator for a specific student outcome). There are also initiatives within the School, and LSSU, to increase new student enrollment, by means such as high school visit and lab tours, each of which represent common service activities of the faculty. Faculty members serve as advisors to student chapters of national professional organizations, including SME: previously the Society of Manufacturing Engineers, SAE: Society of Automotive Engineers, ASME: American Society of Mechanical Engineers, IEEE: Institute of Electrical and Electronics Engineers, and SWE: Society of Women Engineers; serving as such an advisor generally involves overseeing that the clubs operate within their bylaws, recruit, fundraise, manage their budgets, and participate in regional and national events. Faculty members participate, finally, in summer orientations, although the chair has usually undertaken the majority of this particular burden.

6-C Faculty Size

As noted above, in Table 6-2, the 10 faculty (even in the absence of one due to retirement) were able to cover almost 90% of the instructional burden, and with only a moderate amount of overload per semester (3.1 contract hours average) and reasonable class sizes (average around 16). All of these figures are the same or better when the full set of faculty members are present for the full academic year, which is the ordinary situation.

All faculty maintain at least 5 hours of some combination of office hours and recitations (in practice, the latter has never exceeded 1 of the 5 hours for any faculty member). Senior student exit surveys consistently support the notion that these interactions are not only sufficient in quantity, but also in quality; a consistent theme is that students have excellent and fruitful access to faculty members.

Each student has a faculty member assigned as an academic advisor, and meet with the faculty member at least once per semester. As noted above (section 6-B), there is an average of around

20 student advisees per faculty member, suggesting a situation in which sufficient attention can be given to each.

University service and professional development activities are discussed in Criterion 6-B and 6-D, respectively.

The faculty have, finally, opportunities to interact with industrial and professional practitioners in a variety of contexts, including senior projects and cooperative education projects (see Criterion 5-A), PDC-sponsored projects (see Criterion 6-D), IAB meetings (see Criterion 2-D), sabbaticals (although in practice this has not been done in this 6 year cycle, and would require significant planning given the size of the faculty and teaching loads) and summer internships (e.g., see CV for Andrew Jones for the latter).

6-D Professional Development

All of the School faculty members have pursued professional development activities over the past five years. These include grant writing, consulting, research, publication of scholarly articles and texts, conference presentations, and attending teaching development training seminars, but the level of these activities is, consistent with the focus of the LSSU mission on teaching, less than is traditional elsewhere in academia. The major activities for School of Engineering & Technology faculty are listed below in Table 6-5. A detailed list of each faculty member's activities can be found in the CVs in Appendix B.

Table 6-5: Summary of Faculty Development Activities

Activity	Number of Active Faculty[1]	Comments
Industrial Consulting	11	Industrial training, consulting through PDC, external consulting, Senior Project support for external industrial customers
Journal/Conference Papers	7	Over 25 papers over a six year period.
Grants and Fundraising	8	Approximately $0.76M over a six year period.
Research	7	Internal projects, external projects, and government projects.
Attendance of Conferences and/or Professional Workshops	12	Over 55 conferences and/or workshops attended over a six year period.
Peer Review for Journals/Conferences	5	Peer review of sets of papers for over 40 journals and/or conferences.

[1] The number of faculty in this table can be greater than the present number of faculty in some cases due to the fact that some faculty members are counted here that are no longer employed at LSSU but worked here within the last 6 years.

Faculty have also had the opportunity to become involved in consulting projects through the Product Development Center (PDC), established in 2008 (see organizational structure in Background, section D). "Center" is to be understood here, not so much a facility (although there is capital equipment associated, and a building in progress), but as a team of one full-time engineer and one part-time engineer that accept a range of consulting projects from industry and entrepreneurs to design or improve engineered products. The concept is that the engineers can pass on some work to promising student employees, and also more specialized work to faculty as experts. While some members of the faculty have indeed carried out work in such projects, most of that was at the end of the previous 6 year cycle with only one faculty member working for an external company with the support of the PDC several years ago within this present 6 year cycle.

Many members of the faculty also regularly serve on the Senior Projects Faculty Board (SPFB). The SPFB oversees all senior year experiences within the School of Engineering & Technology. As many projects are sponsored by industry, *senior projects provide good opportunities for faculty to work closely with industry*. This interaction has resulted in faculty providing training for industrial-based engineers, occasional summer employment opportunities for faculty, and general faculty professional development due to the close industrial ties.

6-E Authority and Responsibility of Faculty

6-E.1 Leadership Structure

The leadership structure within the School of Engineering & Technology consists of a School Chair as well as program coordinators for ECE (EE and CE), ME, and the engineering technology programs. All of these fall under the administration of the dean who is, in turn, under the provost. The latter two have approval/veto authority. Further information about this can be found later in the "Leadership Responsibilities" portion of this subsection.

6-E.2 Establishing policy

This subsection addresses the faculty's role, and those of administrators, in defining the program's curriculum, continuous improvement process, educational objectives, and student outcomes. For all of these areas, it is the faculty that are the primary authority over all of these areas and who plan and originate curricular change proposals, but administrators have approval/veto authority relative to curriculum, specifically.

Curricular matters for the program, including prerequisite structure and the detailed course requirements comprising the program, are planned at the departmental level. The ECE departmental faculty regularly meet (weekly during the academic year), with the ECE coordinator setting the agenda. It is in this forum that the curriculum (among other business) is addressed in detail, and in which any action to change it originates; i.e., administration does not generate its own curricular change proposals. The department ordinarily operates by consensus, although a formal majority vote is, in principle, required to adopt any change; such a vote could be undertaken in the unlikely event there was not clear consensus and a decision could not be forestalled. A change so approved by the ECE faculty is then proposed to the entire School faculty, and a formal vote taken at that level, usually after discussion in a School faculty meeting (discussion may be foregone in the case of minor changes, e.g., prerequisite issues related to courses not common to the ME discipline). Upon School faculty approval, the Dean must approve, after which the proposal proceeds to a University-wide Curriculum Committee, a committee consisting primarily of faculty, but also of administration and student representatives, and in which the School is represented by a single voting faculty member. If approved at that level, it must, finally, receive approval by the Provost, usually after advisory discussion in the Provost Council (a body comprised of the Deans and Associate Provost).

The student outcomes and PEOs for the program, which are provided in Criterion 2 and Criterion 3, and the continuous improvement process outlined in Criterion 4, are defined and revised by the entire faculty of the School of Engineering & Technology (i.e., both ECE faculty and ME faculty collectively). Regular occasion is provided for this by the meetings which review the student outcome and PEO evaluation reports. Of course, external advice, such as that from the IAB, Dean, and others may at times be sought as well, but this is always at the initiative of the School faculty. The Dean and higher administrative instances (Provost, etc.) have no formal approval, veto or other role in the process concerning student outcomes and PEOs, although the atmosphere is collaborative and their input is welcomed and respected.

Thus, all the regular faculty of the entire School has some kind of a role in the program. This includes establishing its student outcomes, PEOs, continuous improvement process, and thereby the general direction of the program. By virtue of the wide involvement of faculty in the assessment process for all of the School's programs, and the similarity in the assessment process for all of the engineering programs, the entire School faculty is in a well-informed position concerning interpreting assessment results for the Computer Engineering program. Minutes of assessment meetings concerning the program student outcomes and PEOs (available for review) demonstrate that the entire faculty, regardless of academic rank or other factor, regularly attends and participates in the deliberations. They also show that ample time is taken in these deliberations such that all perspectives are thoroughly heard and considered, and consensus obtained; accordingly, formal votes are unusual.

In summary, the faculty has autonomy with regard to defining and revising student outcomes, PEOs, and continuous improvement. However, the input of other constituents regarding curriculum is an important part of the process. The former (student outcomes, PEOs, continuous improvement) is addressed by the School faculty collectively, while the latter (curriculum) is primarily planned by the Departmental faculty (with later School faculty discussion and approval).

6-E.3 Implementation of Policy

Implementation of curricular decisions, PEOs, student outcomes, and the continuous improvement process is now addressed.

Curricular decisions, once all approvals are obtained, are ultimately realized by the Registrar (in ensuring that a student completes all curricular requirements before awarding a degree) and the faculty (by virtue of their offering the courses with the intended, as-approved content, and in an effective way).

PEOs are "implemented" by virtue of their dictating a consistent set of student outcomes that support them. The student outcomes, in turn, are implemented by each of the following mechanisms:

- Alignment of the curriculum (i.e., program requirements) to the student outcomes
- Content in specific courses (e.g., to include a design project in a course)
- Sponsorship of student organizations

Regarding the curriculum piece, there must be a process to ensure consistency and quality of the courses, and their inclusion of the elements dictated by the student outcomes. That process is aided by the mutual consent of the faculty in defining the student outcomes, as discussed above. Since all faculty members have had a voice in the student outcomes (which the faculty agreed to align directly with the ABET student outcomes A-K), there is a common commitment to including the elements of the student outcomes in the courses. The process itself has two aspects:

1) Ensuring that each of the qualities specified by the student outcomes is incorporated throughout the curriculum, by identifying sets of courses, each of which supports some element of a student outcome in some way;
2) Ensuring that each course, individually, is both well-taught by the faculty member and that it adequately addresses its course objectives (which ultimately address some elements of the student outcomes, even if indirectly).

To satisfy point 1) of the process, i.e., to be sure that the student outcomes are reflected throughout the curriculum, deliberate planning of the curriculum is necessary; for the Computer Engineering program, this is largely the province of the ECE department, and deliberations on the curriculum are indeed well-represented in the minutes of that body (available for review).

As an example of PEO and student outcome implementation, notice that PEO-I calls for, among other things, an experienced graduate to "...solve problems in their professions." Clearly, solving problems as a professional requires an ability to identify, formulate, and solve problems.

Therefore student outcome E supports PEO-I as it specifically calls for "an ability to identify, formulate, and solve engineering problems." Student outcome E is then supported by various courses within the curriculum that have graded activities related to solving engineering problems. The ECE Department regularly reviews a list of courses (available for review) that should incorporate such assignments. As each course is also separately assessed, there is an opportunity to ensure that such assignments are incorporated into the course syllabus and that grade performance respective to the assignments is tracked. In summary, a process of curriculum planning, reflected most notably in the minutes of the ECE department, as well as a process of course-level assessment, is practiced to satisfy point 1).

To satisfy point 2), a further distinction is necessary between, on the one hand, quality of instruction, and, on the other, faithfulness of the course to its objectives (which will somehow, however indirectly, support the student outcomes and ultimately the PEOs).

The process of ensuring quality of instruction (typically referred to as "evaluation" at LSSU) is the province of the Dean rather than that of Chairs or other faculty. The Dean, however, does utilize faculty members' expertise as peer evaluators during the process of evaluation. The Dean evaluates the instructional performance of faculty, taking account of confidential questionnaires filled-in by students at the end of a course, by visitations to faculty lectures, and by review of samples of course materials. This evaluation is evidently prejudicial for the prospects of the faculty concerned in the annual renewal, tenure and promotion processes.

The process of ensuring faithfulness of the course to its objectives (typically referred to as "course assessment" at LSSU, as opposed to "evaluation") is, on the other hand, the province of the faculty themselves, but collectively. Thus, the practice amongst the department is that each faculty member, during the last week of classes, carries on a discussion with the students about their confidence levels in the various course objectives, adequacy of prerequisites, adequacy of course materials, and other factors relating to the course save the quality of instruction. The students also complete a questionnaire regarding the same topics. The discussion comments and questionnaires, together with grade data broken down by course objective, are then tracked for each course and serve as a basis to ensure faithfulness of the course to its objectives.

Finally, it is worthy of note that yet another factor contributes to quality in the courses (part of point 2) – namely, the many team teaching scenarios. These often pair more experienced faculty with less experienced ones in the same course, which provides for a kind of informal mentoring in teaching that ultimately also contributes to the overall quality of the courses in the program.

The continuous improvement process is implemented, primarily, through curricular change informed by the assessment process and consistent with the student outcomes and PEOs. This process, to function, requires some amount of leadership within the School and the Departments. This leadership is provided by the coordinator (at the Department level) and the Chair (at the School level), and is described in Criterion 8-A.

Criterion 7 FACILITIES

7-A Offices, Classrooms and Laboratories

The program is housed within the School of Engineering & Technology, which is located entirely in the Center for Applied Science and Engineering Technology (CASET) Building. Built in 1980, the three-story structure is home to the areas of Engineering, Engineering Technology, Mathematics, Computer Science, and Fire Science. Two additional non-academic facilities associated with Information Technology are also located in the building: Enterprise Application Services and University Support Services.

The School of Engineering & Technology has approximately 30,000 sq. ft. of usable space, which includes offices, storage areas, labs, and work areas. Details of the classrooms, laboratories, and offices follow.

7-A.1 Classrooms

The CASET building has five classrooms and one lecture room that are assigned by the Registrar's Office, with engineering, engineering technology, mathematics, computer science, and fire science courses receiving the highest priority. Room size and capacity are shown in the Table 7-1 below.

Table 7-1: University-Allocated Classrooms in CASET Building

Room	Type	Size (sq.ft.)	Capacity
CAS-119	Classroom	880	48
CAS-205	Classroom	1,010	40
CAS-207	Classroom	690	30
CAS-210	Classroom	1,100	56
CAS-211	Classroom	585	27
CAS-212	Lecture Room	1,265	76

The School of Engineering & Technology also has three dual use laboratories/classrooms for additional lecture space when needed. These are shown below in Table 7-2.

Table 7-2 Engineering-Allocated Classrooms in CASET Building

Room	Type	Size (sq.ft.)	Capacity
CAS-106A	Classroom/Lab	1,140	22
CAS-310	Classroom/Lab	1,320	30
CAS-311	Classroom/Lab	1,320	24

All classrooms are equipped with a whiteboard or chalkboard, a computer, a document camera, a projector, and a screen. The rooms are arranged in a typical fashion with desk and chairs arranged in rows. The lecture room has fixed desks and chairs arranged in a stepped fashion. Since most engineering courses have enrollments with less than 40 students, the classroom facilities within the building are adequate, and nearly all engineering classes take place in the CASET building. Elsewhere on campus, several large classrooms with capacities up to 165 students are available within a five-minute walk of the engineering facilities.

7-A.2 Laboratories

Laboratory experiences are a central component of the engineering curriculum at LSSU. Most technical courses contain labs. The chemistry and physics labs are located in Crawford Hall; the remainder of the lab facilities used in the engineering program are located in the CASET building. Table 7-3 shows a summary of the lab facilities available to all engineering and engineering technology students, with those used within the program are denoted as such.

Table 7-3: Laboratory Facilities in the School of Engineering & Technology

Room	Name	Size (sq. ft.)	Capacity	CE
CAS-105	Data Acquisition / Microscopy Lab	370	12	
CAS-106A	Materials Testing Lab	1,140	22	
CAS-106B	Engineering Design Center	1,140	30 (6 Teams)	☒
CAS-106C	Thermal Fluids Lab	900	10	
CAS-120	Machine Shop	5,180	20	
CAS-120A&B	Welding Lab &Foundry	1,760	10	
CAS-122	Plastics Molding Lab & Senior Projects Construction Area	2,240	20	☒
CAS-124	Vehicle Testing Lab & Surface Mount Assembly Lab	1,200	8	☒
CAS-125	Robotics and Automation Center	2,600	16	☒
CAS-209A&B	Computer Lab	1,100	28	☒
CAS-304	Digital Electronics Lab	1,080	14	☒
CAS-306	Analog Electronics I Lab	1,175	16	☒
CAS-309	Analog Electronics II Lab	1,175	16	☒
CAS-310	Electro-mechanical Systems Lab	1,320	30	☒
CAS-310A	Rapid Prototype Center	580	4	☒
CAS-311	Programmable Logic Controllers Lab	1,320	24	☒

The School of Engineering & Technology provides the necessary hardware and software tools required in the teaching of engineering and engineering technology students. Unlike more research-oriented institutions, LSSU labs are nearly all intended for use by the undergraduate engineering and engineering technology students for instructional purposes. All laboratory facilities are available to students during regular school hours, when they are not in use for lab instruction. Computer labs and some labs with security cameras are available for extended hours. Special access arrangements through University Security are regularly used to permit student access to labs during evening and late night hours. In general, laboratory section sizes are typically 16 students or fewer. If student enrollment in a section exceeds the suitable lab size, then multiple lab sections are provided.

7-A.2.1 Data Acquisition / Microscopy Laboratory (CAS-105)

The Data Acquisition / Microscopy lab (CAS-105) is contiguous to CAS-106A, and the two often serve together as a single large lab oriented towards various kinds of materials testing.

It includes microscopes and photographic equipment to support materials characterization, strain gauge mounting and data acquisition equipment, dynamic data collection systems (for acoustic and vibration measurement), ultrasonic and other NDT test equipment, and plastics properties testing equipment. This lab is used primarily for ME and MfgET courses. Students in the relevant courses have access to this lab from 8am-5pm but must be let in by a faculty/staff member.

7-A.2.2 Materials Testing Laboratory (CAS-106A)

The Materials Testing Lab (CAS-106A) contains equipment for tensile and compression testing, hardness testing, and fatigue testing of materials, as well as for polishing and etching in metallographic specimen preparation. Specifically, this laboratory houses a 400,000 lb. Tinius-Olsen compression/tensile testing machine, specimen mounting presses, belt sanders, microscopy polishers, and microscopes. This lab is primarily used for ME and MfgET courses. Students in the relevant courses have access to this lab from 8am-5pm but can only operate the Tinius-Olsen with faculty/staff present.

7-A.2.3 Engineering Design Center (CAS-106B)

The Engineering Design Center (CAS-106B) is a carpeted office space containing eight cubicles, each equipped with chairs, a computer, a phone, a whiteboard, and typical office desk furnishings. The room has a printer common to all cubicles, as well as a large conference table and chairs, a projector and screen for practice presentations, and a collection of supplier catalogs. All senior project teams are assigned their own cubicle where they work on their projects, keep their records, organize their information and make vendor communications (via e-mail or phone). The teams typically hold meetings, which may include the company contacts, suppliers and faculty advisors, at the conference table. This laboratory provides the Senior Project students with office space and conveys the look and feel of working in industry. All typical office supplies are provided. This lab is used exclusively for the senior Engineering Design Projects sequence EGNR-491&495. These students have 24-hour access to this lab via LSSU public safety.

7-A.2.4 Thermal Fluids Laboratory (CAS-106C)

The Thermal Fluids Lab (CAS-106C) contains equipment for examining thermodynamic principles as well as fluid flow. The main equipment are two thermal-fluid trainers with which students can explore the operation of turbines, heat exchangers, and centrifugal pumps. One of these trainers was updated by a 2017-2018 senior project team to provide more capabilities and automate the data acquisition. There is also a wind tunnel, wave tank, and refrigeration cycle trainer. This lab is primarily used for ME courses, but frequently serves as an overflow meeting room for senior project students as well, particularly since it has a large conference table and a telephone set-up for conference calls. Students in the relevant courses have access to this lab from 8am-5pm, senior project students can access this room from CAS-106B after hours.

7-A.2.5 Machine Shop (CAS-120)

The Machine Shop (CAS-120) contains a variety of manual manufacturing processing equipment (benches, hand tools, vices, drill presses, numerous lathes, mills, grinders, saws) and computer automated CNC machines (two lathes, two mills, a plasma torch). An adjacent computer lab is mainly used for CAM software (Creo) programming. The Machine Shop is also connected to various labs, a tool room, and other storage space. This lab is primarily used for ME and MfgET courses, but also provide facilities that the senior Engineering Design Projects sequence (EGNR-491 & 495) can use to fabricate components. Students have access to this lab from 8am-5pm but can only operate the equipment with faculty/staff present.

7-A.2.6 Welding Laboratory and Foundry (CAS-120A&B)

The Welding Lab (CAS-120A) contains arc welders, MIG welders, a TIG welder, Oxy-Acetylene torches, eight arc welding booths, and ten torch welding booths, all of which are well-ventilated. The Foundry (CAS-120B) includes furnaces for melting and heat treating metals, mold benches, flasks, a metal pouring bench and numerous hand tools. This lab is primarily used for ME and MfgET courses, but also provide facilities that the senior Engineering Design Projects sequence (EGNR-491 & 495) can use to fabricate components. Students have access to this lab from 9am-5pm but can only operate the equipment with faculty/staff present.

7-A.2.7 Plastics Molding Laboratory and Senior Projects Construction Area (CAS-122)

The Plastics Molding Lab and Senior Projects Construction Area (CAS-122) includes three different plastics manufacturing machines, and benches. This room is primarily used as a build area for the senior Engineering Design Projects sequence (EGNR-491 & 495), but is also used as a work area for the SAE mini baja vehicle. Students have access to this lab from 9am-5pm but can only operate the equipment with faculty/staff present. Senior project students assigned to this area are given 24-hour access via LSSU public safety.

7-A.2.8 Vehicle Testing Lab & Surface Mount Assembly Laboratory (CAS-124)

The Vehicle Testing Lab (CAS-124) contains a two-wheel vehicle chassis dynamometer. This computer-controlled dynamometer can oppose the drive wheels with up to 268 hp and allows continuous operation at up to 100 mph. The data acquisition system allows for measurements of the tire torque and rpm as well as access to vehicle CAN network used for vehicle speed-torque (or speed-power) mapping, drivetrain vibration studies, vehicle on-board sensor monitoring, simulated towing load / drawbar / hill climb studies, etc. The lab contains a comprehensive safety interlock system (CO shut down, thermal shut downs, ventilation shortfall shutdowns, etc.) along with belt vehicle restraints with chain back-up help ensure safe operation. This lab is primarily used for ME courses. For safety reasons, students only have access to this lab with faculty/staff present.

The Surface Mount Assembly Lab (CAS-124) was equipped between 2009 -2010 through a Michigan Economic Development Corporation 21st Century Jobs Fund grant. Additional funding through the Michigan Initiative for Innovation and Entrepreneurship grant in 2013 augmented the facility with the establishment of the Electronic Products Innovation Center (EPIC). The lab is outfitted with two Surface Mount Technology robotic assembly machines. APS CS40 has a component placement rate of 2100 components per hour handling parts down to EIA 0603 (0.060" by 0.030") while the APS L40 handles EIA 0201 (0.020" by 0.010") components at a rate of 4800 per hour. Both accommodate boards up to 13.5" by 22". Supporting equipment includes 2 SPR-25 stencils and GF12HC reflow oven. Other equipment includes manual hot air rework stations and fluid dispenser for adhesives and solder paste. This lab is primarily used by PDC workers.

7-A.2.9 Robotics and Automation Center (CAS-125)

The Robotics and Automation Center (CAS-125) consists of four industrial robotic lines estimated to be worth about two million dollars. In all there are 15 industrial robots (equipped with multiple end-of-arm tooling options), 2 conveyor lines with pallets, 4 rotary index tables, 1 linear conveyor system, 4 Programmable Logic Controllers (PLC's), 7 vision systems, 18 computer stations, as well as numerous sensors and pneumatic devices. Essentially there are four types of flow lines with robot systems: 1) a big rotary index table with four FANUC industrial robots with an Allen Bradley PLC and HMI, 2) an oval line that uses a Bosch Rexroth Varioflow conveyor, housing 4 Staubli robots integrated with an Allen Bradley PLC, 3) an oval line that uses a Bosch pallet transfer conveyor with 4 FANUC robots integrated with an Allen Bradley PLC and HMI, and 4) a work cell that contains 3 KUKA robots and uses a liner conveyor and a rotary table integrated with an Allen Bradley PLC and HMI. The oval line with the FANUC robots and the work cell with the KUKA robots have vision systems integrated in all of the robots and also different tool change stations and end-of-arm tooling for the robots.

During the 2016-2017 and 2017-2018 academic years, a new robotics work cell was added to the lab. This work cell consists of 3 Kuka KR5-R1400 robots with multiple end-of-arm tooling options, a rotary index table, and a linear conveyor system. In addition it has 3 Cognex 7802 vision systems along with an Allen Bradley PLC and HMI. This work cell also implements safety systems commonly found in industry including 2 Keyence light curtains and a SICK area scanner to detect when a person enters the work cell. Students can program the cell via 3 computer stations. This new system and the rest of the robotics lab will help LSSU maintain the industrial robotics niche in its undergraduate engineering and engineering technology programs.

During the 2015-2016 academic year, the robotics lab went through a major upgrade. The FANUC oval line system was fully updated except for the Bosch conveyor. The oval line system incorporates 4 M10/iA FANUC robots that run on the latest R30iB controller platform, 4 FANUC iRVision 2D Vision systems, a FANUC 3DL Vision system, a FANUC force/torque system, two robot line tracking systems, an Allen Bradley PLC controller with ethernet configuration, 4 SCHUNK robot tool changers, several robot end-of-arm tools (grippers, suction cups, etc.), 4 Dell computers, and several sensors. 10 seats of the Roboguide robotics simulation software was also purchased. The entire system (engineering, hardware, software and installation) is estimated at $750,000.

During the 2009-2010 academic year, the robotics lab also went through a major upgrade. The Staubli oval line system was newly installed. The system incorporates 4 Staubli robots that run on the latest CS8 controller platform, a new Bosch conveyor system (Varioflow system with 8 pallet location stations), 4 Cognex Vision systems, an Allen Bradley PLC5 controller with device net configuration, 4 robot tool changers, several robot end-of-arm tools, and several sensors. The entire system (engineering, hardware, software and installation) was estimated at $500,000.

The Robotics and Automation Center is utilized by all Engineering and Engineering Technology degrees. Students in the relevant courses have access to this lab from 8am-5pm but can only operate the equipment with faculty/staff present.

This lab also used extensively for demonstrations for members from business and industry, K-12 students, visiting faculty, and the community. The Robotics and Automation Center is also the key facility that serves as the home for the summer Robotics Camps and Women in Technology programs. These programs that have been offered every summer since 1991 and each year have attracted between 50 to 100 gifted and talented middle school and high school students from Michigan, Ontario, and beyond. The programs have served well to attract bright young individuals to the engineering and technology fields.

7-A.2.10 Computer Laboratory (CAS-209B&C)

The Engineering Computing Labs (CAS-209B-209C) have 33 current PC-type workstations, two common printers, full network access, and all software that is taught in the curriculum. Computers Dell Optiplex 3020 computers with Intel i5 quad-core CPU, 8GB of RAM, a Quadro P600 GPU, and network access. Specialized software installed on these computers includes Creo, MATLAB, RoboGuide, Ansys Fluent, Arduino, and Witness. This lab is the primary computing lab for engineering and engineering technology students. Students from programs outside of the School of Engineering & Technology are not granted access to this room. Students have 24-hour access to this lab via LSSU public safety, except when it is being used for instruction (even then, it is divisible into two halves by an accordion wall, and only one half is ordinarily used for courses, leaving the other half available for open student use).

7-A.2.11 Digital Electronics Laboratory (CAS-304)

The Digital Electronics lab (CAS-304) has a fixed workbench in the center of the room with five computers and space for student circuit development. Additionally, this room has eight smaller workstations located around the perimeter of the room. Available in the room are, digital multi-meters, digital trainers, logic analyzers, FPGA evaluation boards, and portable oscilloscopes are available as needed. In addition, this lab also serves as an alternate computer lab with 13 computer stations. This lab is primarily used for CE, EE, and EET courses. All engineering and engineering technology students have access to this lab from 8am-5pm, students in the relevant courses have may receive additional after-hours access as needed.

7-A.2.12 Analog Electronics I Laboratory (CAS-306)

The Analog Electronics I Lab (CAS-306) has 8 work stations. Each station contains a power supply (Agilent/HP E3620), multimeter (Keithley 2110), signal generator (Keysight 33210A), oscilloscope (Keysight DSO-X2004A), and computer with LTSpice. This lab is primarily used by the introductory electronics courses for all engineering and engineering technology degrees. All engineering and engineering technology students have access to this lab from 8am-5pm, students in the relevant courses have may receive additional after-hours access as needed.

7-A.2.13 Analog Electronics II Laboratory (CAS-309)

The Analog Electronics II Lab (CAS-309) has 7 work stations. Each station contains two power supplies (Agilent/HP E3620 and BK Precision 1665), multimeter (Fluke 8846A), signal generator (Keysight 33210A), oscilloscope (Keysight DSO-X2004A), and computer with LTSpice. There is an additional "instructor station" that contains additional equipment including a programmable power supply (BK Precision 9201), a DC electronic load (BK Precision 8600), and a power analyzer (Tektronix PA1000). This lab is primarily used by the advanced electronics courses for all engineering degrees. All engineering and engineering technology students have access to this lab from 8am-5pm, students in the relevant courses have may receive additional after-hours access as needed.

7-A.2.14 Electro-mechanical Systems Laboratory (CAS-310)

The Electro-mechanical Systems Lab (CAS-310) has 5 Hampton electrical machine trainers and accessories. These trainers include AC and DC power supplies as well as AC and DC voltage, current, and power meters. The accessories include induction machines, synchronous machines, wound-rotor machines, single-phase machines, DC machines, resistive load banks, inductive load banks, capacitive load banks, torque meters, tachometers, and power analyzers. This lab is primarily used by EE and EET courses, some of which are also available to CE students in the sustainable energy concentration. For safety students are only allowed to use the equipment when faculty/staff are present. The lab is also used as a classroom when needed as it can hold 30 students.

7-A.2.15 Rapid Prototype Center (CAS-310A)

The Rapid Prototype Center (CAS-310A) is overseen by the Product Development Center (PDC) and serves as a laboratory for both PDC projects and Senior Project teams (EGNR-491 and EGNR-495). The majority of the equipment in the lab, with the notable exception of the Stratasys Dimension RP machine, was purchased by the PDC through a Michigan Economic Development Corporation 21st Century Jobs Fund grant. The equipment purchases occurred between 2008 and 2010.

A Stratasys Dimension 3D printer was purchased in late 2015 with donations largely from the IAB. Using ABS+ plastic, the printer can produce parts up to a size of 10"x 10"x12" using Fused Deposition Modeling. The printer is used in a variety of engineering courses (notably, making sample parts for assembly mock-ups in EGNR-491 and EGNR-495), as well as for projects from industry.

A Roland MDX40, a desktop milling machine, purchased in 2009, is used for many of the same activities as the RP machine. It serves as a virtual printer to the 3D CAD software. This device can mill woods, plastics, and soft metals other than aircraft aluminum and steel. This has a serviceable area of 12x12x4 inches and has a rotary axis as well. Prototype parts requiring materials other than ABS can be made on this machine.

A 2013 Michigan Initiative for Innovation and Entrepreneurship grant provided 10 seats of EAGLE Pro Circuit board development software used for creating schematics and printed circuit board artworks for electronic projects. Two licenses are in use by PDC and 8 are located in the computer LAB 209B.

A Next Engine 3D HD Laser Scanner purchased in October, 2009 is used to scan existing parts into a cloud-of-points and from there to 3D CAD. EGNR-491 and EGNR-495, along with the PDC, make use of this machine to scan parts that have no engineering drawing so that modifications or documentation can be made.

These major tools are supplemented by Dremel grinding, drilling and polishing tools and various hand tools. Two computer stations which are set up for CAD and engineering activities are also located in the lab. This lab is primarily used by the PDC workers.

7-A.2.16 Programmable Logic Controller (PLC) Laboratory (CAS-311)

The Programmable Logic Controller Lab (CAS-311) has eight work stations around the outer edge. Each station has a computer, an HMI (Allen Bradley PanelView 600) and a PLC (Allen

Bradley ControlLogix L16) training station. There are also project machines (four "mixing stations" and four "part checkers") designed to provide students with more intense programming experiences similar to what they would encounter in industry. This lab is used primarily by EET, MfgET, and ME degrees. The lab is also used as a classroom when needed (mainly for the lecture portion of the PLC course). Students in the relevant courses have 24-hour access to this lab via LSSU public safety.

7-A.3 Other Facilities

The CASET building has 27 dedicated office spaces for use by students, faculty, support staff, and the administration. Some of these offices are used to house student engineering groups or for storage. Additionally, the Engineering House, a living-learning community for approximately 30 students, is located about 100 yards from the CASET building and the SSMart Zone building is located about 1 mile north of campus. These areas are discussed in the following sections.

7-A.3.1 School Office

The School of Engineering & Technology office suite, has four specialty office spaces that include reception, conference room, photocopy/scan equipment and supplies, and a storage room.

7-A.3.2 Faculty Offices

Faculty offices are furnished with standard equipment that includes a desk and chair, additional chairs for guests, computer, telephone, bookcase(s), and filing cabinet(s). Offices being used for storage are available to house additional faculty members should enrollment and/or programmatic growth warrant.

7-A.3.3 Conference Rooms

The School of Engineering & Technology utilizes several areas for conference rooms. These common areas are used for faculty and student meetings. Four areas, CAS-106B, CAS-126, CAS-203, and CAS-205, are routinely used for conferences. Room sizes vary and can accommodate 6-15 people at one time.

7-A.3.4 Student Club Offices

Office space has been made available to the engineering student clubs. IEEE is housed in CAS-316. ASME is housed in CAS-309A. SAE is housed in CAS-117. SWE is housed in CAS-127. The Engineering and Technology Honor society and other student groups meet in the conference rooms.

7-A.3.5 Engineering House

The Engineering House is a residence on campus in which a select group of engineering and engineering technology students inhabit. The house is adjacent to a number of other living-learning communities from different academic areas. The house costs the same as traditional dorms, but offers many advantages including larger bedrooms, a kitchen, a laundry facility, as well as common areas where students are able to congregate. The house is open to all engineering and engineering technology students, both male and female (housed on separate floors with separate bathrooms).

There is a good mix of students at different points in their academic careers (from freshmen to senior). Many of the students will be in classes together, allowing them to easily work and study together. The upperclassmen will also have taken many of the same classes, and had many of the same experiences, making them a great resource for help and advice.

In exchange for these additional amenities, the students are required to participate in a group project above and beyond their normal course work. The subject of the project is decided upon by the students themselves, but must be approved by the house advisors. While this project does require some additional work, it is an excellent opportunity to gain experience working in an engineering team.

7-A.3.6 SSMart

LSSU and SSMart, a Michigan Smartzone, have a collaborative use agreement in place that provides access to students and SSMart entrepreneurial clients of the combined equipment owned by the two entities. Specifically SSMart makes available a CNC Lathe (Haas TL-1), a150W Laser cutter/etcher, a consumer grade CUBEX Trio Fused Deposition Modeling 3D printer and high resolution OBJET 30 Pro UV Polymer technology 3D printer.

7-B Computing Resources

Lake Superior State University provides computer, network, and internet services to members of the campus community. These services are intended to assist faculty, staff, and students in the accomplishment of their University responsibilities and duties. The computing resources offered by the University adequately supplement those offered within the School of Engineering & Technology and meet the needs of the students in the program.

7-B.1 University-wide Computing Resources

The library hosts three computer labs. Each lab has 24 Dell computers. All computers are running Windows 10 Pro and have Microsoft Office 2016 installed. The standard software installation is available on all computers. A high-speed black and white LaserJet printer is available in the lab on the main floor. In addition to these labs, the library also provides access to 33 Dell computers in the general Learning Commons area, 29 of which are connected to both color and b/w laser printers. In total, the library provides access to 105 computers for student computing use during the hours listed in Table 7-4.

Table 7-4: Library Hours

Day	Hours
Monday	8am - 12am
Tuesday	8am - 12am
Wednesday	8am - 12am
Thursday	8am - 12am
Friday	8am - 7pm
Saturday	11am - 7pm
Sunday	1pm - 12am

There are 4 Dell computers connected to a black and white laser printer. These computers are running Windows 10 Pro and Office 2016 along with the standard software installation. The

Rathskellar is located in the Cisler Student Union and is open all operational hours of Cisler which vary by time of year and events, generally extending well into evening or beyond midnight as demand or events warrant.

7-B.2 Engineering Computing Resources

The primary computer labs used by engineering and engineering technology students are the Engineering Computing Labs (CAS-209B&C). Combined they have 33 current PC-type workstations, two common printers, full network access, and all software that is taught in the curriculum. The computers are Dell Optiplex 3020 computers with Intel i5 quad-core CPU, 8GB of RAM, a Quadro P600 GPU, and network access. Specialized software installed on these computers includes Creo, MATLAB, RoboGuide, Ansys Fluent, Arduino, and Witness.

In addition to the Engineering Computer Lab and the two general LSSU computer labs, there are various computer resources available to students located throughout the laboratories in the CASET building.

7-B.2.1 Engineering Design Center (CAS-106B)

The Engineering Design Center (CAS-106B) is equipped with up to eight computers (one for each senior project team). The computers placed in this room have full network access, engineering software, typically are at least Intel i7 quad-core with at least 12GB of RAM, and are served by a common printer. Students enrolled in EGNR-491 & 495 have 24-hour access to these computers.

7-B.2.2 Robotics and Automation Center (CAS125)

The Robotics and Automation Center (CAS124/125) is equipped with 14 computers. The computers have full network access, are at least Core 2 Duo with at least 2GB of RAM, and are served by a common printer. Numerous software packages and programming languages are used in the Robotics and Automation Center. The Fanuc robots are programmed in the Karel programming language and Teach Pendant language and the Staubli robots are programmed in the VAL3 language. The ladder logic programming for the Allen Bradley PLCs are programmed using the Rockwell software RSlogix. The laboratory also provides access to simulation software packages including RoboGuide and WITNESS. Students in the relevant courses have access to this lab from 8am-5pm, but may receive additional after-hours access as needed.

7-B.2.3 Digital Electronics Lab (CAS-304)

The Digital Electronics Lab (CAS-304) is equipped with 13 computers. The computers have full network access, are at least Intel i5 quad-core with at least 8GB of RAM, and are served by a common printer. Specialized software installed on these computers includes Quartus (digital synthesis), GoLogic (logic analyzer), Code Warrior, Arduino, Creo, and Matlab. All engineering and engineering technology students have access to this lab from 8am-5pm, students in the relevant courses have may receive additional after-hours access as needed.

7-B.2.4 Analog Electronics Labs (CAS-306 and CAS-309)

The Analog Electronics Labs (CAS-306 and CAS-309) are each equipped with 8 computers and a printer. The computers have full network access, and have at least an i5 quad-core with 8GB of RAM. Specialized software installed on these computers includes LTSpice, Arduino, Creo, and

Matlab. All engineering and engineering technology students have access to this lab from 8am-5pm, students in the relevant courses have may receive additional after-hours access as needed.

7-B.3 Computing Resources for Faculty

All faculty members have computers and network connections in their offices, and all faculty computers are at least at least Intel i5 dual-core with at least 4GB of RAM. The minimum software package on these computers includes Windows 7 or Windows 10, Office2010 or later and Internet Explorer, Google Chrome, or Firefox. Other software installed on the faculty computers is based on the courses that they teach.

All faculty members have full Internet access as well as Microsoft networking. There is at least one networked laser printer on each floor of the engineering building for faculty to use for printing. There are also several shared network drives for faculty to exchange information amongst themselves and with students.

Several web based packages are available for both faculty and student use:

a. Moodle is a course management system that allows faculty to supplement, or deliver wholly, the courses they are teaching. Students enrolled in courses with a Moodle component have access to support materials posted by the instructor (using syllabi and assignments), links to Web-based materials, videos, handouts, discussion boards and chat rooms, online quizzing, etc.
b. The 'my.lssu' campus portal is beneficial to staff, students and faculty. It allows for single sign-on access to email, calendar, Moodle, Anchor Access (see item c. below) and FASS (student course scheduling systems). It also offers improved e-mail, groups, chat/message boards, course studio, file sharing, targeted announcements and customizable pages. The portal is role-based, hence users have access to tools and announcements related to their role as a student or faculty member.
c. Faculty and students regularly use Anchor Access, a self-serve computer system, accessible through the 'my.lssu' portal. Anchor Access is just one part of Banner, which also handles finance, advancement, financial aid and more. Through it, students are able to view and pay bills online, print copies of their schedules and view and print transcripts. Automated Graduation Verification has been implemented to assist students and staff in confirming the courses needed to complete a program of study. This component is used in tandem with paper-based verification. Notably, it allows students and their advisors to perform a "what if" analysis to see which courses would be required to complete an alternate degree program.

7-C Guidance

LSSU takes great pride in the hands-on learning opportunities provided to its students. To ensure the safe operation of tools, equipment, computing resources, and laboratories, it is standard practice for faculty members to first discuss general safety procedures for a given laboratory in a classroom setting. These procedures are reinforced by demonstrations in the appropriate laboratory. For a particular laboratory exercise, the basics and theory surrounding a specific device or experiment is presented. Best practices for the operation of a particular device are subsequently discussed and demonstrated. Students then work under the tutelage of a faculty member or technician when operating the device for the first time, during which time they may ask questions or request a review of the procedure. A faculty member or technician remains proximate in any laboratory settings where the possibility of bodily harm exists. Once rudimentary mastery of a device has been learned, students are then able to use the equipment with faculty/staff guidance present throughout the rest of their courses. A more detailed example of guidance for a specific settings is provided below.

Example: Preparation for correctly and safely operating equipment in the Manufacturing Lab utilizes the following steps:

1) The safety procedures are covered in class, and again in lab
2) The assignment is explained and given in lab
3) The basics and theory of the experiment or assignment is covered in class (e.g. the cutting speed and rpm calculation for 1010 mild steel being cut with a high speed cutter), and then it is shown in lab as well
4) The operation of the equipment and the actual assignment is then demonstrated
5) The student is then instructed to do the assignment. If the student has any questions, they are to ask the instructor for further explanation, and if needed the procedure is covered again

Similarly, preparation to properly and safely utilize equipment in the Electrical and Computer Engineering Laboratories is summarized as follows:

7-C.1 Equipment

Use of lab equipment is described and demonstrated in the laboratory setting. The students are then required to demonstrate their proper use the equipment to a faculty/staff member. If the equipment poses a low injury risk student can then use the equipment for the remainder of their degree.

7-C.2 Software

LTSpice circuit simulation and Quartus digital design software are both demonstrated in the lab setting. The students are then required to use the software packages to solve and design different circuits using the software packages. LTSpice software is used in the analog circuits courses. Quartus is used throughout the digital course offerings.

7-C.3 Laboratories

The safety procedures are covered in class, and again in lab. In addition, the safety rules for each laboratory are posted by the entrance. An example of these rules is shown below:

- **Always** assume all circuits are energized unless you know with certainty they are not.
- If you know or suspect that an accident has occurred, take immediate steps to de-energize all affected circuits.
- **Never modify an energized circuit.** Turn off the voltage source before modifying the circuit. Use one hand to make connections and **never** work on electrical circuits with wet or moist hands.
- **Do not** work on a cluttered lab bench. It is important for safety reasons for anyone to easily trace out your test circuit.

- **Think out**, ahead of time, the consequences of closing or opening a switch. **Do not** make adjustments to energized equipment unless specified in the lab and you have thought out the consequences. In addition, the circuit should only be energized for the time it takes to perform the measurements.
- Be sure you **understand** how to properly operate the equipment before you use it.
- If you are unsure of anything or have any **questions** make sure to ask the instructor before proceeding with the experiment.
- **Never** touch moving parts of machinery, and **avoid** standing in the plane of rotation of sprockets or belts. **Do not** wear loose fitting clothing or jewelry, that could contact electrical circuits and/or moving parts of machinery.
- **Never** look directly at electrical arcs; strong ultraviolet radiation can permanently damage your eyes.
- **Never work alone**. Always have at least one other person to help in case of an emergency.

7-D Maintenance and Upgrading of Facilities

The University is committed to continually maintaining and improving the educational environment and facilities used to deliver education. Funding for facilities maintenance and improvement are contained in the University General Fund. Grants from NSF, MEDC, Perkins, and industry, along with donations have been instrumental in acquiring new and replacement equipment.

While there is no annual equipment budget, *per se*, for the School of Engineering & Technology, the laboratories are well equipped and receive adequate funding. The two main sources of revenue that support laboratory facilities via the University General Fund are the course fees and program fees that come from students taking engineering and engineering technology courses. Between the two, approximately $200k is generated per year. Equipment, software, and hardware are upgraded on an "as needed" basis, which has been sufficient.

Most courses have a course fee that depends on the cost of maintaining the equipment and software to support the course. In general, courses that have a lab component have higher course fees than those that do not. Approximately $54k was generated in course fees last year. All courses having the "EG" prefix have a differential tuition of $70 per credit hour called a program fee. The portion of program fees allocated to the School of Engineering and Technology last year was approximately $144k.

7-D.1 Recent Upgrades

Major acquisitions made within the last six years are noted below.

7-D.1.1 *Microscopy / Data Acquisition Lab (CAS-105)*

Year	Item	Quantity	Status
2018	Shore D Durometer testers	2	new
2017	Shore A Durometer testers	2	new
2017	Digital camera for microscope	1	new
2017	Acoustic foam	1	new
2017	DAQ system (sound & vibrations) with anti-aliasing filter	1	new
2017	Lab-grade accelerometer (vibrations) & power supply	1	new

7-D.1.2 *Materials Testing Lab (CAS-106A)*

Year	Item	Quantity	Status
2018	Metallography Mounting Presses	2	new

7-D.1.3 *Engineering Design Center (CAS-106B)*

Year	Item	Quantity	Status
2014	I7 Desktop Computer	7	new

7-D.1.4 *Thermal Fluids Lab (CAS-106C)*

Year	Item	Quantity	Status
2018	Thermo-trainers	1	upgrade
2017	Fin cooling efficiency test stand	1	New
2016	Fogger for wind tunnel flow visualization	1	new
2016	Material heat conduction measurement test stand	1	New
2015	Fluid jet force measurement test stand	1	New
2015	Refigeration trainer	1	Upgrade
2014	Pipe flow loss test stand	1	New
2014	Wave tank, and tanker vessel roll stability scale model experiment	1	new

7-D.1.5 *Machine Shop (CAS-120)*

Year	Item	Quantity	Status
2015	HASS CNC Lathe	1	new
2014	HASS CNC Mill	1	new

7-D.1.6 *Robotics and Automation Center (CAS-125)*

Year	Item	Quantity	Status
2012	Staubli RX60 Robot	1	new
2013	Fanuc LR Mate Robot	2	new
2013	Fanuc M1iA Robot	1	new
2013	Dell Computers	4	1 yr old
2013	Allen Bradley Panel View	1	new
2014	Roboguide Robotics Simulation software	10	new

2015	Fanuc M10iA Robot	4	new
2015	Allen Bradley PLC	1	new
2015	Fanuc 2d iRVision Systems	4	new
2016	Roboguide Robotics Simulation Software	5	new
2016	SCHUNK Robotics End-of-Arm Tooling	4	new
2016	SCHUNK Robotics Tool Change System	4	new
2016	Piab Vacuum End-of-Arm Tooling	4	new
2016	Dell Computers	2	new
2016	Fanuc 3DL iRVision System	1	new
2016	Fanuc Line Tracking System	2	new
2016	Fanuc Force/Torque Sensing System	1	new
2016	Allen Bradley Panel View	1	new
2016	Kuka KR5 R1400 Robots	2	new
2016	Banner Safety PLC	1	new
2016	SICK 2D Area Scanner	1	new
2016	Keyence Light Curtain	2	new
2017	Kuka KR5 R1400 Robots	1	new
2017	Allen Bradley PLC and HMI	1	new
2017	Cognex 7802 Vision Systems	3	new
2017	Rotary Index Table	1	new
2017	Dell Computers	3	new

7-D.1.7 Computer Lab (CAS-209B&C)

Year	Item	Quantity	Status
2015	i5 computers	30	new
2017	i5 Computers	3	new
2017	256GB SSD	33	new
2017	Nvidia Quadro P600 GPU	33	new

7-D.1.8 Digital Electronics Lab (CAS-304)

Year	Item	Quantity	Status
2013	Corobot – mobile robot	1	new
2013	Optiplex 745 – DELL PC	5	used
2013	Optiplex 780 – DELL PC	8	used
2014	Altera DE1-SoC boards	10	new
2014	Altera Cyclone V GX Starter Kit	1	new
2014	Acute TL2118E – Logic Analyzers	10	new
2015	Optiplex 3010 – DELL PC	5	used
2017	Dell Computers	13	new

7-D.1.9 Analog Electronics I Lab (CAS-306)

Year	Item	Quantity	Status
2017	Keysight DSO-X2004A oscilloscope	10	new
2017	Keithley 2110 Digital Multimeter	10	new

2017	Keysight 33210A Function Generator	10	new
2017	Dell Computers	8	new

7-D.1.10 *Analog Electronics II Lab (CAS-309)*

Year	Item	Quantity	Status
2015	Keysight DSO-X2004A oscilloscope	10	new
2017	Dell Computers	7	new
2017	Tektronix PA1000 Power Analyzer	1	new
2017	BK Precision 8600 DC Electronic Load	1	new
2018	BK Precision 9201 DC Power Supply	1	new

7-D.1.11 *Electro-mechanical Systems Lab (CAS-310)*

Year	Item	Quantity	Status
2017	3-Phase Variable Frequency Drives	2	new

7-D.1.12 *Rapid Prototype Center (CAS-310A)*

Year	Item	Quantity	Status
2013	EAGLE Pro Circuit Board Development Software	10	new
2015	Stratasys Dimension 3D Printer	1	new

7-D.1.13 *Programmable Logic Controller Laboratory (CAS-311)*

Year	Item	Quantity	Status
2013	Core 2 duo computers	1	new
2013	PLC Trainers, Desktop	10	new
2013	Panelview Trainers, Desktop	6	new
2013	Part Checkers	3	upgrade
2013	Mixing Stations	3	upgrade
2016	Additional PLC Trainers, Desktop	2	new
2016	Additional Panelview Trainers, Desktop	2	new
2016	Additional Mixing Station	1	new
2016	Additional Part Checker	1	new
2016	Additional Computer	2	used

7-E Library Services

The Kenneth J. Shouldice Library and Learning Commons provide the core research materials needed to support the academic curricula offered by the University. The Library is headed by Marc Boucher, Director of Library Services.

In the fall of 1997, a 35,000 square-foot expansion and remodeling of the existing structure to the University Library was formally opened and full resources made available for faculty and student use. The facility includes ample space for study; over 32 personal computer stations with access to specialized library resource databases and the Internet; small and large study and conference rooms; a small art gallery; the campus's center for testing, tutoring, mentoring and the Faculty Center for Teaching.

7-E.1 Collections

The collection consists of over 140,000 volumes and 850 periodical subscriptions (including both electronic and print), as well as 75,000 microforms. The library uses Ex Libris' Voyager integrated library system for physical item discovery.

7-E.2 Reference and Instructional Services

Reference service provided by professional librarians, is available every day and evening the Library is open, other than weekends. Information literacy and research instructional sessions are not only provided to University students, but local K-12 students, students from Sault Ste. Marie, Ontario, and the surrounding intermediate school district areas such as Paradise, St. Ignace, and Pickford. All research databases are accessible to the general public while on campus, and off-campus access restricted databases are provided to all campus students, faculty and staff.

7-E.3 Resource Sharing

Resource sharing has always been a prominent aspect of library operations at Lake Superior State University. A unique feature of this library is that it is open to the public (on both sides of the international border) and also offers users a joint library card that serves as both their checkout card for LSSU's library as well as all public libraries in the Eastern Upper Peninsula. Our library catalog is shared with Northern Michigan University. Users can locate materials by specific library or collectively. If patrons find materials that are not available at the campus library, library staff will locate it through Interlibrary Loan.

7-E.4 Resources, Special Facilities, and Services

Resources available to students include access to the Internet from any of the computers located in the Library; but more importantly, over 100 research databases (including Science Direct and Applied Science and Technology Full Text) which index thousands of resources, many of which provide full text access to scholarly journals. All of these research databases are available off-campus through the library's proxy server. There are many group study rooms located throughout the library and the main floor also serves as a space for group interaction through the intentional layout of comfortable furniture and accessible technology to enable group engagement. Throughout the year the library hosts several lectures that are open to the entire campus and community.

7-E.5 Reserve

The Library offers both physical and electronic reserves service for faculty to ensure availability of materials for their classes. This allows all students to access materials that are of limited availability. Faculty determine the loan period (one hour, in library use only, overnight, etc.). In most cases, materials are removed from reserve at the end of each semester.

7-E.6 Government Publications

The Library is a selective federal government depository library which means it does not receive all publications from the Government Printing Office (GPO), but select publications that are chosen in addition to those required by the GPO. Currently, the items selected represent about 16 percent of the total items available to us as a selective government depository, and are selected based on relevance to LSSU's academic programs.

7-E.7 Information Literacy Instruction

Library instruction is conducted in a variety of smart classrooms located throughout the Library. Students learn how to access and search the many electronic resources available through the library in addition to a wide variety of information literacy topics such as copyright, proper citations and intellectual property. While general instructional sessions are offered, most instruction targets access and databases that directly relate to the faculty members' special class needs. When not being used for information literacy instruction, these labs are open for general student use.

7-F Overall Comments on Facilities

The School of Engineering & Technology currently has the facilities necessary to meet its program educational objectives and student outcomes. However, the addition of the Robotics Engineering degree program will require additional facilities and equipment when students presently entering the program reach the upper-level courses.

Criterion 8 INSTITUTIONAL SUPPORT

8-A Leadership

As described in Criterion 6-E, decisions on the overall direction of the program are indeed the province of the entire faculty of the School of Engineering & Technology (SET), but the primary responsibility for detailed oversight of the program rests with the five faculty members comprising the Department of Electrical and Computer Engineering.

The School of Engineering & Technology is comprised of only ten faculty members and there are two departments (ECE and ME) and five programs (CE, EE, ME, EET, and MfgET). As a result, the curricula are intertwined and there is considerable overlap in the leadership responsibilities for the various programs. Rather than attempting a somewhat artificial distinction between the various leadership roles that affect the Computer Engineering program, the de facto duties of each the ECE coordinator and the SET chair, relative to the program, are enumerated below. It has been practice that the ECE coordinator takes on the following responsibilities:

- Lead the department in evaluating the student outcomes
- Coordinate course assessment for engineering courses specific to the program
- Ensure all students in the program are assigned an advisor from the department
- Coordinate the mentoring of new department faculty in their advising roles
- Maintain and update all degree audit forms and plans of study forms for the program
- Recommend course substitutions, course waivers, and transfer credit evaluations
- Interview all graduating seniors within the program
- Oversee the program by setting the agenda for and running departmental meetings
- Advise the department concerning curricular matters
- Prepare course or program change proposals and present them at the University level
- Represent the needs of the program at weekly "Chair" meetings (dean, chair, program coordinators)
- Plan the departmental faculty instructional assignments and load distribution
- Assist the School chair in course scheduling and assigning instructors
- Organize and coordinate hiring committees for faculty vacancies in the department
- Lead discussion relevant to the program at the Industrial Advisory Board meetings

The SET School Chair has taken on the following responsibilities:

- Coordinate the overall accreditation efforts for the programs of the School
- Coordinate evaluation of student outcomes and PEOs
- Coordinate the periodic review of the PEOs as well as school mission and goals
- Coordinate course assessment for courses common to engineering programs
- Serve as an approval authority for course substitutions and waivers, and transfer credit evaluations
- Advise all SET freshman and transfer students at orientation
- Write "program review" reports for all SET programs on a five-year cycle
- Establish and maintain transfer equivalency ("articulation") agreements with community colleges

- Lead discussion relevant to the entire School of Engineering & Technology at the Industrial Advisory Board meetings
- Set the agenda and run the meetings of the School of Engineering & Technology
- Set the agenda and run weekly "Chair" meetings (dean, school chair, program coordinators)
- Represent the School of Engineering & Technology at monthly "Deans and Chairs Leadership Group" meetings
- Facilitate scheduling of course offerings and assign instructors
- Provide leadership in School-level long-term planning
- Prepare, recommend, and administer the School budget

Collect and provide feedback regarding tenure and promotion decisions (for the School's, not the Dean's portion of this)Note, furthermore, that in contrast to what may be typical of "chair-level" positions at other institutions, duties related to faculty supervision are *not* part of either of these positions. Firstly, in accordance with concepts of academic freedom affirmed by the faculty-LSSU collective bargaining agreement (attached as Appendix N), neither of these positions involves supervision of instruction. Secondly, pursuant to that same agreement, since both positions are occupied by faculty, and as such, members themselves of the collective bargaining unit, neither position may involve responsibility for performance evaluation (besides in an advisory role as a peer evaluator) or for personnel decisions regarding other faculty.

There is a Dean position for the College of Innovation and Solutions of which SET is a part (shared with other Schools, as described in Section 8-C below). With respect to the Computer Engineering program, this position serves as a final approval authority on course scheduling (and changes to instructor, time, or room), course substitutions/waivers, and budget matters and purchases. The Dean also serves as an approval stage for curricular proposals (new courses, course changes, program changes, etc.) prior to submission to the University-wide Curriculum Committee and thence the Provost's office for final approval. The Dean is also the formal supervisor for all faculty and staff within the SET, carrying out performance evaluations, and serving as an approval stage for hiring decisions recommended by Search committees.

The position of Associate Dean for the College of Innovation and Solutions was put in place for the 2017-18 academic year. This action was taken recognizing the additional duties of the Dean in serving as interim Provost and VP of Academic Affairs. The Associate Dean performed several functions that affected the program such as participation in school meetings, course scheduling, course substitutions/waivers, budget matters and purchases, and curricular proposals. The Dean, by virtue of his role as interim Provost, retained final approval for many of these actions. The position of Associate Dean will be discontinued July 1, 2018 as the newly hired Provost/VPAA begins his duties. Please see Appendix D for changes related to this new structure.

8-B Program Budget and Financial Support

The Chair of SET prepares budgets related to the school and submits them to the Dean. The Dean reviews the budgets from the schools within the College of Innovation and Solutions and in turn submits a budget for the college to the Provost/VP of Academic Affairs for approval. Ultimately the combined Academic Affairs budget is submitted to the VP of Finance.

The Vice President of Finance receives department/school budget requests (one of which is for the SET) and prepares the overall General Fund Budget and Auxiliary Budget summaries. Recommendations are taken to the Senior Management Team for review and finalization prior to presentation to the Board of Trustees for approval.

Recurring LSSU funding for the School of Engineering & Technology, broken down by source, is shown in Table 8-1.

Table 8-1: Summary of SET Funding, Recent Years

Allocations	2014-15	2015-16	2016-17	2017-18
Base Operation	$33,984	$33,984	$33,984	$33,984
Carry Over	$27,332	$89,017	$90,253	$131,390
Course Fees	$47,970	$57,180	$60,255	$54,345
Program Fees	$134,191	$152,216	$154,980	$143,640
Total Allocation	$243,477	$332,396	$339,359	$363,359

The program receives funding from three University sources (base operation allocations, course fees, and program fees), represented by rows in the table. When bona-fide plans for expenditure are articulated to the CFO, funds not utilized in the previous academic year are carried over to the next year; that amount is also shown as a row.

CSSM funds are LSSU allocated funds for the basic operation of the unit. These basic operations would include paper, phones, office supplies, copying, travel, small office related equipment, and other similar items.

Students enrolled in Engineering or Engineering Technology courses also pay course fees and program fees, which the SET receives. The course fees vary from course to course but range from $10-$100, with a median of $60 (for those courses that have *some* course fee); these are set for each course considering the extent of that course's usage of laboratory equipment and expendables, large-volume printing (handouts), and/or renewable license software. The program fee is $70 per credit hour for courses beginning with an EGxx prefix. The School can adjust course fees yearly. Program fees and course fees are adjusted in consultation with the Provost, and require Board of Trustee approval.

As is evident from Table 8-1, the Base Operation component has been stable from year-to-year. On the other hand, course and program fees received are subject to change based upon enrollment.

As noted earlier, all degree programs are closely related, sharing all resources. Funding is not partitioned by program, but the School Chair and Program Coordinators work closely with the Dean to review the needs for each program and make appropriate allocations and purchases.

In addition, not shown in Table 8-1, but consistent enough to regard as "recurring," LSSU is annually eligible to receive a Perkins Voc-Ed Grant. Most years, SET receives $10K; every fourth year, however, SET receives $30K.

Regarding non-recurring, or irregularly recurring, sources of income, there have been equipment sell-offs and donations. Over the last several years, a few thousand dollars have been raised by selling retired equipment on e-bay. Several pieces of donated equipment have been utilized in our labs, including robots for instance.

Occasional targeted donations have been received. For instance, a $10k donation in 2013 donation paid for new PLC trainers. As another example, a fundraising campaign by the IAB in 2015 paid for a 3D printer. In addition, through a collaboration with the Smartzone, SET houses and has access to both a Haas TL-1 CNC Lathe and an Objet 30 Pro high resolution 3D printer.

8-B.1 Teaching Support

Teaching is supported by the occasional use of student assistants, and by the availability of teaching workshops, both on-campus and nationally.

Student class assistants are used, occasionally, in some workshop and computer lab courses. Their roles have included assisting students during the labs with accomplishing the lab work (EGNR-101, EGME-141, EGNR-140, EGEE-125), or in recitation/additional help hours (EGNR-265). These would be students who had previously taken the course, and done well enough to satisfy the current instructor.

More exceptionally, two student "graders" were provided in the Spring 2016 offering of the lecture course EGME-275 Engineering Materials, which had a large enrollment (38 initially), to check/"pre-grade" homework (give comments and tentative scores to worked problems for the instructor's review). This may serve as a precedent henceforth, and the Dean had verbally-stated that it would be dependent upon enrollment numbers in courses. To some extent, the student workers in EGNR-140 have also reviewed and commented on homework.

Teaching workshops exist on campus, via the title-III grant-initiated "Faculty Center for Teaching"; three current SET faculty members have presented at these workshops but the full extent of participation by SET faculty connected with the program has not been monitored. There are usually teaching-related workshops during the development week preceding the Fall semester; as classes are not yet underway at that time, attendance is relatively straightforward for most faculty members.

External workshops are also supported. Jaskirat Sodhi (2014) (no longer with LSSU) and Zakaria Mahmud (2015) each attended the NETI (National Effective Teaching Institute) workshop sponsored by ASEE. Andrew Jones attended (2013) "Enhancing Student Success through a Model 'Introduction to Engineering' Course", Carson, CA. David Leach (2016) attended an ABET IDEAL (Institute for the Development of Excellence in Assessment Leadership) workshop. David Baumann and Robert Hildebrand (2013) attended a one-day ABET workshop (Program Assessment Workshop). David Leach (2016) and Jordan Huff (2017) attended a NIMS (National Institute of Metalworking Skills) CNC training and welding certification. David Leach and Joe Moening will be attending the basic NETI workshop in the summer of 2018 while Zakaria Mahmud will attend the advanced NETI workshop. Masoud Zarepoor is attending an engineering education workshop at Bucknell in the summer of 2018.

Finally, in indirect support of teaching, the University maintains a variety of student services, including counseling, library, placement, admissions, registrar, a learning center (instructing academic success strategies), and tutoring.

8-B.2 Infrastructure Support

Both course and program fees are used for major equipment purchases, computers, lab supplies, equipment maintenance, software, and other related items. Table 8-2 provides a summary of the expenses categories denoting how funds have been spent for the last few years.

Table 8-2: Expense categories and spending

AccountNumber	AccountDescription	Actual 2014	Actual 2015	Actual 2016	Actual 2017	YTD 2018
7001	Supplies-Office	4,198.41	3,622.33	1,134.21	3,022.28	3,328.12
7002	Reference Books	238.99	905.31	624.81	586.29	-
7003	Central Stores	1,958.00	1,700.00	2,200.00	1,184.25	1,433.00
7004	Supplies-Lab	22,427.06	21,372.44	18,254.11	21,058.71	12,507.32
7005	Supplies-Aud Visual	1,190.25	428.46	14.95	2.00	-
7006	Supplies-Photo-Print	-	-	-	-	-
7010	Awards-Plaques	395.61	493.09	374.45	347.94	789.80
7015	Supplies-LSSU Name-Logo Items	334.56	1,290.79	558.00	2,881.87	1,498.70
7020	Supplies-Other	5,295.99	16,490.33	5,495.88	19,635.19	31,490.73
7030	Copies	13,448.32	10,913.56	14,878.96	8,792.28	7,709.80
7031	Printing	1,399.99	1,134.52	3,056.32	2,026.82	2,155.98
7032	Photographic Service	-	-	-	61.60	-
7040	Postage	180.79	1,355.92	1,144.19	199.60	64.47
7050	Telephone	4,291.85	5,204.88	4,894.54	4,680.00	3,900.00
7055	Fax	-	-	-	-	-
7060	Software	-	57.90	5,000.00	204.16	3,120.00
7061	Software Licenses and Maintenance	19,217.45	15,076.84	5,238.00	11,195.00	17,321.95
7065	Computer Hardware	3,953.03	3,392.87	13,237.42	164.84	3,863.88
7070	Equipment <2500	21,040.30	12,034.77	26,497.60	23,588.26	22,883.23
7101	Travel in State	6,356.25	3,883.37	5,911.77	4,323.16	5,671.60
7102	Travel out of State	5,833.01	10,891.48	8,750.95	13,633.78	5,382.37
7103	Travel Students	53.00	-		828.05	8,844.57
7110	Meetings-Luncheons	5,128.36	4,864.81	10,776.89	7,988.62	12,082.72
7111	Guest Lodging-Meals	14.73	-	100.70	775.28	137.80
7112	Conferences	2,710.00	5,168.87	3,270.00	2,359.50	3,240.00
7130	Recruitment--Employee	-	-	-	235.05	-
7131	Recruitment--Student	302.88	244.19	1,473.30	1,062.06	52.76
7210	Rental-Media	-	-	-	-	200.00
7211	Rental-Equipment	-	-	1,300.00	3,738.60	4,338.41
7225	Rental-Other	-	-	2,536.50	-	-
7230	Product Development Center Services	-	-	-	-	-
7252	Honorariums	-	-	-	75.00	53.85
7253	Contracted Services	-	200.00	45,000.00	-	-
7261	Equipment Mtnce and Repair	4,078.26	550.00	-	10,831.00	3,984.94
7271	Legal	-	-	-	-	-
7272	Accreditation	-	-	-	348.06	-
7290	Linen Service	-	292.50	292.50	-	265.50
7320	License-Permits-Fees	-	-	539.50	6,748.00	-
7340	Memberships	2,923.00	2,671.00	3,041.04	5,843.44	4,995.00
7341	Subscriptions-Magazines	-	-	-	-	-
7345	Advertising	-	77.55	-	-	309.00
7365	Professional Development	619.47	1,928.50	5,447.00	5,873.36	550.00
7395	Miscellaneous	92.08	-	-	42.29	90.69
7520	Haz Material Dispose	-	-	1,406.58	957.27	-
7960	Capitalized Equipment Purch	55,900.00	22,470.90	41,990.08	42,787.72	39,876.59
Grand Total		**183,581.64**	**148,717.18**	**234,440.25**	**208,081.33**	**202,142.78**

8-B.3 Resource Adequacy for Teaching and Infrastructure

The budget has also allowed the School of Engineering & Technology to sufficiently meet the teaching needs of the program. Although teaching assistants or graders are rarely used, funding has been adequate for the occasional instances in which they were necessary.

The budget has also allowed the School of Engineering & Technology to sufficiently meet the equipment needs of the program. Although no comprehensive five or ten year equipment replacement plan exists, the ECE department has created an equipment need prioritization list within the last few years where present and future needs are included to help with planning. This document contains budgetary information (e.g. how many devices are needed and at what cost) as well as a ranking of the priority as high, medium, or low. Funding has been adequate for critical and necessary upgrades as well as needed maintenance activities.

8-C Staffing

The staffing of the School of Engineering & Technology is described in the following, in terms of compensated positions (full or part time; salaried, release-time, or stipend assignments); evidently, as is typical in academia, much additional work is also available in the form of service activities by faculty members. All of the positions described have some responsibility, to varying degrees, for the program (as well as other programs).

8-C.1 Clerical Staff

Throughout most of the last 6-year cycle, support staff (for the School of Engineering Technology) has included 1-1/2 full-time positions, i.e., a full-time Academic Assistant, and a half-time administrative assistant. However, the half-time position discontinued as of June 2016.

The Academic Assistant provides clerical support to the faculty and Dean, manages day-to-day activities in the School's office, processes purchase requisitions and manages faculty cardholder accounts, organizes special events (e.g., annual School banquet), provides coordination support for Summer programs (camps for high-school-age and younger), and pursues various other duties as well.

The half-time administrative assistant position had provided assistance for marketing and recruitment, implementation of Engineering admissions policies, and maintenance of assessment and accreditation records. These various duties have been shifted to the full-time Academic Assistant and the chair with some duties discontinued at the SET level (e.g. marketing moving to the university marketing personnel) or discontinued entirely.

Furthermore, there has continuously been a part-time student assistant in place to help the Academic Assistant, including during the summertime.

8-C.2 Administrative Staff

8-C.2.1 Dean

The School was administered by a Dean (see Criterion 8-A above for the Dean's role) whose responsibilities has been divided with the Lukenda School of Business under the auspices of a combined college. Beginning July 1 (the date of this report), a reorganization will place the SET together with both School of Mathematics and Computer Science and the Lukenda School of

Business within the College of Innovation and Solutions under a solitary Dean. The current Chair of the School of Mathematics and Computer Science will assume the role of Dean for the College; whether the Dean will continue to also maintain Chair duties for the School of Mathematics and Computer Science is yet to be finalized.

8-C.2.2 Chair

The Chair (see Criterion 8-A above for his/her role) is a 3-release load hour (1/4-time) appointment, plus the equivalent of 3 load hours converted to a stipend each for the fall and spring semesters (in the 2012 self-study, these were 3 actual load hours), and a $2,000 Summer stipend. That has been consistent during the entire 6-year cycle, except for the Summer stipend, which has varied from $1,000 in summer of 2012 to $2,000 currently, with Summer 2017 having been calculated at 2 load hours (slightly less than $2,000).

8-C.2.3 Coordinators

During some early portions of the 6-year cycle, Coordinators (see Criterion 8-A above for their respective roles) received 2 release hours (out of 12 for full time) per semester, i.e., these were 1/6 time assignments. During the majority of the cycle the ME coordinators received 2 release hours per semester resulting in 1/6 time assignment and the ECE coordinator (as well as the Engineering Technology coordinator) received 1 release hour (1/12-time). Note that the release time for the ECE coordinator has been reduced from the 2 release hours mentioned in the previous self-study report from 2012.

8-C.2.4 Director of Robotics

There is a 3-release hour (1/4-time) assignment for running the Robotics laboratory of the SET. Note that courses such as EGRS-215, EGRS-381, EGRS-385, EGRS-430, EGRS-435, and EGRS-481 make extensive use of this laboratory. The director develops the robotics laboratory through industrial donations and grants, and plays key leadership roles nationally in the Society of Manufacturing Engineers and the Robotics Industry Association.

8-C.3 Academic Staff

8-C.3.1 Instructional Staff

The ten full-time faculty positions (all tenured or tenure-track) have already been detailed in Criterion 6.

In addition, some usage is made of adjunct faculty. In particular, the two Laboratory Engineers frequently act in this capacity, and the courses they typically instruct (or co-instruct) courses including the lab components of EGET-110 *Applied Electricity*, EGEE-210 *Circuit Analysis*, EGME-110 *Manufacturing Processes*, and EGET-175 *Applied Electronics*, and occasionally both the lecture and lab components of EGRS-365 *PLC's*. More directly related to the program is their role as project advisor in the capstone EGNR-491-495 sequence.

The PDC (Product Development Center) of the larger College also employs a full-time Engineer, and has employed two during the early portion of the 6-year cycle; these have sometimes served as adjuncts for EGNR-491-495 sequence course topics and team advising, EGEE-370 *Electronic Devices*, EGME-141 *Solid Modeling*, EGNR-245 *Calculus Applications for Technology*, and EGET-310 *Electronic Manufacturing Processes*.

8-C.3.2 Technical Staff

Two-full time Laboratory Engineers are assigned to the School of Engineering & Technology. An Electrical/Computer Laboratory Engineer is responsible for the maintenance and operation of all electrical and computer equipment in the laboratories. A Mechanical Laboratory Engineer is similarly responsible for the maintenance and operation of all mechanical equipment in the laboratories. Both Laboratory Engineers design and manufacture equipment for use by faculty in the laboratory and/or the classroom. These positions are full-time, twelve month appointments.

8-C.4 Resource Adequacy for Clerical, Administrative, and Academic Staffing

The School of Engineering and Technology has had sufficient clerical staffing to meet the critical needs of the program. The loss of the half-time administrative assistant in 2016, however, has resulted in some diversion of teaching, administrative, and marketing resources away from the day-to-day needs of the academic programs.

Similarly, budgetary allocations are sufficient to meet the *immediate* administrative staffing needs of the program, but may not be sufficient to ensure the long-term sustainability and/or growth of the program. Although the School chair receives 25% release time supplemented plus the equivalent of 3 load hours converted to a stipend each for the fall and spring semesters and the equivalent of 2 load hours in stipend for the summer, that position encompasses administrative leadership for all 6 programs in the School; furthermore the release time for the ECE departmental coordinator (and the engineering technology program coordinator) has been reduced within the last 6 year cycle from 2 load hours per semester to 1 load hour per semester such that the amount of release time is not high enough to reflect the amount of time needed to fulfill the responsibilities of the position..

The School of Engineering and Technology currently has sufficient instructional and technical staffing to meet the needs of the program, provided the ten positions remain filled. Currently there is a search to replace the ECE faculty member last taught in the spring of 2017 (although the effective retirement date was December 2017). At the completion of that search the ten regular faculty members, supplemented by the aforementioned adjunct instructors, are able to deliver all the courses that are required to support the program. Furthermore, the two full-time laboratory engineers have the resources to maintain all equipment and facilities used by the program.

8-D Faculty Hiring and Retention

8-D.1 Faculty Hiring Process

The reader is referred to Appendix N, the contract between the faculty and the University, wherein its Appendix B (Appendix B of the Faculty Agreement within Appendix N of this document) provides a detailed description of the procedure for formation and conduct of a faculty hiring committee. This is a University-wide procedure to which the School adheres (in fact, this procedure for the whole University was modelled after our longer-standing practices in the School of Engineering & Technology), but it does not address some of the specific additional practices that have developed for, and the philosophy for the conduct of, searches in within the School of Engineering & Technology. There is one search in progress conducted to replace a retired ECE faculty member. There have been six searches for ME/MfgET faculty during the previous six years.

Consistent with the institution's primary mission of teaching, and the School's philosophy of maintaining an applied emphasis in its engineering and technology programs, the evaluation process employed in the hiring of new faculty accordingly places a greater emphasis on a candidate's promise as an instructor and on industrial experience than it does on academic research credentials (although the latter *is* also a factor of lesser weight). A faculty candidate is generally expected to have some teaching experience (either as faculty member or a teaching assistant) and to possess excellent communication skills.

After initial screening of CVs, the search committee typically extends invitations for phone interviews to up to a dozen candidates. These are contacted by a committee member, by phone, at which time, as a matter of transparency, the salary (presently about $65,000-$70,000 for these openings, which is considered low on the market) is related, as well as something of the geographical and climatological features of the region (rural and wintery), and the nature of the position (heavy teaching loads with little research emphasis). One or more of these factors may cause some of the candidates to withdraw at this point, saving them and the committee needless time expenditure. The remaining phone interview candidates then speak with the entire committee on the telephone for about 20 minutes to half-an-hour, at which time the search committee questions them on teaching interests, inclinations to teach laboratories, capstone projects, etc. Up to 3 of those candidates, whichever are most promising (if enough are), are then selected for campus visits.

During the campus visit, candidates give a sample lecture (on a topic specified by the hiring committee chair and generally kept the same for all visiting candidates); this lecture is ordinarily given to both students and faculty (including those not participating in the search committee). Feedback is thereafter solicited from the students and faculty in attendance, and is given much weight in the subsequent hiring decision. Besides the guest lecture, consideration is also given to the candidate's performance in an informal research (or professional) presentation, to collegiality as observed at interactions throughout the day, including meals and one-on-one interviews (including with HR, the Provost, and sometimes the President, who convey their respective feedback), and to feedback from the candidates' references. However, it remains the guest lecture that most often proves decisive.

Historically (and into the early phases of the 6-year cycle), the search committee would select the best candidate, and also rank the other candidates in case of an offer being declined (as happens fairly frequently). The Dean and Provost then had formal authority to negotiate and hire, but tended to support the committee decisions. More recently, the search committees have been discouraged from selecting and ranking, in favor of merely indicating "qualified" or "not qualified."

8-D.2 Faculty Retention

Retention of qualified faculty is partially a matter of correct selection in the search and hiring process, i.e., by identifying a "good fit" faculty hire for the SET. The optimal faculty hire, given the relatively high instructional load, should be committed to instruction, rather than exclusively to research, as well as adaptable to the geographical and climatological particulars of Michigan's Eastern Upper Peninsula (i.e., relative remoteness in a wintery setting). Moreover, while such a person may well be a subject matter expert, the willingness to function as a generalist, and with bonafide laboratory and project skills, is ideal. Given these attributes, a faculty member is likely to find a degree of satisfaction in the work that is conducive to retention.

A School-specific PD fund (beyond that of the University), to bolster faculty retention, has also been available during the 6-year cycle, and still continues in a more restricted form. In 2012, subsequent to the EAC of ABET visit which had cited the various engineering programs for issues of faculty retention, the SET committed to provide a fund for workshops/conferences, summer stipends for scholarly endeavors, and other PD activities. Accordingly, for a portion of the cycle, these funds have been available for the purposes described, and may be allocated to Engineering Technology-related PD just as well as to Engineering-related. In the last three years, however, stipends have been discontinued, so that the fund is now limited to travel reimbursement and materials/equipment.

Retention has not been an issue for the ECE Department, having retained all faculty members over the past six years aside from the one retirement. However, it has been an issue for the ME Department, which has hired and lost six (one due to retirement) faculty members in the past six years, and has impacted the ECE faculty workload somewhat.

8-E Support of Faculty Professional Development

The "Agreement" (Appendix N) between Lake Superior State University and the Faculty Association provides each faculty member with $1000 per academic year for professional development; at the beginning of the 6-year cycle (through 2013), this level was at $800, so it has undergone a $200 annual increase during the cycle. A faculty member's professional development fund can carry over from academic year to academic year, but not to exceed $4,000 (unchanged). Expenditures from professional development funds must be related to the faculty member's professional development or teaching objectives. In addition, faculty members, who are officers of professional organizations or presenters at national conferences, have received additional support to travel to workshops and conferences from departmental and/or Dean's budgets.

Note also the additional SET PD fund described in Criterion 8-D. For a couple of years during the 6-year cycle, this provided stipends for scholarly work, as well as travel and materials reimbursement. Although the stipends have been discontinued, the funding continues to exist for travel and materials.

The "Agreement" between Lake Superior State University and the Faculty Association also provides a total of up to three semesters of sabbatical leave at full pay per academic year (it had been four, through 2013). A tenured faculty member is eligible for a Sabbatical Leave after five (5) academic years of employment as a faculty member at the University, so long as s/he has not had a Sabbatical Leave within the previous five (5) years. A Sabbatical Leave Committee comprised of two Deans, appointed by the Provost, and six faculty members elected by the faculty consider the applications for sabbatical leave and make recommendations to the Provost. No engineering faculty member has been awarded a sabbatical during the last 6-year cycle. The last sabbatical award to an engineering faculty member was a full-time sabbatical for the 2011-2012 academic year, that being just prior to this 6-year cycle.

PROGRAM CRITERIA

The EAC of ABET program criteria for Computer Engineering programs state that:

A. The structure of the curriculum must provide both breadth and depth across the range of engineering topics implied by the title of the program.
B. The curriculum must include probability and statistics, including applications appropriate to the program name; mathematics through differential and integral calculus; sciences (defined as biological, chemical, or physical science); and engineering topics (including computer science) necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components.
C. [The curriculum] must include advanced mathematics, typically including differential equations, linear algebra, complex variables, and discrete mathematics.

The LSSU Computer Engineering program meets all of these criteria. This has already been demonstrated in previous sections of the self-study report. This section will provide the appropriate references to those other sections.

Program Criteria (A)

That the Computer Engineering curriculum provides breadth and depth across the range of computer engineering topics may be seen in Criterion 5-A.4 *Prerequisite Structure*, particularly in Figure 5-1: *Prerequisite Structure for the Computer Engineering Curriculum*, and in Criterion 5-A.5 *Depth in Subject Areas*.

Program Criteria (B)

That the Computer Engineering curriculum includes probability and statistics, including applications appropriate to the program name may be seen in Criterion 5-A.5 *Depth in Subject Areas*, particularly in Table 5-6: *Mathematics & Basic Sciences Component of Curriculum* (probability and statistics) and Figure 5-2: *Mathematics Component as Related to Subsequent Courses* (application of probability and statistics).

That the Computer Engineering curriculum includes mathematics through differential and integral calculus may be seen in Criterion 5-A.5 *Depth in Subject Areas*, particularly in Table 5-6: *Mathematics & Basic Sciences Component of Curriculum*.

That the Computer Engineering curriculum includes sciences may be seen in Criterion 5-A.5 *Depth in Subject Areas*, particularly in Table 5-6: *Mathematics & Basic Sciences Component of Curriculum*.

That the Computer Engineering curriculum includes engineering topics necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components may be seen in Criterion 5-A.5 *Depth in Subject Areas*, particularly in Table 5-7: *Engineering Core Component of Curriculum* and *Table 5-8: Engineering Topics in the Curriculum*, and in Criterion 5-A.6 *Major Design Experience*.

Program Criteria (C)

That the Computer Engineering program includes discrete mathematics topics may be seen in Criterion 5-A.5 *Depth in Subject Areas*, particularly in *Table 5-9: Advanced Mathematics in Engineering Core Curriculum.*

APPENDICES

The remainder of the document contains the following appendices:

Appendix A	Course Syllabi
Appendix B	Faculty Vitae
Appendix C	Equipment
Appendix D	Institutional Summary
Appendix E	University Organizational Chart
Appendix F	Policy for Substitutions and Waivers
Appendix G	Student Outcome Evaluation Reports
Appendix H	Senior Exit Survey Results
Appendix I	Syllabi for Sample Courses
Appendix J	Course Assessment Summaries for Sample Courses
Appendix K	Pre-Requisite Forms for Sample Courses
Appendix L	Plans-of-Study
Appendix M	Degree Audits
Appendix N	Faculty Association Contract

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**School of Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**Degree Audit Form – BS-CE (F2018)** **Plan of Study Form – BS-CE (F2018)** **Flowchart of CE Courses (New Draft Plan of Study)**
This documentation is relevant to Question number:	**15**
Briefly summarize the content of the file and its value as evidence supporting program review:	**These documents describe the program curriculum and advising tools for it.**

School of Engineering and Technology

BS Degree in Computer Engineering

(For Students Entering in the 2018-2019 Academic Year)

Student Name: ____ Advisor Approval: ____ Date: ____

Student ID: ____ ECE Coordinator Approval: ____ Date: ____

Intended Month of Graduation: ____ SET Chair Approval: ____ Date: ____

All information below should be from the student's most recent transcript and/or transfer evaluation.

GENERAL EDUCATION REQUIREMENTS

Communication (6 credits required)

ENGL110 - 3 ____

ENGL111 - 3 ____

Humanities (6 credits; different disciplines; see catalog)

Elective ____ - __ ____

Elective ____ - __ ____

Social Science (6 credits; different disciplines; see catalog)

Elective ____ - __ ____

Elective ____ - __ ____

Computational Literacy [Mathematics] (3 credits)

(fulfilled by departmental requirements)

Natural Sciences (7 credits)

(fulfilled by departmental requirements)

Diversity (3 credits; see catalog)

Elective ____ - __ ____

Communication Skills (3 credits)

COMM101, 201, or 225 COMM____ -__ ____

☐ **GEN-ED Requirements met by MTA or MACRAO**

Students must satisfy all of the following minimum requirements for graduation:

- ☐ 2.0 overall GPA
- ☐ 2.0 General Education GPA
- ☐ 2.0 departmental GPA
- ☐ 124 total credits (minimum)
- ☐ 32 credits from Mathematics (including EGNR340) and Natural Science
- ☐ 30 credits earned at LSSU
- ☐ 24 credits 300/400 level in major earned at LSSU

DEPARTMENT REQUIREMENTS

Complete the Computer Engineering Core (85 credits required)

CHEM115 - 5 ____

CSCI105 - 3 ____
(C or better required)

CSCI121 - 4 ____
(C or better required)

CSCI201 - 4
or ____
CSCI221 - 3

[1]CSCI341 - 4 ____

EGEE125 - 4 ____
(C or better required)

EGEE210 - 4 ____
(C or better required)

EGEE250 - 4 ____

EGEE280 - 4 ____
(C or better required)

[1]EGEE320 - 4 ____

[1]EGEE355 - 4 ____

EGEE370 - 4 ____

[1]EGEE425 - 3 ____

EGNR101 - 2 ____

EGNR140 - 2 ____

EGNR340 - 1 ____

EGNR346 - 1 ____

MATH151 - 4 ____
(C or better required)

MATH152 - 4 ____
(C or better required)

MATH251 - 4 ____

MATH308 - 3 ____

MATH310 - 3 ____

PHYS231 - 4 ____
(C or better required)

PHYS232 - 4 ____

Complete One of the Senior Year Experiences (6-13 credits required)

Industrial Project

EGNR491 - 3 ____

EGNR495 - 3 ____

Cooperative Project

EGNR250 - 2 ____

EGNR450 - 4 ____

EGNR451 - 3 ____

EGNR491 - 3 ____

Research Project

EGNR260 - 2 ____

EGNR460 - 4 ____

EGNR461 - 2 ____

Complete Technical Electives (13 minimum credits required)

Technical Elective** ____ - ____ ____

Robotics & Automation Concentration

Complete all of the following:

EGRS385 - 4 ____*

EGRS430 - 4 ____*

EGRS435 - 3 ____*

General Technical Electives

** ____ - __ ____

** ____ - __ ____

** ____ - __ ____

** ____ - __ ____

Sustainable Energy Concentration

Complete all of the following:

EGNR261 - 3 ____*

[1]EGNR361 - 1 ____*

And any two of the four below:

[1]EGEE330 - 4 ____*

[1]EGEE411 - 3 ____*

EGEE475 - 4 ____*

[1]EGNR362 - 3 ____*

* (C or better is required for all courses within a concentration)

** CSCI281 or higher, EGEE310 or higher, EGME275 or higher, EGEM220, EGET310, EGRS365, EGRS460 or higher, MATH215 or higher, or any course from the concentrations.

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[1] Theses courses may be offered only every other year

School of Engineering and Technology

BS Degree in Computer Engineering

(For Students Entering the Program in the 2018-2019 Academic Year)

Freshman Year – Fall Semester

CHEM-115 General Chemistry (4,3)	5
CSCI-105 Introduction to Computer Programming (2,2)	3
EGNR-101 Introduction to Engineering (1,2)	2
ENGL-110 First-Year Composition I (3,0)	3
MATH-151 Calculus I (4,0)	4
	17

Freshman Year – Spring Semester

CSCI-121 Principles of Programming (4,0)	4
EGEE-125 Digital Fundamentals (3,2)	4
EGNR-140 Linear Algebra and Num Methods for Engineers (1,3)	2
ENGL-111 First-Year Composition II (3,0)	3
MATH-152 Calculus II (4,0)	4
	17

Sophomore Year – Fall Semester

CSCI-2xx Computer Science Core Elective	4
EGEE-250 Microcontroller Fundamentals (3,2)	4
MATH-251 Calculus III (4,0)	4
PHYS-231 Applied Physics for Engineers and Scientists I (3,2)	4
	16

Sophomore Year – Spring Semester

EGEE-210 Circuit Analysis (3,2)	4
MATH-310 Differential Equations (3,0)	3
PHYS-232 Applied Physics for Engineers and Scientists II (3,2)	4
Communication Elective (3,0)	3
Social Science Elective (3,0)	3
	17

Junior Year – Fall Semester

†CSCI-341 Discrete Structures for Computer Science (4,0)	4
EGEE-280 Introduction to Signal Processing (4,0)	4
EGEE-370 Electronic Devices (3,3)	4
EGNR-340 Advanced Numerical Apps for Engineers (0,2)	1
Concentration/Technical Elective / Engineering Option	3
	16

Junior Year – Spring Semester

†EGEE-355 Microcontroller Systems (3,3)	4
Concentration/Technical Elective / Engineering Option	4
Humanities Elective (3 or 4 cr)	4
Social Science Elective (3,0)	3
	15

Senior Year – Fall Semester

†EGEE-320 Digital Design (3,3)	4
EGNR-491 Engineering Design Project I (2,3)	3
EGNR-346 Probability and Statistics Lab for Engineers (0,2)	1
MATH-308 Probability and Mathematical Statistics (3,0)	3
Concentration/Technical Elective / Engineering Option	4
	15

Senior Year – Spring Semester

†EGEE-425 Digital Signal Processing (2,2)	3
EGNR-495 Engineering Design Project II (1,6)	3
Concentration/Technical Elective / Engineering Option	3
Cultural Diversity Elective (3,0)	3
Humanities Elective (3,0)	3
	15

Total Credits: 128

Computer Science Core Elective Courses

CSCI-201 Data Structures and Algorithms (4,0) 4 (*Fall*) CSCI-221 Computer Networks (2,2) 3 (*Spring*)

General Technical Electives (14 cr)

CSCI-281 or higher
EGEE-310 or higher
EGEM-220
EGME-275 or higher
EGET-310
EGRS-460 or higher
MATH-215 or higher
Any course from concentrations

Renewable Energy Concentration (14 cr)

EGNR-261 Energy Systems (3,0)
†EGNR-361 Energy Systems Lab (0,3)
†*EGEE-330 Electro-Mechanical systems (3,2)
†*EGEE-411 Power Distribution & Trans (3,0)
*EGEE-475 Power Electronics (3,3)
†*EGNR-362 Vehicle Energy Systems (2,3)
*= must take two of the four
General Technical Elective

Robotics & Automation Concentration (14 cr)

EGRS-385 Robotics Engineering (3,3)
EGRS-430 Sys Integration and Machine Vision (3,3)
EGRS-435 Automated Manufacturing Systems (2,3)
General Technical Elective

†=course offered only every other year

Computer Engineering

Core Courses

See reverse side for details about the available degree concentrations.

Course
Semester [Credit]

Pre / Co-requisite

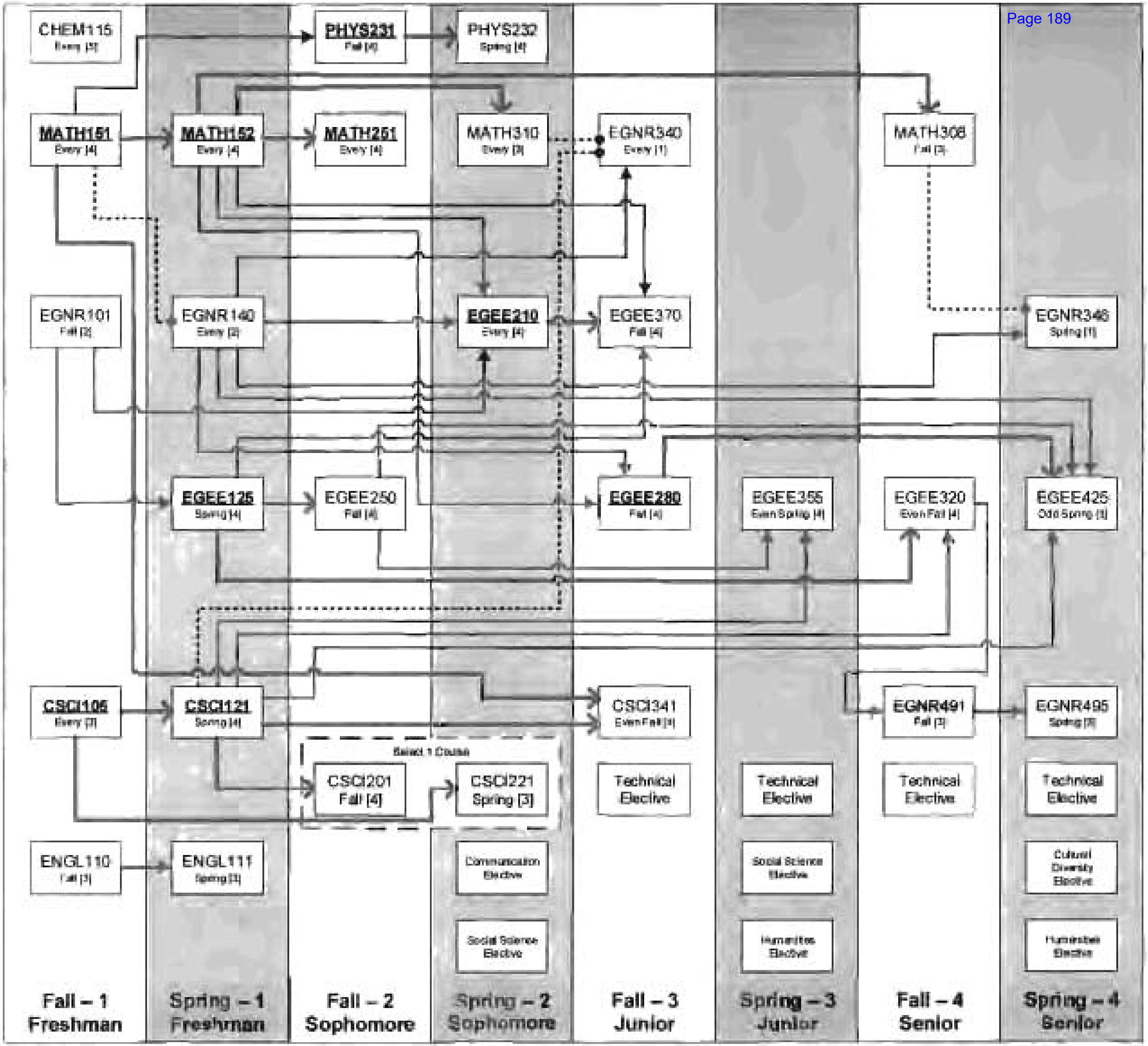
Pre-requisite
(D- or better required)

Pre-requisite
(C or better required)

Courses that are bolded and underlined, such as **EGEE210**, require a grade of C or better to graduate.

This chart assumes you have the required prerequisites or tested into MATH151 Calculus.

Revised 13NOV18



Computer Engineering

Core Courses

Course
Semester [Credit]

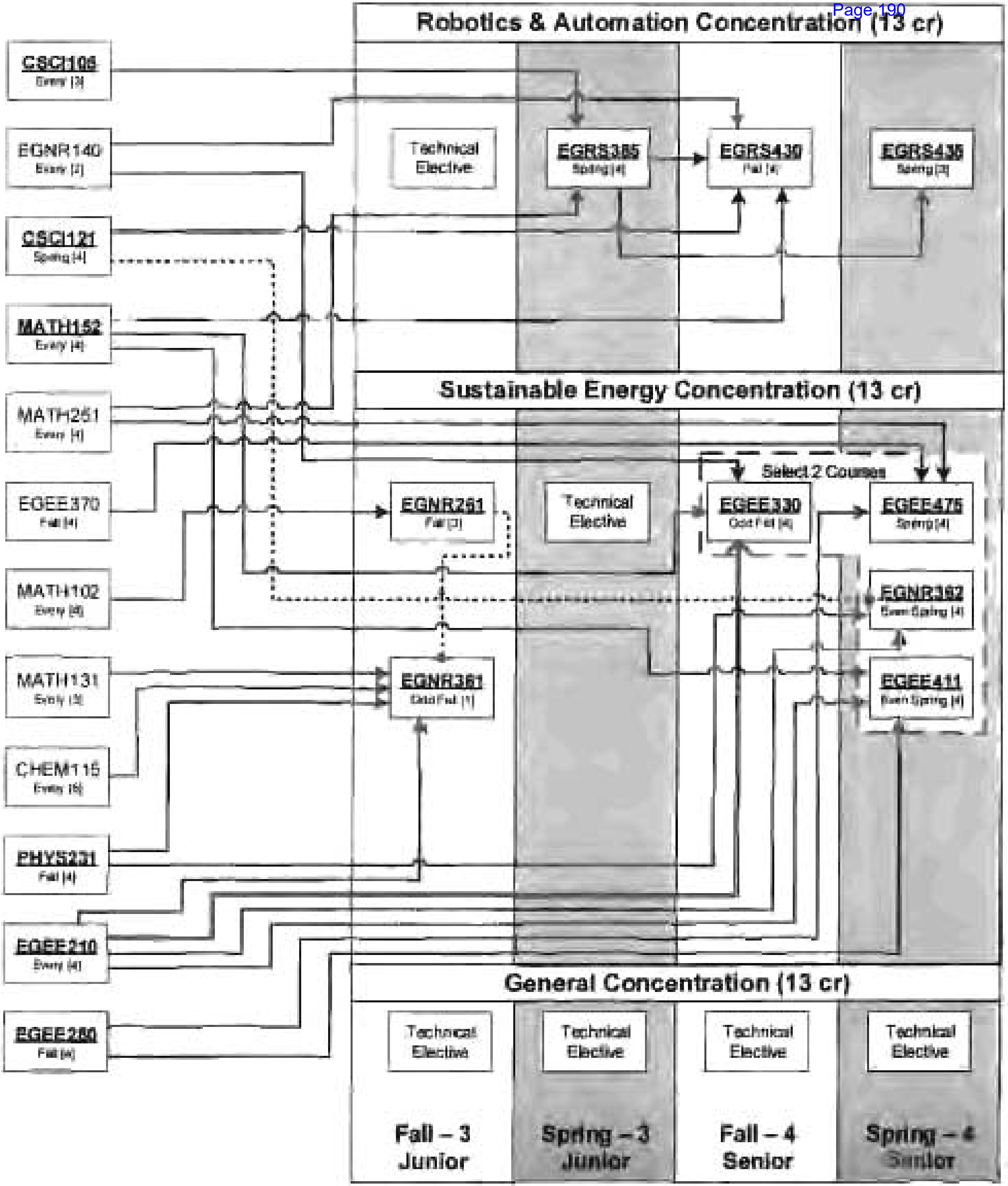
Pre / Co-requisite

Pre-requisite
(D- or better required)

Pre-requisite
(C or better required)

Courses that are bolded and underlined, such as **EGEE210**, require a grade of C or better to graduate.

Technical Elective List
- CSCI281 or higher
- EGEE310 or higher
- EGEM220
- EGME275 or higher
- EGET310
- EGRS365
- EGRS460 or higher
- MATH215 or higher
- Any course from concentrations



Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering and Technology**
Document Title (if attached) or Filename (if emailed):	**Senior Project Posters**
This documentation is relevant to Question number:	**16**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Provides example(s) of projects involving students in this major.**

LAKE SUPERIOR
STATE UNIVERSITY

2017-18
Steering Column Effort Test

nexteer AUTOMOTIVE

SEA

SUPERIOR ENGINEERING AND AUTOMATION

Project Statement

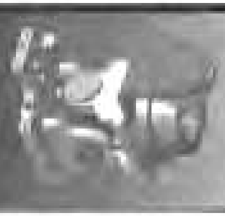
Create a semiautomatic alignment process using a robot with vision capabilities on a steering column and collect minimal telescoping effort data.

Project Objectives

- More accurate data
- Faster data acquisition
- Faster overall process

Project Motivation

- Improve Nexteer's process for better testing results
- Reduce non-operation time in the validation stage for higher volume of part testing
- Availability of data to present to OEMs



SEA Compliance Device

Design Objectives

- Use Fanuc 3DL sensor to align tool frame of robot to column axis
- Utilize mechanical device to reduce radial loading
- Use visual basic code in conjunction with LabView to display live data (Force vs Distance)
- Minimize axial force distribution data
- Reduce cycle time to under 16 seconds

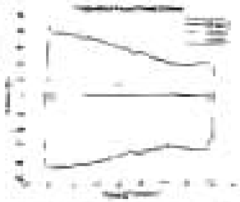
Team Members

[redacted]

Faculty Advisor:
Dr. Masoud Zarepoor

Industrial Customers:
Tim Bennett, Fred Berg, Dave Prior, Scott White

DAQ Raw Data



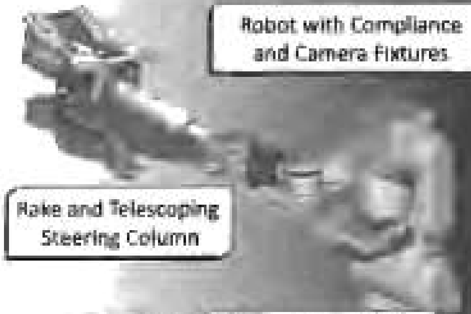
DAQ Analyzed Data

Sault Machine Works

smart vision lights

Customer Bio

Nexteer Automotive is a leader in the automotive industry with a multibillion dollar steering and driveline business delivering electric and hydraulic steering systems, steering and driveline components, automated driving, etc. to OEMs around the world. Nexteer has over 13,000 employees in over 50 countries. Their customers include Ford, GM, BMW and others.



Robot with Compliance and Camera Fixtures

Rake and Telescoping Steering Column

SEA Compliance and Camera Fixtures

Special Thanks

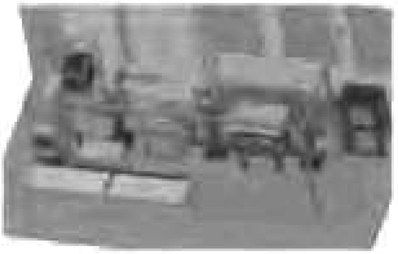
- Fanuc
- Sault Machine Works
- SmartVision
- LSSU PDC
- LSSU Faculty

Learn More Here

Project Summary

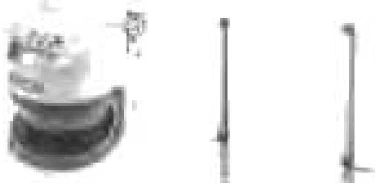
Team KUKA Roboline Upgrade (KRU) has implemented a third KUKA robot to the pre-existing two robot KUKA workcell in LSSU's Robotics Lab. In addition to updating the workcell's controls, vision, and safety systems, Team KRU installed a rotary index table used to transport work pieces between two robots, a worktable, and end-of-arm tooling for the third robot. Team KRU also updated all documentation for the workcell and created two new lab exercises. Finally, a synchronized robotics motion project and a robotic deburring project were completed to demonstrate the capabilities of this workcell.

The KUKA Robotics Workcell



The fully completed robotics workcell now contains:

- 3 KUKA KR5 R1400 robots
- A rotary index table and a linear conveyor system
- Multiple end-of-arm tooling for the each robot
- Automatic tool-change capability
- Ethernet/IP communications
- 3 Cognex vision systems
- Allen Bradley PLC (Programmable Logic Controller) with HMI (Human Machine Interface)
- 3 new computer stations
- Safety system with a SICK area scanner and 2 Keyence light curtains (shown below)



K.R.U.

KUKA ROBOLINE UPGRADE

Senior Projects 2017-2018

Faculty Advisor
Jim Devaprasad

Team KUKA Roboline Upgrade
[redacted]

Industrial Contacts
[illegible]
[illegible]

Vision System

Team KRU installed a Cognex 7802 vision system for each of the three robots. The vision system includes several advanced capabilities such as autofocus, integrated lighting and on-board processing. An image of the camera can be seen below.

Project Benefits

The main project benefits are:

1) Addition of a new robotics platform to LSSU's Robotics Lab
2) Future LSSU engineering students can get lab experience on KUKA robots and Cognex vision software
3) New project demonstrations created to highlight LSSU Robotics capabilities to visitors
4) New platform for future senior and research projects
5) Experience for Team KRU members on robotics system integration

Synchronized Robotic Motion

Team KRU developed a piano demonstration using Autodesk's Maya software in conjunction with the Mimic software plugin and KUKA's EntertainTech software. Maya is a 3D computer animation software that uses time-based programming and has been used extensively in the production of films and video games. The Mimic plugin allows for time based animation of KUKA Robots. Mimic then exports data as a program file which can be executed using KUKA's EntertainTech software package. These technologies allowed the three robots to play two pianos in sync. An image of the robots playing the pianos is shown below.

Robotic Deburring

Team KRU developed a demonstration that simulates the deburring process of marine boat propellers. The process utilizes a deburring tool manufactured by ATI. The RoboTeam software package was used to traverse the complicated geometry of the propeller blades. RoboTeam has many features including program and motion synchronization, collision avoidance and operation of multiple robots from a single SmartPAD. An image of the robots performing the deburring sequence can be seen below.

Project Made Possible By:

KUKA
SCHUNK
LAKE SUPERIOR STATE UNIVERSITY
COGNEX
TEXTRON AVIATION

CORNING

AUTOMATION OF A PARTICULATE FILTER REPAIR STATION

2017-2018 Senior Projects

LAKE SUPERIOR
STATE UNIVERSITY

Project Contributors

SMC

FASTENAL

Industrial Customer

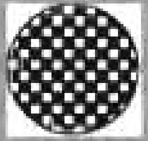
The industrial customer (IC) for this project is Corning Incorporated. Headquartered in Corning, New York and founded in 1851 they are responsible for some of the most advanced glass technologies. Boasting 107 locations in 24 countries they are truly a global company. Special thanks to Gail Dyer (LSSU Alumna) for her guidance on this project.

Project Benefits

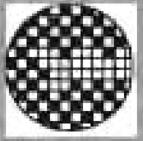
- Tested feasibility of automating the current manual process
- A small but safe work cell near high traffic areas
- More precise, consistent process achieved through use of automation
- Improved cycle times
- Learning experience for students

Project Statement

Team Automated Repair Cell (ARC) was charged by Corning to create an automated robotic cell which integrates machine vision with a collaborative robot. The project automated a previously manual process at Corning of repairing ceramic diesel particulate filters. The vision system identified the imperfections in the filters and a custom built end of arm tool (EOAT) performed repairs on the filters. The EOAT punched out unwanted caps and filled in unwanted holes repairing the filter matrix which restored the perfect checkerboard pattern of holes and caps in the filter.



Perfect Filter



Filter missing caps

Filter missing holes

What is a Collaborative Robot?

Standard industrial robots require additional safety equipment such as light curtains, fencing, and area scanners in order to follow industry standard guidelines. Corning has provided the team with a FANUC Collaborative Robot that features contact stop capabilities. The FANUC CR-7ia/L robot automatically stops when unexpected contact is made. This allows the robot to be used without additional safety equipment while still following industry safety standards.

Team Members

[redacted]

ARC
Automated Repair Cell

Faculty Advisor:
Eric Becks

Industrial Customer
Gail Dyer

Project Outcomes

Custom end of arm tooling was developed for the robot to complete both types of repair operations on the filter. The work cell utilizes an extremely high resolution camera to detect errors in the filter and validate proper repair of the filter. An Allen Bradley Programmable Logic Controller (PLC) was used to manage communications within the work cell.

Light Inspection System

(2017-2018)

AUTOMOTIVE LIGHTING AND VISION SYSTEMS

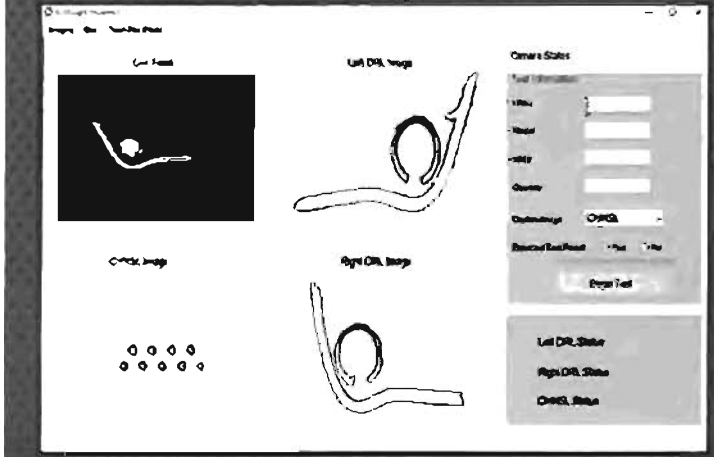
Project Statement

Team Automotive Lighting and Vision Systems (ALVS) was responsible for researching and developing a machine vision system to automate the inspection of light elements during automotive assembly. The project includes a high resolution machine vision camera, mobile test cart, light assembly stands, and a graphical user interface.

Graphical User Interface

The main focus in developing the user interface was to create a simple, user-friendly environment to interact with the hardware and vision software. The team designed a graphical user interface (GUI), and implemented the vision system software functionality directly into the code. With this interface, plant operators can set up configurations for new vehicle models and conduct tests on both the front headlight assemblies, and the rear center high-mount stop light while viewing all of them on the same basic screen. The program stores all of the information from each test and exports it into an external data file. Failed test results can be viewed easily within the interface via the error log tab in the toolbar. This feature will help manufacturers swiftly locate vehicles with faulty components in the assembly line.

GUI Layout



Team Members

[redacted]

Industrial Contact
Mark Compton

Faculty Advisor
David Leach

LAKE SUPERIOR
STATE UNIVERSITY

Check us out
on YouTube!

Esys Automation is an engineering and manufacturing systems integration firm located in Auburn Hills, Michigan. The company specializes in turnkey solutions that serve the automotive and manufacturing industries.

Project Result

The Team researched and tested several potential vision techniques and methods prior to creating the algorithm that determines whether the lights are functioning properly. The end product is a fully adjustable vision system that can be easily adapted for use in different environments with different car models.

Setup and System Design

Fixtures were designed to be fully adjustable to accommodate a diverse range of testing scenarios. The team created fixtures to hold the light assemblies as well as the camera and laptop. The camera fixture was made to be mobile so it can move relative to the three light positions.

Test Equipment

Automation Controls

Senior Projects: 2016-2017

Project Statement

Along with team Conveying Automation Solutions (CAS), team Automation Controls Engineering (ACE) created an educational KUKA robotic platform for students at Lake Superior State University. The new robotic platform allows students to familiarize themselves with KUKA systems and also train students how to correctly follow safety standards used in industry today.

This project features two KUKA [illegible] robots. These robots offer new capabilities such as synchronous robot movement. The cell includes a linear slide that allows the robots to hand items between each other. The cell also features safety equipment including light curtains and an area scanner. These features are new to LSSU's robotics lab and offer a unique learning experience for students. This project helps keep LSSU's robotics lab current with technology used in industry today.

The Cell

PLC (Programmable Logic Controller)
Team ACE is using an Allen-Bradley CompactLogix PLC and also a Banner safety controller. The PLC is responsible for all inputs and outputs while the safety controller is responsible for the safety aspects of the cell.

HMI
For the HMI, an Allen-Bradley PanelView Plus [illegible] with 12.1 inch touch screen capabilities is utilized.

Servo Drive/Motor
The cell features an Allen-Bradley Kinetix 350 servo controller. This controls the movement of the conveyor.

Sensors
Primary sensors in the cell are for end-of-arm tooling identification and gripper sensors. A limit switch at each end of the conveyor will limit the distance the conveyor can travel.

I/O Switch Boxes
The switch boxes utilize eight basic toggle switches and eight LED lights for educational purposes.

Faculty Advisor
Jeff Kay
Electrical/Computer
Laboratory Engineer

Automation Controls Engineering Team
[redacted]

Industrial Customer
Eric Becks
Engineering Projects Manager/Director

Please scan the QR code to learn more about this project

Project Made Possible By:

SCHUNK LAKE SUPERIOR STATE UNIVERSITY Parker COGNEX KUKA JR AUTOMATION TECHNOLOGIES LLC

KUKA Robot Features

The KUKA robots have a reach of about 1.4 meters. The robots are placed in such a way that their work envelopes slightly overlap. This allows the robots to interact with each other when utilizing RoboTeam. The [illegible] have a maximum payload of [illegible]. The three largest joints on the robot, axis 1-3, have a maximum speed of [illegible]°/s while the three smaller joints at the end of the arm, axis 4-6, have a maximum speed of over [illegible]°/s. The robot is very precise with a pose repeatability of [illegible].

Key Robot Features:

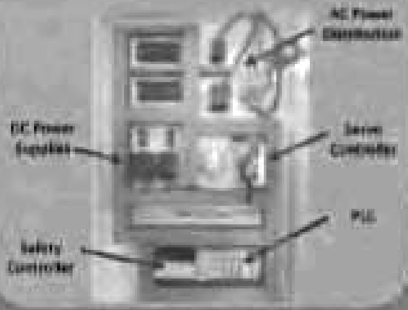
- KUKA SmartPAD
- KR C4 small-size controller
- Robot collaboration software – RoboTeam
- Cognex [illegible]

Electrical

The cell needs various hardware that requires both power and communication wiring. Team ACE developed the power distribution and communication required for the cell.

Junction Boxes
Junction boxes are used for cleanly routing signals to the PLC. This allows the PLC to monitor and control signals within the cell.

PLC Cabinet
The PLC is installed in the main cabinet. The cabinet houses all main power distribution, network communications, and control systems.



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Controls and Vision Systems
Engineering Senior Project 2016-2017

Project Description: *Pharm-Assist*

The *Pharm-Assist* project is an automated prescription dispensing machine designed to assist pharmacy employees and increase the time they are available for customer service. Team CVS was tasked with Phase 2 of the *Pharm-Assist* project, where the main goal was to reduce the cost of the workcell. Building off the previous team's proof of concept workcell, team CVS designed and built a 3D gantry system which replaced the FANUC delta robot that was used in the previous iteration. Along with replacing the robot, team CVS converted a majority of the control of the system from PLC (Programmable Logic Controller) to Raspberry Pi (mini-computer). The main focus of Phase 2 was to build and test a rigid gantry design that would be reliable and fast (30 pills per minute). Other areas of focus for the project included reducing noise and vibration from the previous year's design, improving the security of the cell, and converting the power of the cell from 240 Volts to 110 Volts.

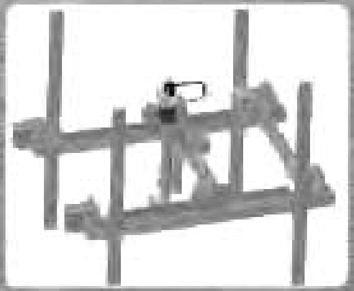
Team Controls and Vision Systems:

[redacted]

Dr. Joseph Moening (Faculty Advisor)

Gantry Design:

The team chose a "Core XY" design for the gantry system, as seen pictured below. This design allows the motors that drive the X & Y movement of the gantry to be stationary and mounted on the frame rather than having to move with the carriage. This reduces the weight that the motors need to move and therefore increases the maximum speed at which the XY plane of the gantry can move.



Company Background:

4D Systems, LLC. sponsored Phase 1 and Phase 2 of this senior project. 4D Systems is an automation integration company that automates production processes for their clients, as well as providing software and software services to the engineering community. This company is located in Flint Township, Michigan and has been open since 2011. Mr. Jean Pierre Rasaiah is the president and founder of the company. Mr. Rasaiah and Mr. Brett Newill, both alumni of Lake Superior State University, were the industrial contact for the project.

Project Benefits:

With the completion of Phase 2 of this project, many people will benefit. The team members of team CVS will benefit from working with 4D Systems and completing their senior project. This will allow them to gain valuable real world engineering experiences. 4D Systems will benefit by having a prototype which they can expand upon and eventually market to pharmacies and nursing homes. The users of the workcell will benefit by being able to spend more time with the customers, increasing customer service.

Project Outcomes:

- Designed, built, and tested rugged 3D gantry system
- Speed of pill dispensing: 30 pills per minute
- System delivers correct prescriptions 95% of the time
    - Accomplished by detecting if a pill is dropped from the End of arm tooling (suction cup)
- Total cost of project was under $10,000
- Improved security from previous iteration
    - Accomplished by the use of electronic locks and a fingerprint scanner
- The cell produces less than 65dB of noise (slightly louder than office conversation)
- Vibrations were reduced 25% from the previous iteration

WHEEL
INSPECTION
SYSTEMS

Rim Quality Inspection via Vision
Senior Project 2016-17

LAKE SUPERIOR
STATE UNIVERSITY

Sponsored By:

ESYS

Industrial Contact:
Mark Compton

Wheel Inspection Systems:

Team Members:

[redacted]

Faculty Advisor:
David McDonald

Project Statement:

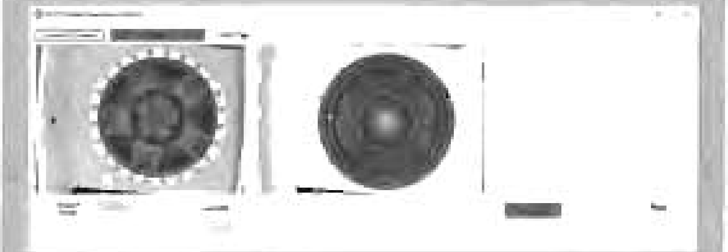
Team Wheel Inspection Systems (WIS) was tasked with researching and developing a system to automate the inspection of automotive rims using an industrial grade camera and machine vision software.

Company Background:

Esys Automation is a robotics integration company located in Auburn Hills, Michigan. The company was established in 1999, and it specializes in turnkey automation for the automotive industry.

GUI Interface:

The picture below shows the user interface of the vision system. Here, users can set up and run tests on automotive rims. The user can acquire an image of the rim via a camera, run a live feed from the camera, load a previous test image, reference an ideal image, and run the vision algorithm. The GUI will display the results of the test.

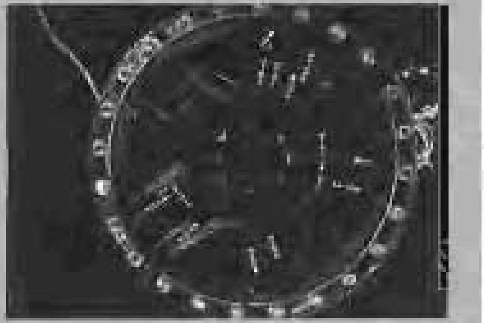


System Design:

The pictures to the right show Team WIS's shroud. The shroud is a chamber designed to block outside light and to scatter light inside the shroud. High-intensity bar lights, a high resolution camera, and a rim are mounted in the shroud. This system allows for a controlled testing area of vision algorithms on automotive rims.

Project Result:

The team researched the effect of different lighting positions and intensities on the surface of the rims. Based on the research, the team was able to create an algorithm using a visions system that could inspect automotive rims.



LAKE SUPERIOR
STATE UNIVERSITY

PART 2: Degree-Level Review

Degree Program: B.S. Electrical Engineering

Explain how the program works to address each of the following questions. For each question, respond with a narrative and supporting evidence.

Assessment (CC 4.B and CC 4.C)

13. Provide evidence that the degree-level program outcomes are clearly stated and are effectively assessed, including the "use of results." Attach the 4-Column Program Assessment Report.

All program outcomes are publicly posted at: https://www.lssu.edu/school-of-engineering-and-technology/accreditation-outcome-reporting/

Refer to Sections 3 (Student Outcomes) and 4 (Continuous Improvement) of the Electrical Engineering ABET Self-Study Report. Also, refer to the 4-column report from Summer 2018.

14. Explain how results from degree assessments were used to improve the degree program. Include specific examples.

Refer to Section 4 (Continuous Improvement) of the Electrical Engineering ABET Self-Study Report.

Quality, Resources and Support (CC 3.A)

15. Explain how the program ensures that degree program-level and course-level learning outcomes are at an appropriate level. Attach evidence, including a degree audit for the program.

Program-level outcomes are Student Outcomes A-K specified by ABET. Refer to Sections 3 (Student Outcomes) and 5 (Curriculum) of the Electrical Engineering ABET Self-Study Report. A degree audit is also attached.

The Lumina Foundation's Degree Qualification Profile (DQP) is suggested as a resource for answering the questions about what students should know and be able to do at each degree level:
http://de greeprofile.org/wp-content/uploads/2017/03/DQP-grid-download-reference-points-FINAL.pdf

Intellectual Inquiry (CC 3.B).

16. **Explain what the program does to engage students in collecting, analyzing, and communicating information; mastering modes of inquiry or creative work; developing skills integral to the degree program. Attach examples of undergraduate research, projects, and creative work.**

    Refer to 5-A.6 (Major Design Experience) of the Computer Engineering ABET Self-Study Report; this section is written such that it is applicable to all SET bachelor's degrees. Binders with the Senior Project work can be found in the CAS203 cabinets in the 2nd cabinet from the right on the north wall.

LAKE SUPERIOR
STATE UNIVERSITY

Academic Program Review

Appendix Cover Sheet

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**School of Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**ABET EE Report - Final**
This documentation is relevant to Question number:	**EE-related reports (multiple questions)**
Briefly summarize the content of the file and its value as evidence supporting program review:	**This file contains the self-study report for the ABET ETAC Fall 2018 visit, including a variety of information that is useful for the assessment of the EE program.**

ABET

Self-Study Report

for the

Bachelor of Science in Electrical Engineering

at

Lake Superior State University

Sault Sainte Marie, Michigan

June 30, 2018

CONFIDENTIAL

TABLE OF CONTENTS

Criterion 0 BACKGROUND INFORMATION

0-A Contact Information

Andrew Jones, PhD
Associate Professor and ECE Program Coordinator
Lake Superior State University
650 W. Easterday Ave.
Sault Ste Marie, MI 49783
+1 (906)635-2138, FAX (906)635-6663
ajones@lssu.edu

0-B Program History

The Bachelor of Science in Electrical Engineering is administered by the Department of Electrical and Computer Engineering, which is part of the School of Engineering & Technology. A brief historical background of the University, the School, and the Electrical Engineering program follows.

0-B.1 Lake Superior State University

To address the needs of returning World War II veterans and to provide opportunities to the people of the Eastern Upper Peninsula of Michigan, Lake Superior State University was originally founded as a branch of Michigan Technology University (MTU) in 1946. The campus gained autonomy from MTU in 1969 and was renamed Lake Superior State College. University status was granted in 1987 and the institution was finally named Lake Superior State University (LSSU).

LSSU is the smallest 4-year public institution of higher learning in the state of Michigan. LSSU grants Bachelor of Science and Bachelor of Arts degrees in forty-nine areas, and Associate degrees in twenty-four areas. The enrollment as of fall 2017 was approximately 2,100 students (head count; ~1,900 full-time equivalent), of which about 88% were from the state of Michigan and about 7% were from the province of Ontario. The number of full-time faculty in the 2017-2018 academic year was 97. LSSU is accredited by the Higher Learning Commission of the North Central Association of Colleges and Schools.

0-B.2 School of Engineering & Technology

After gaining autonomy from MTU in 1969, three Bachelor of Science degrees in Engineering Technology were eventually introduced. The Mechanical Engineering Technology (MET) program was introduced in 1977, the Electrical Engineering Technology (EET) program was introduced in 1981, and Manufacturing Engineering Technology (MfgET) program was introduced in 1987. The EET and MET programs received continuous TAC of ABET accreditation until their discontinuation in 1999.

In 1994, the engineering technology faculty and constituents (alumni, employers of graduates, Industrial Advisory Board, and area educators) reviewed the three engineering technology programs and reached the decision to discontinue the EET and MET degrees in favor of Electrical Engineering (EE) and Mechanical Engineering (ME) degrees. The decision was based on better serving a larger audience of Michigan's industry and public and on input from alumni. In 2000, a Computer Engineering (CE) degree was added.

The LSSU School of Engineering & Technology now offers Bachelor of Science degrees in Computer Engineering, Electrical Engineering, Mechanical Engineering, Electrical Engineering Technology, and Manufacturing Engineering Technology. The School of Engineering & Technology has developed a reputation for high quality graduates and for its ability to provide an excellent undergraduate education in the area of robotics. In that respect, the School will be offering a new Bachelor of Science degree in Robotics Engineering starting fall 2018 which was formally approved this summer.

0-B.3 Electrical Engineering Program

A plan to convert the EET degree program to an EE degree program was created in 1995 and implementation of the plan began in 1996. Beginning with the 1996 academic year, no EET freshmen were admitted and only EE freshmen were admitted. In subsequent years (sophomore, junior, senior), new engineering curriculum was put into place as the EET curriculum was phased out. By 1999, the completed EE degree program was in place, and the first graduates of the new EE degree program occurred in the 2000 academic year. During the conversion process, the Department of Electrical and Computer Engineering was formed.

Initial accreditation of the Electrical Engineering program occurred in 2000. ABET conducted a site visit in Fall 2000, which resulted in accreditation of the Electrical Engineering program through September 30, 2003, and a request for an interim report in Fall 2002. The Fall 2002 interim report resulted in accreditation of the Electrical Engineering program through September 30, 2007. Subsequently reaccreditation was awarded in 2007, and most recently 2013, effective until September 30, 2019.

Major revisions to the Electrical Engineering program since the last site visit in Fall 2012 include the following.

1. Removed the vehicle systems concentration due to low enrollment and to allow the creation of a new concentration.
2. Created a Sustainable Energy concentration, replacing the vehicle systems concentration. This was mentioned in the previous self-study report as it was developed before the last visit, but was not approved until after the visit. This required the creation of the following courses:
    a. EGNR-261 Energy Systems and Sustainability
    b. EGNR-361 Energy Systems and Sustainability Lab
    c. EGNR-362 Vehicle Energy Systems (modification from an existing course)
    d. EGEE-411 Power Distribution and Transmission
3. Deleted a course EGEE-375 Electronic circuits which was in the EE core. This course covered transistor circuit design including discrete transistor amplifiers and integrated circuit amplifiers such as opamps.
4. Created a new course EGEE-475 Power Electronics which replaced EGEE-375 in the EE core. This course covers power electronics including rectifiers, DC-DC converters, and inverters.
5. Extended the length of the laboratory from 2 hours to 3 hours for EGEE-210 *Circuit Analysis* in order to provide more troubleshooting opportunities for the students.

6. Removed EGRS-461 Design of Control Systems from the core to enable students to take a free technical elective, offering more student choice and flexibility.
7. Retirement of faculty member Prof. David McDonald (Summer 2017)
8. Removed, Spring 2013, EGEE280 lab and increased lecture hours from 3 to 4 (3 hours lab and 3 hours lecture became 4 hours lecture, weekly).
9. Increased, Spring 2013, credit count in EGNR450 from 2 credits to 4 credits and in EGNR451 from 2 to 3 credits (these courses appear in the Cooperative Project alternative of the Senior Sequence block).
10. Replaced the four "program outcome objectives" (employability, societal awareness, professionalism, and fundamental technical skills), as described in the 2012 self-study, with the eleven Student Outcomes A – K, exactly corresponding to the ABET student outcomes.
11. Split, Spring 2014, the third Program Educational Objective into two (now the third and fourth). The third concerns professional growth and development and the fourth concerns societally-beneficial activity (see Criterion 3 for complete statements).

0-C Options

The Electrical Engineering program may be completed, following any of the following technical elective concentrations:

- Robotics & Automation: Robotics Engineering (EGRS-385), Systems Integration & Machine Vision (EGRS-430), and Automated Manufacturing Systems (EGRS-435). A grade of "C" or better is required in all of the above courses.
- Digital Systems: Digital Design (EGEE-320), Microcontroller Systems (EGEE-355), and Digital Signal Processing (EGEE-425). A grade of "C" or better is required in all of the above courses.
- Sustainable Energy: Energy Systems and Sustainability (EGNR-261), Energy Systems and Sustainability Lab (EGNR-361), Power Distribution and Transmission (EGEE-411), and one of the following: Vehicle Energy Systems (EGNR-362) or Thermodynamics (EGME-337). A grade of "C" or better is required in all courses that are taken.
- General: EGEE-320 or higher, EGME-225 or higher, MATH-215 or higher, EGRS-365, EGRS-461, EGEM-320, EGET-310, or any course from the other concentrations.

0-D Program Delivery Modes

Courses in the Electrical Engineering program are offered during daytime and evening hours, on regular weekdays only, and using a traditional lecture/laboratory format (the vast majority of it is unavailable at off-campus sites, or through web-based or distance education avenues; presently, only General Education courses, are available on-line). A small cooperative education component can be used, at the student's option, however, to satisfy a portion of the senior capstone course; that, of course, largely takes place at an employer site.

0-E Program Locations

The program is available, exclusively, at the main campus of Lake Superior State University, in Sault Ste. Marie, Michigan.

0-F Public Disclosure

For the Electrical Engineering program, the Program Education Objectives (PEOs), Student Outcomes (SOs), annual student enrollment and graduation data is available at the URL:

https://www.lssu.edu/school-of-engineering-and-technology/accreditation-outcome-reporting/

0-G Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them

The ABET final statement subsequent to the visit of Fall 2012 resulted in the following citations remaining unresolved:

> "Criterion 8. Institutional Support This criterion requires that the resources available to the program be sufficient to attract, retain and provide for the continued professional development of a qualified faculty. Since the last accreditation visit, the program has experienced a significant turnover in the faculty. If the resources available to the program are not adequate for the retention and continued professional development of the faculty, there is the potential that future compliance with this criterion could be jeopardized."
>
> Due Process Response: The EAC acknowledges receipt of documentation showing that a proposal for additional funding for faculty to attend workshops/conferences and provide summer stipends for scholarly endeavors, and to support other professional development activities was approved by the LSSU Board of Trustees. However, additional professional development funding alone might not be enough to retain qualified faculty.
>
> The concern remains unresolved.

The 30-day response from LSSU to ABET was more detailed than as paraphrased above, concerning the promised professional development (PD) and stipend support, reading:

> "Specifically, LSSU Engineering program fees will be raised from $60/semester to $70/semester, with 75% of these program fees being returned to Engineering versus the current 50% return. These modifications to the Engineering program fees scheme will generate ~$52,000/yr to be used for professional development activities (~$21,000/yr) and summer stipends (~$25,000/yr). A small portion of the generated funds (~$6,000/yr) will be used to reimburse the LSSU General Fund for Engineering Program Coordinators being at two release hours per semester versus the standard one release hour. This increase of course load release will provide additional time to complete administrative duties, particularly those related to maintaining ABET accreditation. (1 extra hour/coordinator x 3 coordinators/semester x 2 semesters/yr x $890/hour = ~$6,000/yr).
>
> "With ten faculty distributed amongst the three accredited engineering programs at LSSU, the new funds will provide ~$5,000/yr per faculty member for professional development and scholarship."

The ABET finding cites high faculty loads and lack of professional development opportunities as background to the turnover problem. The latter will be discussed in terms of the PD funding program that sought to address it, below. Concerning the former, faculty load, see Criterion 6-B of this report, in which it is noted that high loads have continued (and are, in fact, higher now than 6 years ago).

The latter circumstance, lack of professional development opportunities, may best be discussed in terms of the status of the action plan to which reference was made in the final statement from 2012. The funding history of that professional development and stipend program, cited in the due process response as a mechanism to abate the turnover problem, is provided in Table 0-1, below.

Table 0-1: Funding History of PD / Stipend Funding in Response to 2012 Criterion 8 Weakness

				Fiscal Year		
Acct Code	**Description**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18***
	Compensation					
6170	Salary	19,486.00	32,637.00			
6710	FICA	1,467.08	2,467.19			
6722	TIAA Retirement	2,338.32	3,916.44			
	subtotal	23,291.40	39,020.63			
	Supplies and expenses					
7002	Reference Books		670.61	179.92		
7020	Supplies	576.35		255.47	57.25	
7061	Software Licenses	2,994.00				
7070	Non-capital Equipment	6,146.56			87.49	
7340	Memberships			99.00		
	subtotal	9,716.91	670.61	534.39	144.74	
	Travel, conference fees					
7101	Travel In State				502.58	227.60
7102	Travel Out of State			480.70	1,386.15	2,032.60
7112	Conferences	1,150.00		2,000.00	400.00	4,290.00
7365	Professional Development		1,928.50	5,447.00	2,620.00	
	subtotal	1,150.00	1,928.50	7,927.70	4,908.73	6,550.20
	Grand totals	**34,158.31**	**41,619.74**	**8,462.09**	**5,053.47**	**6,550.20**

*as of 6-15-18 Banner query

As the table shows, the program was substantially active for the first two years at levels only somewhat short of the commitment, *after which* the program declined dramatically, as explained below.

The maximum annual funding peaked at about 80% of the promised ($52 k) figure, during the 2nd year only, the 1st year being somewhat close as well, at about two-thirds of the promised level. Most faculty in the School of Engineering & Technology (SET) participated during that time, and stipends were granted on the order of a few thousand dollars per recipient, as well as reimbursements of various other PD-related expenses.

Thereafter, the Dean stipulated new eligibility requirements for participation, namely that there should be *direct* student benefits from any approved activity, but that there should *not* be a direct connection to any specific course. This change ruled out the faculty specialty-area research projects (whereas faculty, widely in academia, would tend to understand the "scholarly endeavors" of the 2012 due process response to include individual faculty research within specialization areas, and not as necessarily implying student participation), effectively confining the awards to pedagogy-type research and degree-advancement (tuition/travel/fees expenses towards an MS degree); it also ruled out any of the lab-upgrade types of projects, as those were regarded as tied to specific courses. It has generally proven too difficult to find projects that fall between these two limitations, explaining the lack of projects (and therefore the lack of funding) since, as can be seen in the far lower funding totals for the last 3 years.

Furthermore, the CFO, at the same time (after 2 years) and since, disallowed any use of the funding for stipends or pay of any kind (even though stipends were part of the language of the original commitment), which has made participation significantly less attractive for faculty to pursue, even if projects could somehow be found that fit the now very narrow definition of eligibility. Accordingly, the program has remained largely inactive, with little to no participation in recent years, and funding at levels well below the $52k promised.

Returning, finally, to the EAC statement, it notes "Additionally, there is a lack of opportunity for teaching and/or research during the Summer…". As the research aspects have already been addressed, so it remains to describe the situation concerning teaching opportunities. The only "coursework" offered in Engineering for most Summers has been the Coop-program, with between 1 and 3 students enrolled per Summer. There has been no classroom-type coursework however. In Technology, two Summer courses (EGRS382 and EGRS482) were offered in 2014, taught by the same faculty member to two students, and one Technology course in Summer 2016 (EGRS381) for three students (same faculty member again). In summary, summertime instruction has been an extremely marginal phenomenon, and it can therefore still be said that Summer teaching opportunities, practically, do not exist.

Criterion 1 STUDENTS

1-A Student Admissions

Most students enrolled in the Electrical Engineering program are adequately prepared to perform well in the demanding curriculum. The average ACT/SAT score of all students enrolled in the program is shown below in Table 1-1. In 2015, the state of Michigan selected to use SAT scores instead of the ACT scores as in previous years as a standard for high school juniors to take. That change took effect in spring of 2016, hence the reason for illustrating both ACT and SAT. As a comparison, the average ACT/SAT score of all students enrolled in any degree program at LSSU is also shown in Table 1-1.

Table 1-1: ACT/SAT Scores of Students by Academic Year

Year	ACT Scores of EE Students	SAT Scores of EE Students	ACT Scores of LSSU Students	SAT Scores of LSSU Students
2012-2013	27.8	NA	22.4	1034
2013-2014	24.0	NA	22.3	1076
2014-2015	23.0	NA	22.2	971
2015-2016	23.7	NA	22.2	1012
2016-2017	25.8	NA	22.6	1093
2017-2018	28.8	1304	22.5	1092

1-A.1 Admission of First-Time-in-College Freshmen

LSSU considers any applicant with 19 credits (19 semester hours, or 29 quarter hours) or less of university or college coursework to be a freshman. The following policy applies to them. Those applicants with more than 19 credits of university or college coursework are considered to be transfer students.

The academic background of the applicant must demonstrate an ability to meet the requirements of an engineering program at LSSU. For those students entering directly from high school, admission to the engineering programs is based on high school grade point average and ACT/SAT scores. Admissions standards for admittance into Electrical Engineering have changed over the past six years. Prior to 2017, the standard was a high school GPA of 2.75 or above, an ACT composite score of 24 or above, or SAT score of at least 1110. Starting in the fall of 2017, the current admission standards for the admittance into the program are the following criteria (all need to be satisfied):

1. Acceptance into LSSU.
2. Placement into MATH-111 (College Algebra) or higher. Currently an ACT Math minimum score of 23 or a SAT Math minimum score of 540.

Applicants not meeting the above criteria but meeting admission requirements for the University will be admitted into AS-General Studies-Engineering major, essentially a place-holder major for those aspiring to Engineering, but not yet qualified to take most early courses in the program; these students receive advising from a liberal arts advisor, as most of their course selections are General Education, so long as they remain in this major.

1-A.2 Transfer from AS-General Studies-Engineering to Electrical Engineering (If Necessary)

In order for a first-time-in-college freshman who is in the AS-General Studies-Engineering major (see above) to move into the Electrical Engineering program, that student must make good academic progress and be prepared to enter Calculus I (MATH151). Specifically, to be admitted to the program, the student must attain a C or better in College Algebra (MATH111) and a C or better in College Trigonometry (MATH131), and earn an overall GPA of 2.0 or higher.

1-B Evaluating Student Performance

Student performance in a course is evaluated by the course instructor, who assigns, at the completion of the course, a grade on an A-F scale, where F is a failing grade. There are no courses in the program graded on a pass-fail basis. The GPA is monitored by the University on a semesterly basis in order to insure the student is in good academic standing.

1-B.1 Grading

Pursuant to concepts of academic freedom, which are affirmed by the faculty-LSSU collective bargaining agreement, the School of Engineering & Technology (SET) does not mandate any methodology by which instructors are to arrive at grades, nor any distribution of grades, etc. Instead, grading policies are left to the judgment of the individual faculty member; the assurance of quality and consistency in grading is therefore *not directly enforced* by virtue of common policies, but rather *indirectly* attained by virtue of the care taken in the process of making faculty appointments to ensure that the faculty candidate has a mastery of his/her field and is a person of judgment. (please refer to □ for discussion of this process). Moreover, the dean prepares performance evaluations of faculty members, as discussed in □, and issues of fairness and accuracy of grades could be addressed, and feedback given, if necessary.

The student can appeal to the instructor of a course for a grade change, but the instructor's grade cannot be overruled by the dean, provost, or even president.

1-B.2 Monitoring of Grades

To satisfy any course requirement in the Electrical Engineering program, or for a course to serve as a prerequisite, the student must obtain a passing grade in that course. Additionally, certain fundamental courses require a grade of C or better. Furthermore, maintaining an adequate GPA (2.0 or better) is a condition for continued enrollment in the program.

All efforts are made to monitor student performance *during*, and not merely after, a course in order to be in a position to take corrective action, i.e., to encourage better study habits and learning approaches, when appropriate. Thus, instructors are encouraged to submit midterm grades, which not only apprise a student of his/her performance midway through a course, but also alerts the academic advisor and academic support units of the University when that student is not performing well. The IPASS (Individual Plan for Student Success) program, in particular, can provide an academic intervention in such a scenario.

1-B.3 Academic Standing

For a student to remain in good academic standing at the University, he/she must maintain a cumulative GPA of at least 2.0. A student who does not meet this requirement will be placed on probation. Any student who is on probation for two consecutive semesters or a student who has more than 19 credits and has a GPA of less than 1.6 will be dismissed from the University.

Upon dismissal from the University, the student must wait two semesters (summer may be counted for one semester) to elapse before re-enrollment or may petition the Scholastic Standards Committee for immediate readmission should extenuating circumstances exist.

1-B.4 Prerequisites

Each engineering course has prerequisites, usually a list of courses, identifying the necessary background a student must have to be successful in said course. The School of Engineering & Technology employs two methods to guarantee that student meet the prerequisites. The first method results from working diligently with the Registrar's office so that a student will not be able to register for a class in the on-line process if they have not satisfied the prerequisites. Additionally, after grades for the current semester are verified, if a student failed to satisfy any of the prerequisites for an enrolled course, the student is automatically notified and deregistered from the course for that future semester. The second method is the prerequisite compliance form. At the start of the semester each student completes a prerequisite compliance form for each SET course. Samples of these forms are located in Appendix K. The instructor for the course then reviews these submissions. Starting in fall 2017, some engineering classes piloted a new prerequisite compliance form that not only identifies the prerequisite courses but also the specific topics that are needed. Two of these new forms are also found in Appendix K.

A student may communicate to the instructor of a course and request for an override of a course's prerequisite. This occurs many times with transfer students or students that have taken classes at other institutions and the credits have not yet transferred. In any case, it is up to the instructor's discretion to either allow the student to register by providing an override in the on-line registration process or deny the override. If an override is granted, it is up to the student to register for the course. Additionally, at the start of the semester, the student must complete the prerequisite compliance form. If the reason for the override has not yet been resolved, the reason will be recorded on the form. Based on a student not satisfying the prerequisite, the instructor may further discuss the issue with the student and arrive at a solution where either the student would prove their understanding of previous topics or the student would be unenrolled from the course. The new, piloted prerequisite compliance forms provide a means and space specifically to record that solution.

1-C Transfer Students and Transfer Courses

Ideally, a student who plans to transfer into the Electrical Engineering program at LSSU should contact the coordinator of the program. The coordinator assists the student in selecting courses that transfer directly into the program (specific courses from specific institutions with a precious evaluation history). The coordinator evaluates the courses that potentially transfer and processes the paperwork necessary to admit the student into the degree program.

1-C.1 Admission of Transfer Students

LSSU classifies any applicant as a transfer student if that student has enrolled in a postsecondary institution any time after the summer following his/her high school graduation. The following policy applies to them.

Official university or college transcript(s) should be sent to the Registrar's Office. The results of any advanced placement or aptitude tests taken in high school or college should also be sent to the Admissions office.

The academic background of the applicant must demonstrate an ability to meet the requirements of an engineering program at LSSU. A minimum GPA of 2.0 on all college level coursework and eligibility to return to the former college are required for admittance into the Electrical Engineering program. Students with grade point averages of less than 2.0 will be admitted into the AS-General Studies-Engineering major.

1-C.2 Transfer from AS-General Studies-Engineering to Electrical Engineering (If Necessary)

In order for a transfer student who is in the AS-General Studies-Engineering major due to not meeting initial admission requirements for the Electrical Engineering program, that student must make good academic progress (GPA 2.0 or higher) and be prepared to enter College Algebra (MATH111).

1-C.3 Transfer of Courses

For repeated courses, the grade for the most recent course will be used. Generally, a chemistry course, English composition courses, a computer course with "C" as the preferred language, and some elective courses in social sciences and humanities transfer into the engineering programs. Mathematics courses in differential and integral calculus, differential equations, probability and statistics, along with calculus-based general physics also transfer into the engineering programs. Sophomore engineering courses may transfer directly into engineering programs if they have similar content and prerequisites as LSSU engineering courses. The appropriate chair, or dean, determines if a course is transferable into an engineering program. Engineering program coordinators will be furnished a copy of the student's transcripts. If the student has performed academically well in the previous years, the chair and academic advisor may elect to waive the need for the student to take EGNR101, "Introduction to Engineering".

1-C.4 MACRAO/MTA Agreement between Michigan Colleges and Universities

An agreement regarding the transfer of General Education credit exists between participating Michigan colleges and universities called the Michigan Transfer Agreement (MTA). Prior to the MTA's implementation in the summer of 2015, there was a similar mechanism called the MACRAO transfer agreement. Since LSSU participated fully and without provision in the MACRAO transfer agreement, any transfer student who had completed the General Education requirements at any participating institution automatically met all General Education requirements at LSSU. This is also the case for the MTA. The details of this agreement are given below.

A minimum of 30 semester hours of coursework must be taken at one of Michigan's participating institutions. The courses needed to satisfy the MTA requirements are as follows:

- One course in English composition
- A second course in English composition or one course in communication
- One course in mathematics
- Two courses in social sciences (from two disciplines)

- Two courses in humanities and fine arts (from two disciplines excluding studio and performance classes)
- Two courses in natural sciences including at least one with laboratory experience (from two disciplines)

Additionally, the student must earn a minimum grade point of 2.0 in each of these courses for the MTA to be approved.

1-D Advising and Career Guidance

The purpose of academic advisement is to provide guidance for students to succeed in their academic pursuits. This includes:

a. Advising students on the sequence of courses that should be completed to finish their degree in a timely manner.
b. Providing information on academic support services available on campus such as counseling, preparing résumés and seeking job opportunities.
c. Interpreting LSSU's policies on issues such as dropping courses, taking an "I" grade, transferring courses from other institutions, waiving courses, and substituting courses.
d. Fostering a sense of joint responsibility towards lifelong learning.
e. Providing resources for students in various appeal processes such as an extension of probation or financial-aid programs.
f. Supplying recommendation letters for future student employment, scholarships, graduate school, etc.

The following sections describe the role of engineering faculty in advising and ensuring that students remain in good academic standing as they pursue their degree.

1-D.1 Assignment of Students to Faculty Advisors

All students admitted into the Electrical Engineering program are assigned a faculty advisor who teaches courses in their major. The program coordinator or the school chair advises all incoming freshmen and all transfer students during their first year. The students are re-assigned a new faculty advisor for the remainder of their time. The dean's office maintains updated advisee lists and posts them outside the School of Engineering & Technology office. Students may request a change of academic advisor, but the coordinator of the program is responsible for the approval of all advisor changes.

New faculty members receive training as part of their orientation allowing them to effectively advise their assigned students. Within the School of Engineering & Technology (SET), new faculty members are mentored by other experienced SET faculty members in the areas of degree audits, substitution waiver form, and advising methodologies. Additionally, staff at LSSU provides occasional training of the University's web-based Banner system, transfer evaluations, placement tests, financial-aid appeals, and other policies and procedures relevant to student advising.

The faculty receives a list of their advisees and written documents related to the students' academic background. Faculty members also have access to the University's web-based Banner system (Anchor Access) to review the academic records of their advisees.

1-D.2 Faculty Advising

A student and his/her faculty advisor meet a minimum of once per semester. Furthermore:

a. The faculty advisor and student review the student's success toward meeting program requirements and review student progress toward the degree. A degree audit sheet is updated every semester. Midterm grades of courses in progress can also be reviewed.
b. The faculty advisor and student plan the student's courses for the next semester. The faculty advisor ascertains that the student has completed prerequisites and is in good scholastic standing before allowing the student to schedule any new courses for the next semester. Electronic removal of an advising hold, preventing registration prior to advising, serves as the formal mechanism to ensure that.
c. Both the faculty advisor and the SET chair approve all course waivers or substitutions.

1-E Work in Lieu of Courses

Besides regular course work, four types of experiences, Dual Enrollment, Departmental Examination, Advanced Placement, and College Level Examination Program, may count toward a degree in any LSSU program, including the Electrical Engineering program.

1-E.1 Dual Enrollment

High school juniors and seniors may take classes at Lake Superior State University through the High School Dual Enrollment Program. These courses may count toward the Electrical Engineering program either as a core class (typically MATH-151 Calculus I, MATH-152 Calculus II, ENGR-101 Introduction to Engineering, or CHEM-115 General Chemistry I) or as a General Education course. Attendance as a High School Dual Enrollee does not constitute admission into any four-year degree program at the University.

Only students who have received endorsements in Mathematics, Science, Reading, and Writing are eligible to take courses in those areas. All students are eligible to take courses in other areas. Grade point average is not a determining factor in eligibility to enroll.

1-E.2 Departmental Examination

A policy exists for students to "test out" of a course by taking a Departmental Examination. The department is free to administer its own examination for any course that it offers. The student must have the written approval of the School of Engineering & Technology chair to take the examination. The student must receive a grade of C or better on the examination in order to receive credit for the course, in which case the credit earned by exam is recorded as transfer credit on the student's transcript.

Although the policy for Departmental Exams exists, there has not been a single instance of its usage for an Electrical Engineering program core or elective course in the past six years.

1-E.3 Advanced Placement (AP)

Course credit is awarded to students who receive a score of 3, 4, or 5 on any Advanced Placement exam listed in Table 1-2 below. The student will receive credit for the specified courses on the chart after being granted unconditional admission to Lake Superior State

University. Note that Table 1-2 is not a complete list and only includes those courses which may count toward credit in the Electrical Engineering program.

Table 1-2: AP Courses for Electrical Engineering Program

Advanced Placement Exam	LSSU Course Equivalent	Type of Course in CE Curriculum
Art – History of Art	ARTS -250, ARTS-251	General Education – Humanities
Biology	BIOL131, BIOL132	General Education – Natural Sciences
Calculus AB	MATH-151	Engineering Core
Calculus BC	MATH-151, MATH-152	Engineering Core
Chemistry	CHEM-115	Engineering Core
Computer Science A	CSCI-319	Engineering Elective
English – Language & Composition	ENGL-110, ENGL-111	General Education – Communications
English – Literature & Composition	ENGL-110, ENGL-111	General Education – Communications
European History	HIST-102	General Education – Social Science
French Literature	FREN-355, FREN-356	General Education – Humanities
French Language	FREN-351, FREN-352	General Education – Humanities
German Language	GRMN-241, GERM-242	General Education – Humanities
Human Geography	GEOG-201	General Education – Social Science
Macroeconomics	ECON-201	General Education – Social Science
Microeconomics	ECON-202	General Education – Social Science
Music – Listening & Literature	MUSC-220	General Education – Humanities
Physics C: Mechanics	PHYS-231	Engineering Core
Physics C: Electricity and Magnetism	PHYS-232	Engineering Core
Physics C	PHYS-231, PHYS-232	Engineering Core
Psychology	PSYC-101	General Education – Social Science
Spanish Language	SPAN-261, SPAN-262	General Education – Humanities
Spanish Literature	SPAN-380, SPAN-381	General Education – Humanities
United States Government & Politics	POLI-110	General Education – Social Science
United States History	HIST-131, HIST-132	General Education – Social Science
World History	HIST-101, HIST-102	General Education – Social Science

1-E.4 College Level Examination Program (CLEP)

Course credit is also awarded to students who receive a passing score on any College Level Examination Program (CLEP) subject exam listed in Table 1-3 below. The student will receive credit for the specified courses on the chart after being granted unconditional admission to Lake Superior State University. These credits are not awarded grades and do not apply towards the student's GPA. Note that Table 1-3 is not a complete list and only includes those courses which may count toward credit in the Electrical Engineering program.

Table 1-3: CLEP Courses for Electrical Engineering Program

CLEP Exam – Passing Score	LSSU Course Equivalent	Type of Course in CE Curriculum
American Government – 50	POLI-110	General Education – Social Science
Biology – 50	BIOL-131, BIOL-132	General Education – Natural Sciences
Calculus – 50	MATH-151	Engineering Core
Chemistry – 50	CHEM115	Engineering Core
College Composition – 50	ENGL-110	General Education – Communications
French Language – 58	FREN-251	General Education – Humanities
French Language – 66	FREN-251, FREN-252	General Education – Humanities
History of the US I – 50	HIST-131	General Education – Social Science
History of the US II – 50	HIST-132	General Education – Social Science
Introductory Psychology – 50	PSYC-101	General Education – Social Science
Introductory Sociology – 50	SOCY-101	General Education – Social Science
Principals of Macroeconomics	ECON-201	General Education – Social Science
Principals of Microeconomics	ECON-202	General Education – Social Science
Spanish Language – 58	SPAN-261	General Education – Humanities
Spanish Language – 66	SPAN-261, SPAN-262	General Education – Humanities
Western Civilization I – 50	HIST-101	General Education – Social Science
Western Civilization II – 50	HIST-102	General Education – Social Science

1-F Graduation Requirements

The name of the degree awarded through successful completion of the Electrical Engineering program is Bachelor of Science in Electrical Engineering.

Two semesters before the student plans to complete degree requirements and graduate, he/she submits a *Degree Audit* form and a *Declaration of Candidacy for Degree* form to the Registrar's office. The *Degree Audit* denotes all previous coursework and lists the courses to be taken during the final two semesters. The faculty advisor, program coordinator, and school chair must approve the *Degree Audit*. The Registrar determines the University requirements remaining for graduation, and the student is informed in writing of the remaining requirements. Any degree requirements not denoted on the *Degree Audit* are immediately brought to the attention of the school chair, program coordinator, and faculty advisor.

The *Degree Audit*, which is discussed in the Curriculum section (Criterion 5), contains all the requirements for the B.S. Electrical Engineering degree. However, those requirements are summarized in Table 1-4 below.

Table 1-4: Summary of Requirements for the B.S. Electrical Engineering Degree

Course Requirements	
General Education	24 credits
Electrical Engineering Core	82 credits
Engineering Capstone and Technical Electives	19 credits
	125 credits
Other Requirements	
General Education GPA	2.0
Engineering GPA	2.0
Overall GPA	2.0
Minimum Credits at LSSU	30 credits
Minimum 300/400 Credits at LSSU	24 credits

1-G Transcripts of Recent Graduates

There have been 32 graduates of the Electrical Engineering program over the past six years. A list of these students is shown in Table 1-5 below. At LSSU, "program options" are noted as "program concentrations". Each student's "concentration" is listed on his/her transcript. The four possible concentrations available for a student in Electrical Engineering are "Robotics and Automation", "Digital Systems", "Sustainable Energy", and "General". Transcripts for any of these students can be provided upon request.

Table 1-5: Graduates of the past six years

Student	LSSU ID	Graduation
[redacted]	[redacted]	Spring 2012
[redacted]	[redacted]	Spring 2012
[redacted]	[redacted]	Spring 2012
[redacted]	[redacted]	Spring 2013
[redacted]	[redacted]	Spring 2013
[redacted]	[redacted]	Spring 2013
[redacted]	[redacted]	Spring 2013
[redacted]	[redacted]	Summer 2013
[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	Spring 2014

[redacted]	Spring 2014
[redacted]	Spring 2014
[redacted]	Spring 2015
[redacted]	Spring 2016
[redacted]	Spring 2016
[redacted]	Summer 2016
[redacted]	Spring 2017
[redacted]	Spring 2017
[redacted]	Spring 2017
[redacted]	Spring 2017
[redacted]	Spring 2017
[redacted]	Spring 2018
[redacted]	Spring 2018
[redacted]	Spring 2018
[redacted]	Spring 2018

Criterion 2 PROGRAM EDUCATIONAL OBJECTIVES

2-A Mission Statement

The University-level mission statement reads:

> *"We equip our graduates with the knowledge, practical skills and inner strength to craft a life of meaningful employment, personal fulfillment, and generosity of self, all while enhancing the quality of life of the Upper Great Lakes region."*

This mission statement is published in the LSSU Catalog and on the University's web-site at the following URL:

https://www.lssu.edu/president/mission-vision/

The School of Engineering & Technology, as well, has maintained a Mission Statement since 1996 when the School was formed. The School has reviewed and modified the Mission Statement periodically, most recently in Spring 2014, so that it now reads:

> *"To produce sought-after engineers and technologists by providing a rigorous undergraduate learning experience characterized by close student-faculty interaction."*

This mission statement is published at the School's web page on the following URL:

https://www.lssu.edu/school-of-engineering-and-technology/accreditation-outcome-reporting/

It is apparent by comparing the two mission statements that the mission of the School is supportive of that of the University as a whole, and not conflicting in any fashion.

LSSU's statement dictates that we "equip our graduates… to craft a life of meaningful employment, personal fulfillment, …", and the School of Engineering & Technology responds by committing itself to a "produces sought after engineers"; evidently, the "meaningful employment" is attainable by those who are (by employers) "sought after", after which "personal fulfillment" is within reach of those well-enough prepared, by virtue of "a rigorous undergraduate learning experience".

The School's mission is, moreover, further clarified by a set of appended School goals (also periodically revised, most recently in Spring 2014 as well) as follows:

A. Deliver an undergraduate education that is current and provides knowledge and skills to be successful in professional careers or graduate school.
B. Provide programs that focus on the applications of fundamental principles of engineering, technology, mathematics, science, and computing to benefit society.
C. Provide courses which incorporate and develop skills in communication, design, ethics, teamwork, technology, and capstone experiences relevant to the students' degrees.
D. Provide an education and opportunities for students with diverse abilities to enhance their professional growth and capacity for life-long learning.
E. Engage in continuous improvement activities through ongoing external and internal reviews.
F. Enable faculty, staff, and students to apply engineering solutions that support regional economic growth and develop intellectual property.

G. Maintain the School's viability, productivity, and effectiveness by supporting enrollment, retention, and placement initiatives.
H. Provide a supportive environment in which faculty, staff, and students are recognized as essential in the realization of the mission.

Again, these clarifications to the School mission are aligned with the LSSU mission. Certainly, A through D can be seen as building the students future prospects for "meaningful employment, personal fulfillment, and generosity of self". Moreover, where LSSU endeavors to be "enhancing the quality of life of the Upper Great Lakes region", the School, correspondingly, through goal F, tries to "apply engineering solutions that support regional economic growth". Thus, the School's mission, and its goals, are highly complementary to that of LSSU as a whole.

These goals also serve as a link between the School's Mission Statement and the Program Educational Objectives (PEOs) to be discussed in the following section.

2-B Program Educational Objectives

The Department of Electrical and Computer Engineering has the responsibility, in accordance with the School's mission and goals, to educate and prepare its students for meaningful and productive careers in engineering. To provide measures of how well this responsibility is met, the faculty have developed four Program Educational Objectives (PEOs).

Program Educational Objectives define the skills and qualities that practicing engineers should have after some period of employment. These are based on the needs of our graduates, and of employers of our graduates; input from our Industrial Advisory Board (IAB), graduates, and employers, as well as the judgment of the faculty applied to the review of such input, guide the gradual evolution of these objectives. They specify the expected knowledge, abilities, skills, and qualifications of experienced Electrical Engineering graduates, i.e., graduates with approximately three years of professional experience. The Program Educational Objectives are applicable either to working graduates or to graduates pursuing advanced degrees.

The PEOs for the Electrical Engineering program are, moreover, common to the Computer and Mechanical Engineering programs as well. They are published on the website on the following URL,

https://www.lssu.edu/school-of-engineering-and-technology/accreditation-outcome-reporting/

and reads as follows:

Graduates of the Computer Engineering, Electrical Engineering, and Mechanical Engineering programs having three or more years of experience:

I. will have applied engineering knowledge and skills to solve problems in their professions.
II. will have demonstrated application of design and/or research principles subject to technical, practical, ethical, and other societal constraints.
III. will have set professional goals, experienced professional growth, engaged in ongoing professional development and learning activities.
IV. will be capable self-learners and make meaningful contributions to society.

2-C Consistency of the Program Educational Objectives with the Mission of the Institution

The critical focus of the Electrical Engineering program is to afford undergraduates of varying backgrounds and abilities every opportunity for achieving success as practicing Electrical Engineers or in their graduate programs. Specific emphasis in the program is given to professional and industrial-related engineering practice. The relation between the Program Educational Objectives and the School Goals is shown in Figure 2-1 below.

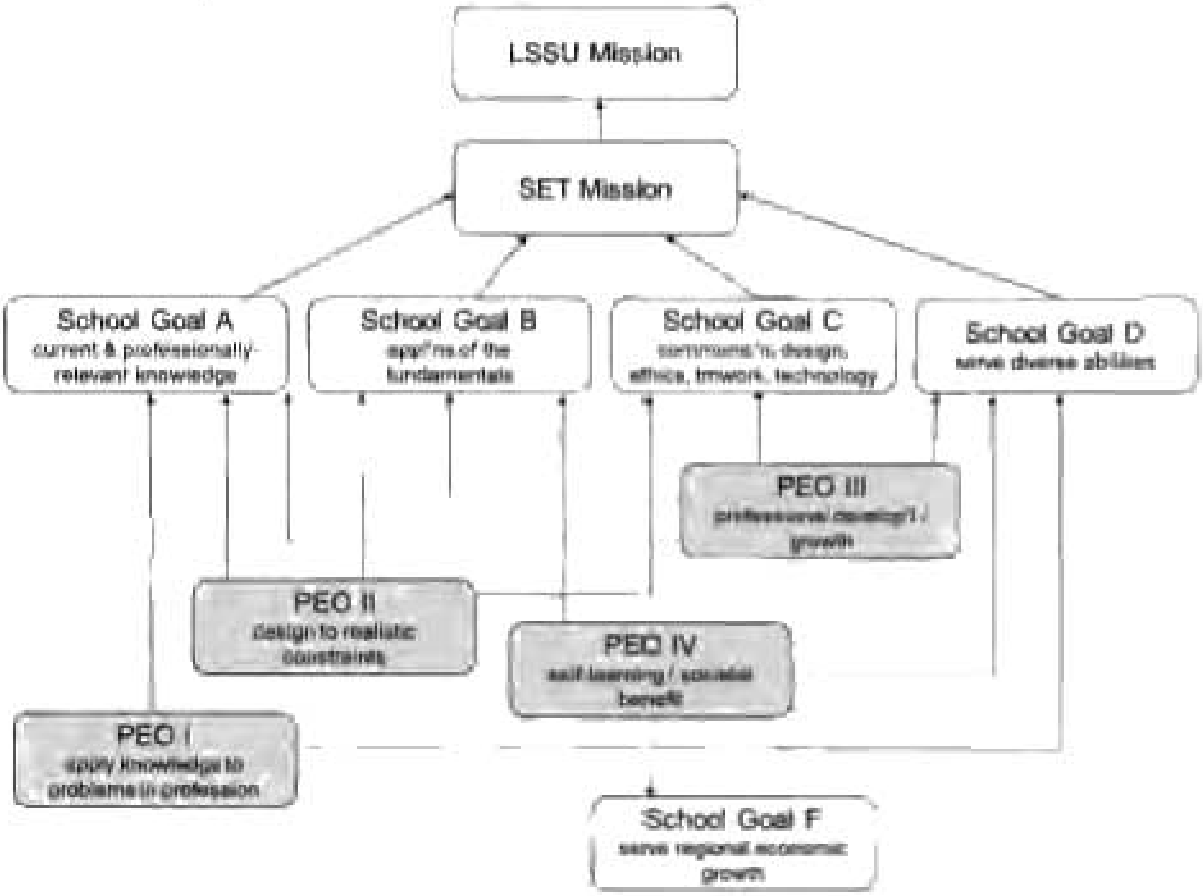


Figure 2-1: Relationship of Program Educational Objectives (in brief paraphrase) to the Mission, through the School Goals (paraphrased)

The Program Educational Objectives directly support the first four School Goals (A through D) which are focused upon student skills and abilities. The goals are the link to the mission statement for the School (and thence to that of LSSU). The last three School Goals (E through G) are only more indirectly relevant to the Program Educational Objectives, since they focus on faculty and institutional activities rather than the delivery of the program. Indeed, Goal E relates to the assessment process whereby feedback is obtained that redirects some of the ways the program is delivered. Goals F and G relate to the School's economic development and other activities that make for a healthy environment in which the program is delivered. However, the mapping acknowledges that societal benefit could be towards the regional economy in the case of some alumni.

2-D Program Constituencies

The School of Engineering & Technology recognizes as its principal constituents, all of the following:

- Current Students
- Alumni
- Faculty/Staff
- Employers of graduates
- Industrial Advisory Board (IAB)

This is not an exhaustive list that precludes other, perhaps more situational, interest groups; for instance, the economic development roles of the College, which the School supports, would suggest including entrepreneurial and industrial customers of the Product Development Center, and even the wider population of the Eastern Upper Peninsula – Northern Lower Peninsula region, which can be regarded as a beneficiary of the economic growth objectives of the School. Nevertheless, given the *primary* mission of the School to focus on offering quality academic programs, the list does identify the primary constituents.

The Industrial Advisory Board (IAB), in particular, was formed in 1985 and currently consists of approximately 30 members. IAB members possess a variety of professional experiences in the engineering and technology fields. The Board meets twice per year, once at a central Michigan location, and once on campus for program review and critique.

Notice that the PEOs define the attributes expected of alumni, a few years into their careers. Accordingly, the *alumni*'s needs are met, and *students*' needs on track to be met, by the PEOs by virtue of their being the recipients of the positive, self-beneficial attributes defined. It is evident, after all, that these are traits one widely considers desirable to attain; these stakeholders benefit by attaining them (in the present for alumni, and in the future for students).

The *employers*, as a stakeholder, have the need for engineers with adequate capabilities; the PEOs defined here imply those kinds of capabilities. The *IAB* stakeholder group is largely a subset of the employers, so that its needs are met by the PEOs in the same fashion.

2-E Process for Review of the Program Educational Objectives

It is evident that PEOs represent a goal for the product of a slow process, i.e., an engineering professional developed first by a 4-year curriculum and then further by the first few years of a professional career. Hence, it is not desirable to make rapid or frequent changes to how the PEOs are defined. The PEOs are best seen as the foundation of a long-term plan for which stability is desirable.

The constituents listed in section D, above, all have, by various mechanisms, a voice in the process of establishing and evaluating the continued relevance and attainment of Program Educational Objectives. Alumni and their employers have a voice through surveys collected from them, or by unsolicited feedback they may provide on other occasions. Students have a voice through individual course feedback questionnaires and, finally, through graduate exit interviews. The IAB is periodically solicited for feedback on the occasion of its biannual meetings; its feedback may either focus upon the relevance of the objectives themselves, or upon their degree of accomplishment.

Upon review by the faculty every several years, occasion is also provided to redefine the PEOs themselves, if necessary. Such redefinition could be motivated by comments obtained from any of the constituents mentioned above. It could also be motivated by trends the faculty observe in the needs of industry, to which the School is well-attuned thanks to its economic development activities, as well as its regular meetings with its Industrial Advisory Board and its involvement with senior project sponsoring industries. The faculty of the School, by majority vote, have complete discretion over the PEOs.

Criterion 3 STUDENT OUTCOMES

3-A Student Outcomes

The student outcomes for the LSSU Electrical Engineering program are the same as those in ABET Criterion 3 (A) through (K). These student outcomes are listed below:

A. an ability to apply knowledge of mathematics, science, and engineering.
B. an ability to design and conduct experiments, as well as to analyze and interpret data.
C. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
D. an ability to function on multidisciplinary teams.
E. an ability to identify, formulate, and solve engineering problems.
F. an understanding of professional and ethical responsibility.
G. an ability to communicate effectively.
H. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
I. a recognition of the need for, and an ability to engage in life-long learning.
J. a knowledge of contemporary issues.
K. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The student outcomes are documented, along with School mission statement, School goals, and program educational objectives, on the LSSU web site at the following URL:

https://www.lssu.edu/school-of-engineering-and-technology/accreditation-outcome-reporting/

3-B Relationship of Student Outcomes to Program Educational Objectives

The program education objectives for the program are listed below.

Graduates of the Computer Engineering, Electrical Engineering, and Mechanical Engineering programs having three or more years of experience:

I. will have applied engineering knowledge and skills to solve problems in their professions.
II. will have demonstrated application of design and/or research principles subject to technical, practical, ethical, and other societal constraints.
III. will have set professional goals, experienced professional growth, engaged in ongoing professional development and learning activities.
IV. will be capable self-learners and make meaningful contributions to society.

The eleven student outcomes (A-K) prepare students to attain, later as alumni, the four program educational objectives (I, II, III, and IV) through the course work as outlined in Criterion 5. A mapping of the student outcomes to each program educational objective is found in Table 3-1. The table lists each of the student outcomes and to what degree it supports each of the program educational objectives.

Table 3-1: Mapping of Student Outcomes to Program Educational Objectives

Student Outcome	PEO - I Apply Knowledge to Problems in Profession	PEO - II Design to Realistic Constraints	PEO - III Professional Development / Growth	PEO - IV Self-Learning / Societal Benefit
(A) Math, Sci., Eng.	High	Moderate	N/A	Moderate
(B) Experiment	Moderate	High	N/A	Moderate
(C) Design	High	High	N/A	High
(D) Teams	Low	Low	High	Moderate
(E) Problem Solving	High	High	N/A	Moderate
(F) Ethics	Low	High	High	High
(G) Communication	Moderate	Low	Moderate	High
(H) Broader Impacts	Low	High	Moderate	High
(I) Life-Long Learning	N/A	N/A	High	High
(J) Contemporary Issues	Moderate	Moderate	High	Moderate
(K) Modern Tools	High	Moderate	Moderate	Moderate

3-B.1 Program Educational Objective I

Graduates of the Electrical Engineering program having three or more years of experience will have applied engineering knowledge and skills to solve problems in their professions.

This objective is supported primarily by student outcomes A, C, E, and K. These outcomes are about applying knowledge and skills, designing systems, and solve problems all of which are directly needed for graduates to fulfill this objective. There are other outcomes that are not directly required but can help students to solve problems in their profession.

3-B.2 Program Educational Objective II

Graduates of the Electrical Engineering program having three or more years of experience will have demonstrated application of design and/or research principles subject to technical, practical, ethical, and other societal constraints.

This objective is supported primarily by student outcomes B, C, E, F, and H. These outcomes are about understanding impacts of engineering and ethical responsibilities, interpreting data, solving problems, and designing systems within constraints all of which are directly needed for graduates to meet this objective. There are other outcomes that are not directly required but can help students to design systems given various constraints.

3-B.3 Program Educational Objective III

Graduates of the Electrical Engineering program having three or more years of experience will have set professional goals, experienced professional growth, engaged in ongoing professional development and learning activities.

This objective is supported primarily by student outcomes D, F, I, and J. These outcomes are about working on teams, understanding ethical responsibilities, knowledge of contemporary issues, and recognizing the need for life-long learning all of which are directly needed for graduates to meet this objective. There are other outcomes that are not directly required but can help students to experience professional growth.

3-B.4 Program Educational Objective IV

Graduates of the Electrical Engineering program having three or more years of experience will be capable self-learners and make meaningful contributions to society.

This objective is supported primarily by student outcomes C, F, G, H, and I. These outcomes are about understanding ethical responsibilities and the impact of engineering solutions, recognizing the need for life-long learning, as well as the ability to design a system and communicate effectively all of which are directly needed for graduates to meet this objective. There are other outcomes that are not directly required but can help students to make meaningful contributions to society.

Criterion 4 CONTINUOUS IMPROVEMENT

4-A Student Outcomes

The process for continuous improvement of the program is primarily a combination of student outcome and course assessment/evaluation. Assessment and evaluation of the student outcomes provides a means of improving the program while course assessment improves each individual course.

4-A.1 Overview of the Continuous Improvement Process

The block diagram shown in Figure 4-1 provides an overview of the continuous improvement process. The process starts with the ABET-EAC criteria as well as the missions and goals of the University, College, and School. From the criteria and missions the program educational objectives (PEOs) and the student outcomes are developed. The program educational objectives, in addition to input from the industrial advisory board and employers of our graduates are used to inform in determining the program curriculum. From the program curriculum courses and individual course objectives are designed. An essential component in this process is regularly measuring student performance in both the student outcomes and course objectives.

In addition to measuring student performance, constituent feedback is a vital part of our assessment process. Given our small student population, the sample size for student work is rarely statistically significant. The small size can also cause student performance to fluctuate as the academic ability of a particularly class varies. This can make it challenging to make definitive conclusions about changes made to a course and/or the program. As a result more qualitative mechanisms are used in conjunction with student performance.

Student feedback is an essential component in our assessment. The small student population allows the faculty to get to know the students which makes them more comfortable with providing meaningful feedback. This includes formal feedback in the form of written and verbal from course assessment as well as senior exit surveys and interviews. In addition, informal feedback such as conversations with students also plays an important role but is difficult to document. Faculty are also in contact with alumni and employers who provide valuable feedback to improve courses and the program.

Faculty regularly evaluate the student performance and constituent feedback. After thorough deliberation, recommendations for changes to courses or programs are developed. For minor changes, these recommendations are then implemented by course instructors. Larger changes may require approval from the University-wide curriculum committee and the Provost. These changes are usually initiated by the school chair or program coordinator.

The process, so described, takes place at the School level (SET) in the case of courses common to the Engineering programs (EE, CE, and ME). If the course is specific to the program, then the process described takes place at the Department level instead.

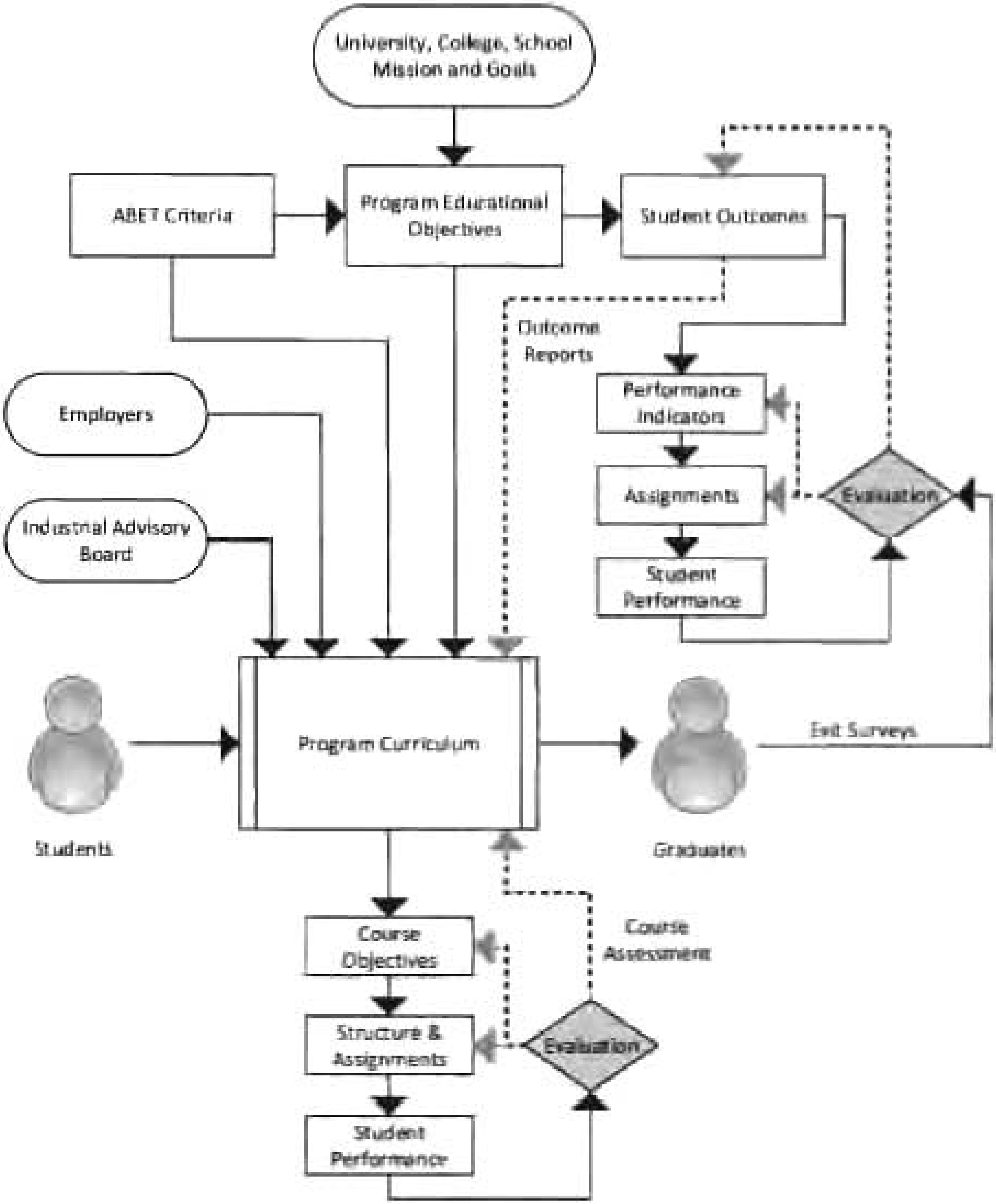


Figure 4-1: Overview of the Continuous Improvement Process

4-A.2 Student Outcome Evaluation

In order to evaluate student performance for each student outcome (A-K), one, two, or three performance indicators were established by the department or school. Each performance

indicator is associated with a specific assignment/activity in one of the upper-level core courses in the curriculum. Student attainment of the performance indicator is evaluated by the instructor and, in some cases when practical, another knowledgeable faculty member. Additionally, seniors are surveyed regarding their attainment of each student outcome at the end of their final semester. Upon completion of the survey the program coordinator conducts an interview with each graduate. To determine the attainment of the student outcomes, and hence the efficacy of the program, the performance indicators and the senior survey results are evaluated on a three-year cycle.

To develop the performance indicators for each student outcome, an appropriate course to sample student work must be selected. Thus for each engineering course in the curriculum, the faculty of the School of Engineering & Technology determined the extent of coverage and expected level of attainment for each student outcome. Then upper-level courses with a relatively high-level of expected attainment were selected to ensure a summative assessment. Due to the relatively small number of students, some of the performance indicators include activities from courses that encompass students from the other engineering programs. Next, for each of the selected courses, the performance indicators for the selected outcomes were developed. These performance indicators are designed to be a specific illustration of the outcome as it relates to the selected course. Finally, the specific assignment within the course is selected to assess student performance. These assignments are usually final exams or other summative items.

The performance indicators are evaluated every time a course containing the associated assignment is offered. The performance of each student (or for large classes a sample; for lab exercises and term projects, these may be from each group rather than each student) on the selected assignment is evaluated solely for the capability denoted by the performance indicator. Each sample of student work receives a score of 1, 2, 3, or 4 depending on how well the student meets the expected capability defined by the performance indicator. The meaning of the score is listed in Table 4-1 below and ranges from unacceptable to exemplary. The evaluation is performed by the instructor(s) responsible for teaching the course and, when possible, an additional reviewer with expertise in the area. For some student outcomes the industrial advisory board (IAB), employers, and alumni score student work. An example of this is outcome G (communications) where many IAB members as well as employers and alumni attend the senior capstone presentations.

Table 4-1: Scoring of Student Work for Performance Indicators

Score	Meaning
1	Unacceptable
2	Below Standard
3	Meets Standard
4	Exemplary

After individually scoring the student work, the reviewer(s) discuss the results and develop recommendations if needed. The results recommendations are reported in the *course assessment summary* report that is written at the conclusion of each course. A sample of an evaluation summary can be seen in Figure 4-2. The summary starts with a description of the student outcome, the extent of coverage and level of achievement, as well as the performance indicator and selected assignment. Next, the student scores and a brief explanation are given. Finally, the recommendations for future changes are listed.

Evaluation of ABET-EAC Student Outcome A (EGRS-460 Fall 2017)

ABET Statement

ability to apply knowledge of mathematics, science, and engineering.

Extent of Coverage in Course

✓✓✓ = *focus*

Expected Level of Achievement in Course

M,s,E = higher-level mathematics, basic-level science, higher-level engineering

Performance Indicator

ability to mathematically characterize a physical system's input-output relationship and use this to predict its response to an input {EE,ME}

Student Work to Evaluate

EGRS-460 - final exam question covering the step response of a physical system.

Evaluation of Student Work Relative to Student Outcome

- The student work evaluated was final exam question #1.
- The student work was evaluated by David Baumann (instructor).
- On final exam question #1 the students were given the choice of analyzing a simple mass-spring-damper mechanical system or a simple RLC electric circuit. The students were asked to (a) find the differential equation relating input to output, (b) find the transfer function, (c) find and (d) sketch the step response. Other than variable names (f and x for the mechanical systems and v_1 and v_2 for the electrical system), both systems have identical answers to (a), (b), (c), and (d).

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
DB			EE-1	EE-3	3.8
		ME-7	ME-7	ME-3	2.8

- The "Below Standard" samples mostly included the correct differential equation and transfer function, but all took erroneous approaches to formulate the step response. The "Meets Standard" samples had only errors in formulating and/or sketching the step response. Many samples were on the borderline between "Below Standard" and "Meets Standard".
- In the general, the application of science (setting up either the free-body diagram or analyzing the electrical circuit to obtain the differential equation) was quite good. But in many cases, the application of math (solving the differential equation) was poor.

Recommendation for Future Relative to Student Outcome

- This problem is a decent gauge of the students' ability to mathematically characterize a physical system's input-output relationship and use this to predict its response to an input. Continue to use it.
- For the EE's, there is no cause for concern since all 4 student work samples were "Meets Standard" or higher.
- For the ME's, there may be cause for concern since only 10 of 17 student work samples were "Meets Standard" or higher, while the coverage is extensive (✓✓✓) and expectation for achievement is high-level for math and engineering (M,s,E).

Figure 4-2: Sample Student Outcome Evaluation

Copies of student work and evaluation summary sheet are placed in the appropriate student outcome binder (A-K). Then once every three years the department evaluates each student outcome by considering the results of each performance indicator and the results of the *senior exit surveys* (Appendix H) over the previous years. Each objective is examined, and discussed in detail if there is cause for concern. The reviewers discuss their findings and recommendations. Faculty members share their experiences and brainstorm ideas to help improve the student performance. These results and any approved changes are then recorded in the *student outcome evaluation* report (sample of which can be seen in Appendix G). Small changes are implemented by the instructor(s) of the appropriate course(s), while larger changes are implemented by the department or school (with input from the industrial advisory board and approval from the curriculum committee where appropriate). The efficacy of these changes are then discussed during the next evaluation of the outcome.

4-A.3 Summary Results of Student Outcome Evaluation

A summary of the student outcome evaluation results is provided below. The detailed results can be found in the *student outcome evaluation* report in Appendix G. For the sake of completeness and clarity, each student outcome is stated below followed by the associated performance indicators. Next, the selected course and assignment of student work to be evaluated is given. After that, the level of exposure and the expected level performance for the selected assignment are listed. Then, the average score of the student work for the most recent assignment is given. Finally, a brief summary of the analysis and recommendations (if any) of the outcome are included.

4-A.3.1 Student Outcome (A)

an ability to apply knowledge of mathematics, science, and engineering

Performance Indicator (A1)

the ability to solve a partial differential equation (PDE) numerically
EGNR-340 – final exam question on PDE's
(✓✓ = stress, Me = advanced-level math, basic-level engineering)
2.7 average of student work from Spring 2018

Performance Indicator (A2)

the ability to mathematically characterize a physical system's input-output relationship and use it to predict its response to an input
EGRS-460 – final exam question on step response of a physical system
(✓✓✓= focus, MsE = advanced-level math, basic-level science, advanced-level engineering)
3.8 average of student work from Fall 2017

Performance Indicator (A3)

the ability to apply vector calculus and Maxwell's equations
EGEE-345 – final exam problem on analyzing electric field due to a ring of charge
(✓✓✓= focus, MS = advanced-level math, advanced-level science)
1.5 average of student work from Spring 2017

Analysis and recommendations

There is a concern that student performance in this outcome is not at the expected level. Examples of issues students had meeting this outcome include:

- Many students have difficulties approaching a problem and only attempt to do so on a surface level.
- There is a general weakness amongst students while working with complex numbers.

It was recommended that a common procedure for analyzing and solving problems along with support material be developed and used across all engineering courses. This common procedure will help reinforce the process of solving problems to students. A further recommendation is to add additional material on complex numbers to EGNR-140. This additional exposure to complex numbers will help students gain more experience and become more comfortable using them.

4-A.3.2 Student Outcome (B)

an ability to design and conduct experiments, as well as to analyze and interpret data

Performance Indicator (B1)

the ability to develop a valid and reliable experimental procedure that will validate a product
EGNR-495 – design review on final product testing
(✓✓ = stress, ** = developed)
2.8 average of student work from Spring 2016

Performance Indicator (B2)

the ability to produce control charts and use them to monitor an on-going manufacturing process
EGNR-346 – control charts report
(✓✓ = stress, ** = developed)
3.0 average of student work from Fall 2017

Analysis and recommendations

There is currently no concern regarding this outcome. However, because of the small number of samples in EGNR346, this performance indicator should be monitored.

4-A.3.3 Student Outcome (C)

an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

Performance Indicator (C1)

the ability to reformulate implied customer needs as specifications and produce an acceptable design solution
EGNR-491 – product design review
(✓✓✓= focus, *** = high)
2.8 average of student work from Fall 2015

Performance Indicator (C2)

the ability to design, construct, and evaluate a high-order filter circuit to meet technical specifications
EGEE-310 – final design project report
(✓✓ = stress, *** = high)
2.8 average of student work from Fall 2016

Analysis and recommendations

There is currently no concern regarding this outcome. While the average is a little low, only one senior project team was below standard and that is likely due to them doing the assignment on short notice. All other teams performed at the standard so there is no cause for concern at this time.

4-A.3.4 Student Outcome (D)

an ability to function on multidisciplinary teams

Performance Indicator (D1)

the ability to provide constructive criticism of team members
EGNR-495 – peer evaluations
(✓✓✓ = focus, *** = high)
2.6 average of student work from Spring 2018

Analysis and recommendations

There is currently no serious concern regarding this outcome given past data.

4-A.3.5 Student Outcome (E)

an ability to identify, formulate, and solve engineering problems

Performance Indicator (E1)

the ability to translate a human need into technical specifications
EGEE-310 – final design project report
(✓= exposure, * = foundational)
2.3 average of student work from Fall 2016

Analysis and recommendations

There is a slight concern that student performance in this outcome is not at the expected level. Examples of issues students had meeting this outcome include:

- It is apparent that the students did not demonstrate that they have the ability to translate a human need into a technical specification. With the exception of the one group, all of the others went straight from selecting cutoff frequencies to determining transfer functions without providing any additional specifications or rationale for them.

However, there were also difficulties in the assigned problem that made it difficult to evaluate. The assignment could be adjusted to make it more board thereby allowing the students to better demonstrate their ability to translate. It was recommended that the assignment be monitored for one more offering and then determine if a new assignment (possibly from a different course is needed).

4-A.3.6 Student Outcome (F)

an understanding of professional and ethical responsibility

Performance Indicator (F1)

the ability to apply perspectives from established ethical philosophies in the analysis of a case study
EGNR-495 – ethics essay
(✓✓✓ = focus, ** = developed)
2.8 average of student work from Spring 2016

Analysis and recommendations

There is no cause for concern.

4-A.3.7 Student Outcome (G)

an ability to communicate effectively

Performance Indicator (G1)

the ability to make formal engineering presentations
EGNR-495 – final project presentations
(✓✓✓ = focus, *** = high)
3.0 average of student work from Spring 2016

Performance Indicator (G2)

the ability to write prose containing technical information
EGEE-345 – research essays
(✓= exposure, ** = developed)
3.4 average of student work from Spring 2017

Analysis and recommendations

There is no concern. It is however recommended that the grading form for G1 be modified to better separate the IAB's rating for the team's ability to communicate and that of the project outcome.

4-A.3.8 Student Outcome (H)

the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

Performance Indicator (H1)

the ability to describe the impact of engineering solutions in a global, economic, environmental, and/or societal context

EGEE-345 – research essays
(✓= exposure, * = foundational)
2.7 average of student work from Spring 2017

Analysis and recommendations

Looking ahead to the changing ABET-EAC criteria, F, H, and J will be combined into Outcome 4. This new outcome could be appropriately addressed in the corresponding sections of the Project Definition and Plan (PDP) document that all Senior Project teams are required to write. While not necessary under the new criteria, the current assignment is working well in EGEE-345 and could be maintained

4-A.3.9 Student Outcome (I)

a recognition of the need for, and an ability to engage in life-long learning

Performance Indicator (I1)

the ability to define and clarify customer needs through technical investigation
EGNR495 – faculty subjective evaluation for each individual on their respective team
(✓✓= stress, ** = developed)
3.5 average of student work from Spring 2018

Analysis and recommendations

There are no concerns.

4-A.3.10 Student Outcome (J)

a knowledge of contemporary issues

Performance Indicator (J1)

the ability to use examples from a realistic case study in making arguments
EGNR-495 - ethics essay
(✓= exposure, * = foundational)
3.2 average of student work from Spring 2016

Analysis and recommendations

There is no concern.

4-A.3.11 Student Outcome (K)

an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Performance Indicator (K1)

the ability to solve a recursive problem by writing a program in a structured programming language, implementing the recursion in an iterative loop
EGNR-340 – exam question on Newton-Raphson root search or on Euler's method for solving an ordinary differential equation (ODE)
(✓✓✓= focus, ** = developed)
2.7 average of student work from Spring 2018

Performance Indicator (K2)

the ability to apply modern engineering software and techniques to produce and evaluate a solution
EGEE-310 – final design project report – use of MATLAB and PSpice
(✓= exposure, ** = developed)
3.0 average of student work from Fall 2016

Analysis and recommendations

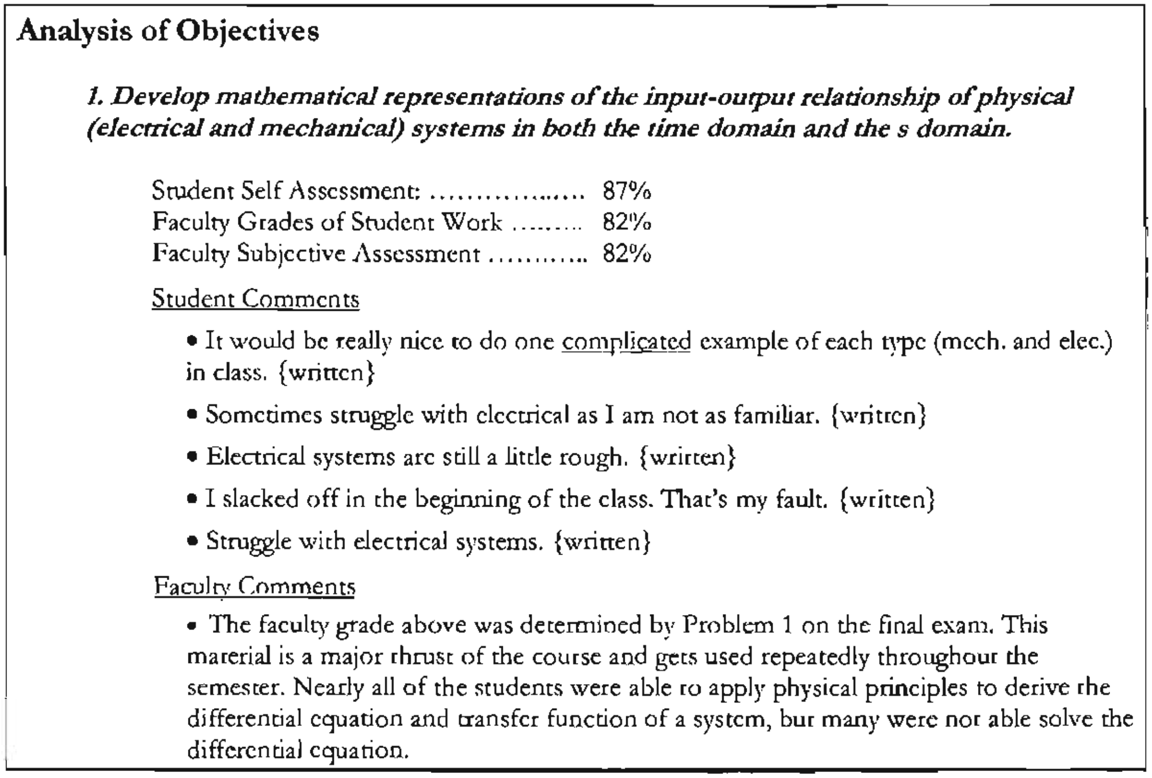
There is no concern.

4-A.4 Course Assessment

Course assessment is another important component of the continuous improvement process. At the completion of every engineering course offering, the instructor assesses the course objectives as well as student feedback and produces a *course assessment summary* report (samples of which can be seen in Appendix J). The report includes student comments, an analysis of student attainment in the course objectives, and an action plan for the next offering.

During the final two weeks of the semester, students are asked to complete a survey in each of their engineering courses. This survey has them rate (1-10) and comment on their abilities in each of the course objectives as well as the necessity of prerequisite courses. In addition, faculty can include additional questions to obtain specific feedback about the course. Faculty also facilitate a discussion with the class to obtain more feedback about objectives and the course.

Upon completion of the course, the instructor generates a course assessment summary report summarizing that course offering. For each course objective, the report includes the instructor's subjective score, student's self-rated score, grades of student work, and student comments. The instructor then provides a narrative on the performance and comments from students for each objective. An example of the objectives section of a report from EGRS-460 can be seen in Figure 4-3. Next, the summary report provides a brief analysis on the prerequisite courses, which can be seen in Figure 4-4. This includes the students rating (1-10) on how well the prerequisite prepared them for this class as well as any comments by students. Then the instructor provides their comments related to the prerequisite. If the course is used to evaluate any of the student outcomes it will contain a summary of the evolution of student work as previously seen in Figure 4-2. The summary report also provides a list of action plans. This includes a brief analysis of the efficacy of the most recent course improvements as seen in Figure 4-5 which shows a portion of the previous offerings section of the EGEE-125 report. Finally, a list of the recommended change for the next course is included in the summary report. An example of this list can be seen in Figure 4-6 which is a portion of the EGEE-125 report.



Analysis of Objectives

1. Develop mathematical representations of the input-output relationship of physical (electrical and mechanical) systems in both the time domain and the s domain.

Student Self Assessment: 87%
Faculty Grades of Student Work 82%
Faculty Subjective Assessment 82%

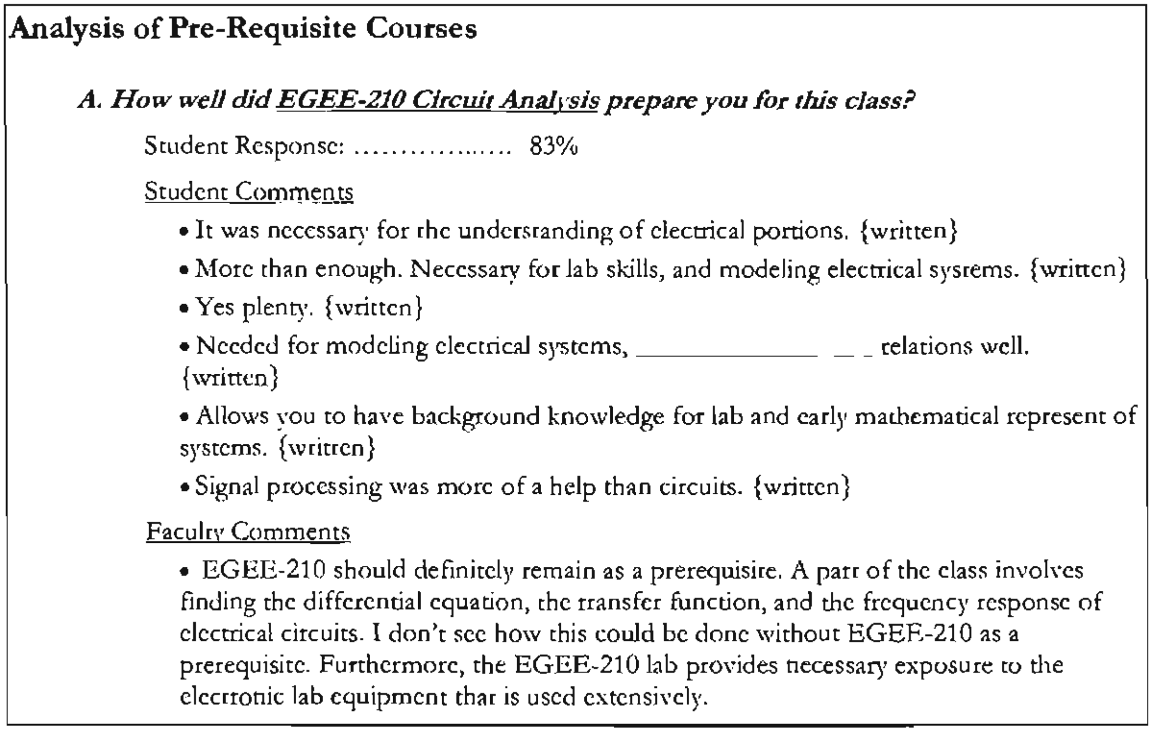
Student Comments

- It would be really nice to do one complicated example of each type (mech. and elec.) in class. {written}
- Sometimes struggle with electrical as I am not as familiar. {written}
- Electrical systems are still a little rough. {written}
- I slacked off in the beginning of the class. That's my fault. {written}
- Struggle with electrical systems. {written}

Faculty Comments

- The faculty grade above was determined by Problem 1 on the final exam. This material is a major thrust of the course and gets used repeatedly throughout the semester. Nearly all of the students were able to apply physical principles to derive the differential equation and transfer function of a system, but many were not able solve the differential equation.

Figure 4-3: Objectives Section of the EGRS-460 Course Assessment Summary Report



Analysis of Pre-Requisite Courses

A. How well did EGEE-210 Circuit Analysis prepare you for this class?

Student Response: 83%

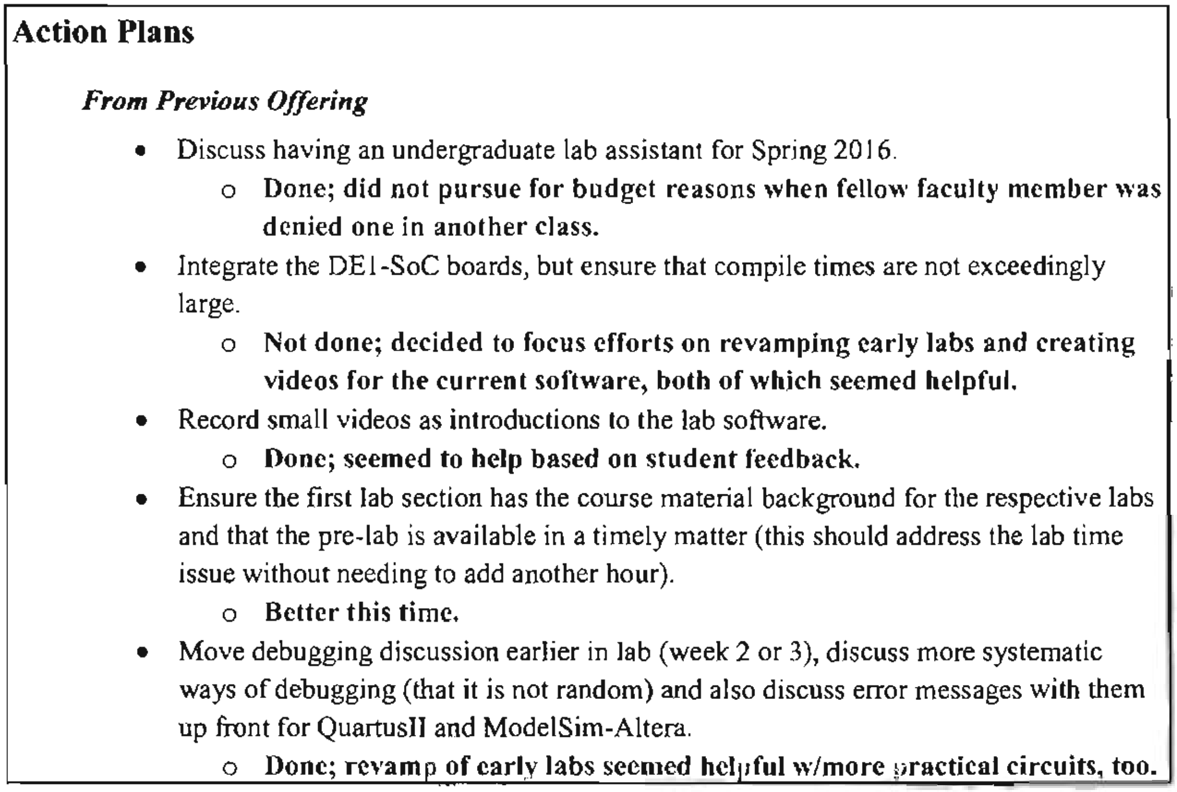
Student Comments

- It was necessary for the understanding of electrical portions. {written}
- More than enough. Necessary for lab skills, and modeling electrical systems. {written}
- Yes plenty. {written}
- Needed for modeling electrical systems, _______________ __ _ relations well. {written}
- Allows you to have background knowledge for lab and early mathematical represent of systems. {written}
- Signal processing was more of a help than circuits. {written}

Faculty Comments

- EGEE-210 should definitely remain as a prerequisite. A part of the class involves finding the differential equation, the transfer function, and the frequency response of electrical circuits. I don't see how this could be done without EGEE-210 as a prerequisite. Furthermore, the EGEE-210 lab provides necessary exposure to the electronic lab equipment that is used extensively.

Figure 4-4: Prerequisite Section of the EGRS-460 Course Assessment Summary Report

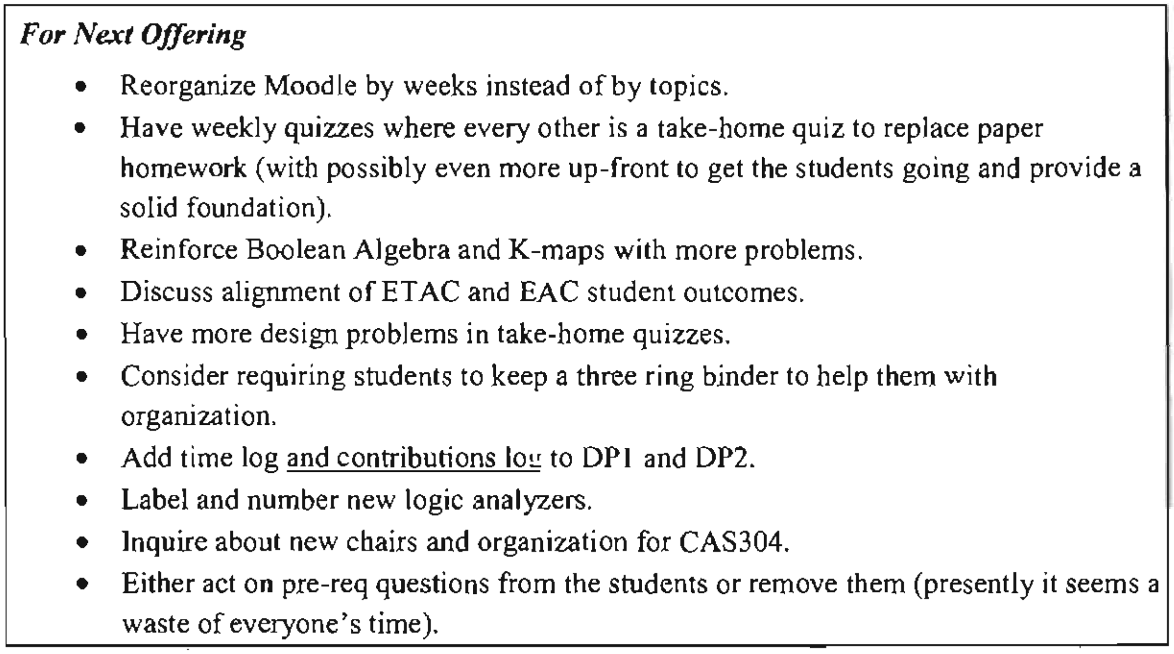


Action Plans

From Previous Offering

- Discuss having an undergraduate lab assistant for Spring 2016.
  - **Done; did not pursue for budget reasons when fellow faculty member was denied one in another class.**
- Integrate the DE1-SoC boards, but ensure that compile times are not exceedingly large.
  - **Not done; decided to focus efforts on revamping early labs and creating videos for the current software, both of which seemed helpful.**
- Record small videos as introductions to the lab software.
  - **Done; seemed to help based on student feedback.**
- Ensure the first lab section has the course material background for the respective labs and that the pre-lab is available in a timely matter (this should address the lab time issue without needing to add another hour).
  - **Better this time.**
- Move debugging discussion earlier in lab (week 2 or 3), discuss more systematic ways of debugging (that it is not random) and also discuss error messages with them up front for QuartusII and ModelSim-Altera.
  - **Done; revamp of early labs seemed helpful w/more practical circuits, too.**

Figure 4-5: Previous Offering Section of the EGEE-125 Course Assessment Summary Report



For Next Offering

- Reorganize Moodle by weeks instead of by topics.
- Have weekly quizzes where every other is a take-home quiz to replace paper homework (with possibly even more up-front to get the students going and provide a solid foundation).
- Reinforce Boolean Algebra and K-maps with more problems.
- Discuss alignment of ETAC and EAC student outcomes.
- Have more design problems in take-home quizzes.
- Consider requiring students to keep a three ring binder to help them with organization.
- Add time log and contributions log to DP1 and DP2.
- Label and number new logic analyzers.
- Inquire about new chairs and organization for CAS304.
- Either act on pre-req questions from the students or remove them (presently it seems a waste of everyone's time).

Figure 4-6: Next Offering Section of the EGEE-125 Course Assessment Summary Report

Each engineering course is then evaluated within the appropriate venue at least once every two years. The department evaluates the courses that appear solely in the programs core. Other "cross-disciplinary" courses that are also contained in the other engineering program cores are evaluated by the school. The senior capstone sequence (EGNR-491&495) is evaluated by the senior project faculty board, which because of our small size constitutes the majority of the faculty. The schedule for course evaluation is shown below in Table 4-2 and includes the venue in which it is evaluated. This schedule includes all courses offered by the School of Engineering & Technology (SET), and is intended to illustrate the regular pattern of course offerings and subsequent evaluation. The courses listed for spring of 2018 (S18) and later are the future assessment plan as courses are assessed during the subsequent semester at the earliest.

During evaluation the instructor leads a discussion about the student performance and student feedback. Each objective is examined, and discussed in detail if there is cause for concern. This provides an opportunity for faculty members to share their experiences and brainstorm ideas to help improve the student performance. If additional changes are recommended by the department or school they are recorded in the meeting minutes and the *course assessment summary* report. The instructor then implements the changes during the next offering of the course (or if needed, initiates a curricular change proposal). The efficacy of these changes are then discussed during the next evaluation of the course.

Table 4-2: Course Evaluation Schedule

☐	Not Offered
X	Offered
▨ X	Scheduled to be Evaluated
▨ X	Evaluated by School of E&T
▨ X	Evaluated by Department of ECE
▨ X	Evaluated by Department of ME
▨ X	Evaluated by Senior Projects Faculty Board

4-A.5 Summary of the Improvement Process

In summary curricular improvements (at both the course and program level) are made by the School of Engineering & Technology faculty using a combination of student outcome and course evaluations. While student performance provides the most important indicator of achievement, given our small size, constituent (student, IAB, and employer) feedback is also a vital part of continuous improvement. All curricular changes are made by the School of Engineering & Technology faculty based on the results of these evaluations. Ultimately, the program is improved by small changes to courses (course layout, syllabi, grading structure, extent of coverage, *etc.*), changes to content in courses (alteration of objectives, topical content, *etc.*), and large curricular changes (course deletion, course addition, shifting material from one course to another, adding new material to the curriculum, *etc.*). The smaller changes tend to be made at the time of course evaluation while the more significant changes tend to be made at the time of student outcome evaluation.

4-B Continuous Improvement

Continuous improvement is an important part of maintaining a quality program. As such assessment is an important part of the School of Engineering & Technology. Below are a few examples of changes made within the Electrical Engineering program.

4-B.1 Improvement Example for Student Outcome C

In the spring semester of 2013 the department evaluated student outcome C and determined that there was a concern. While the student performance on the selected assignment was reasonable, faculty identified that the amount of exposure to design reviews between the various concentrations is different. Students pursuing the digital concentration receive more opportunities, as design reviews are a component of some of the digital courses (EGEE-320 Digital Design and EGEE-355 Microcontroller Systems). Students in other concentrations do not experience design reviews until senior projects (EGNR-491&495). Thus there was a concern that students outside the digital concentration were underprepared for this outcome.

To help correct this imbalance it was recommended that a design review be added to a core course ensuring that all EE students have that experience. It was later determined that the design review be added to EGEE-310 Network Analysis as it already had a substantial final design project.

During the EGEE-310 course assessment the instructor indicated that the design review was beneficial and helped students complete the project. In the latest evaluation of student outcome C it was found that there is no cause for concern in this area. Verbal feedback from senior project students indicated that the design review in EGEE-310 was beneficial. Although it is nearly impossible to say conclusively that the addition of the design review improved student performance in outcome C; it is thought to be a benefit to the students and will continue as a part of the course.

4-B.2 Improvement Example for Student Outcome A

In the last ABET report (2012) it was mentioned that students were underperforming in the area of mathematics, part of student outcome A. It was recommended that a grade of "C or better" for MATH-310 Differential Equations be added as a program requirement. It was thought that increasing the minimum acceptable grade would force students to have a better understanding of the material. This change was implemented for students starting in the fall of 2013.

During last evaluation of student outcome A, it was determined that there is still a slight concern regarding students mathematical ability. It appears that "C or better" requirement had no significant effect on student performance. Upon further examination of student work, some students have difficulties with how to even approach a problem. These students seem to search for equations in the book and try to apply it to the problem even if they are unrelated. One could describe the issue as often, but not always, a tendency to approach problem-solving very superficially. In these cases, the student approaches the situation with a goal of trying to reduce almost all problems to the simplistic model of applying whichever equation happens to be readily available, with too little concern for its relevance or validity in the circumstances, and always expecting to apply it in the fashion of determining an output based on known inputs. Understanding of the underlying principles, cognizance of approximating assumptions made, and actual meaning of the physical quantities involved, is given little value in this way of thinking.

This is a complicated issue that will take significant time and effort to address. As a first step, the faculty will develop a common procedure for students to use in analyzing and solving problems. This procedure, along with supporting material, will be used for all ECE courses (and possibly all engineering courses in general). It is thought that repeatedly using the same steps in analyzing and solving problems will help students understand how to approach and solve problems that they are not familiar with. This common procedure will be developed in the upcoming academic year (2018-2019). This outcome will continue to be monitored and additional changes will be made to further improve student performance.

4-B.3 Improvement Example for Student Outcome F

In the last ABET report (2012) it was mentioned that students indicated that they thought ethics (student outcome F) should be removed from senior projects (EGNR-495). The recommended action was to create a new General Education course that would cover ethics, economics, and sustainability as it applies to the design and use of technology. This course would then allow for the removal of that material from senior projects giving student more time to focus on their project.

For a number of reasons, the creation of this class was not possible. However, based on faculty discussions and student feedback it was decided to bring in an expert in ethics. Thus, Dr. Jason Swedene a Professor in Department of Humanities & Philosophy who specializes in ethics began teaching the ethics portion of senior projects in the spring of 2017.

From the latest student outcome evaluation, there is no concern for outcome F. Student feedback regarding the ethics portion has overall been very positive, with students enjoying Dr. Swedene's lectures. Some students indicated that they would prefer that ethics be moved to the fall semester of senior projects (EGNR-491). The possibility of moving this topic is currently being explored and may occur in the future. Overall, it seems that bringing in Dr. Swedene was beneficial to the program.

4-B.4 Future Improvements to the Process

As discussed, there is a continuous improvement process in place and being used to improve both the courses (course assessment) and the program (student outcome evaluation). However, the adherence to this process needs to be improved moving forward. There is a very strong history of using course assessment as the primary means for improvement of the program (up until the last ABET accreditation). As a result programmatic changes are often discussed during these course assessment meetings especially for summative courses such as the senior capstone sequence (EGNR-491&495). This itself is not an issue. However, the recommendations and rationale were not always properly documented and included in the student outcome evaluation reports. Thus these reports have not necessarily contained the complete summary. Moving forward, the department and school must be more diligent in documenting the assessment and evaluation of the student outcomes. This should be easier with the experience gained from going through the student outcome evaluation process.

4-C Additional Information

Additional information regarding assessment and the student outcomes can be found in:

- *Course Assessment Summary* reports (Appendix J)
- *Student Outcome Evaluation* report (Appendix G)

Criterion 5 CURRICULUM

5-A Program Curriculum

5-A.1 Plan-of-Study

For the purpose of planning and evaluating the curriculum, as well as academic advising, the ECE department has summarized the full set of course requirements in two complementary formats. These are to be found in the Electrical Engineering *Plan-of-Study* document, wherein the courses comprising the curriculum are arranged in a suggested temporal semester-by-semester sequence in which students could feasibly take them, and in the Electrical Engineering *Degree Audit Sheet* document, wherein the arrangement is instead alphabetical by discipline; the latter serves at the University level, moreover, as a kind of check-off sheet for meeting program requirements. The most up-do-date versions of these documents (applicable to students starting in Fall 2018) are found in Appendix L and Appendix M; versions for earlier years will be available as part of the display materials at the visit.

Table 5-1 through Table 5-4, below, collects this information in terms of a list of courses (sequential, i.e., as in the first mentioned document, the "plan-of-study"), but also indicating to which curricular components they contribute, and providing recent enrollment information.

Courses are all semester-length where a semester consists of 15 weeks; 14 weeks of instruction and 1 week when final examinations and other summative activities occur.

Table 5-1: Curriculum: EE w/Robotics & Automation Conc.

Electrical Engineering: Robotics & Automation Concentration 126 credit hours (minimum possible)

Course (Department, Number, Title) List all courses in the program by term starting with first term of first year and ending with the last term of the final year	Indicate Whether Course is Required, Elective or a Selected Elective	Subject Area (Credit Hours)				Last Two Terms the Course was Offered	Maximum Section Enrollment for the Last Two Terms the Course was Offered
		Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other		
1st YEAR: FALL							
CHEM115 General Chemistry	R	5				F17/S18	75
EGNR101 Introduction to Engineering	R		2 ✓			F16/F17	54
ENGL110 First-Year Composition I	R			3		F17/S18	24
MATH151 Calculus I	R	4				F17/S18	29
Social Science Elective e.g. PSYC101 Intro. to Psychology*	SE			3		F17/S18	98
1st YEAR: SPRING							
EGEE125 Digital Fundamentals	R		4			S17/S18	27
EGNR140 Linear Algebra & Numerical Appl'ns for Engineers	R		2			F17/S18	28
ENGL111 First-Year Composition II	R			3		F17/S18	24
MATH152 Calculus II	R	4				F17/S18	20
Social Science Elective e.g., SOCY101 Intro. to Sociology*	SE			3		F17/S18	35
2nd YEAR: FALL							
EGEE250 Microcontroller Fundamentals	R		4			F16/F17	16
EGEE280 Introduction to Signal Processing	R		4			F16/F17	23
MATH251 Calculus III	R	4				F17/S18	27
PHYS231 Applied Physics for Engineers & Scientists I	R	4				F16/F17	49
2nd YEAR: SPRING							
EGEE210 Circuit Analysis	R		4			F17/S18	22
EGNR265 C Programming	R		3			F17/S18	22
MATH310 Differential Equations	R	3				F17/S18	24
PHYS232 Applied Physics for Engineers & Scientists II	R	4				S17/S18	40
Humanities Elective e.g. HUMN251 Humanities I*	SE			3		F17/S18	61

3rd YEAR: FALL							
EGEE310 Network Analysis	R		4			F14/F16	8
EGEE370 Electronic Devices	R		4			F16/F17	10
EGNR340 Numerical Methods for Engineers	R	3				F17/S18	14
EGNR346 Probability & Statistics Lab for Engineers	R		1			F16/F17	8
MATH308 Probability & Mathematical Statistics	R	3				F16/F17	28
COMM101 Fundamentals of Speech Communication	R			3		F17/S18	24
3rd YEAR: SPRING							
EGEE345 Fundamentals of Engineering Electromagnetics	R		3			S15/S17	11
EGEE475 Power Electronics	R		4			S17/S18	6
EGEM220 Statics	R		3			F17/S18	14
Cultural Diversity Elective e.g. SOCY 103 Cultural Diversity*	SE			3		F17/S18	48
EGRS385 Robotics Engineering	SE		4			S17/S18	23
4th YEAR: FALL							
EGEE330 Electro-Mechanical Systems	R		4			F15/F17	11
EGNR491 Engineering Design Project I	R		3✓			F16/F17	39
EGRS460 Control Systems	R		4			F16/F17	22
EGRS430 System Integration & Machine Vision	SE		4			F16/F17	27
4th YEAR: SPRING							
EGNR495 Engineering Design Project II	R		3✓			S17/S18	39
Hum. Elec. e.g., HUMN253 World Mythology*	SE			3		S16/S18	93
General Technical Elective, e.g. EGEE411 Power Distribution & Transmission*	SE		3			S16/S18	6
EGRS435 Automated Manufacturing Systems	SE		3			S17/S18	16
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		32	70	24			
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM							
PERCENT OF TOTAL		25%	56%	19%			
Minimum Semester Credit Hours (Total must satisfy either credit hours or percentage)		32 Hours	48 Hours				
Minimum Percentage (Total must satisfy either credit hours or percentage)		25%	37.5 %				

*Example courses used for Illustration

Table 5-2: Curriculum: EE w/Sustainable Energy Conc.

Electrical Engineering: Sustainable Energy Concentration 125 credit hours (minimum possible)

Course (Department, Number, Title) List all courses in the program by term starting with first term of first year and ending with the last term of the final year	Indicate Whether Course is Required, Elective or a Selected Elective	Subject Area (Credit Hours)				Last Two Terms the Course was Offered	Maximum Section Enrollment for the Last Two Terms the Course was Offered
		Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other		
1st YEAR: FALL							
CHEM115 General Chemistry	R	5				F17/S18	75
EGNR101 Introduction to Engineering	R		2✓			F16/F17	54
ENGL110 First-Year Composition I	R			3		F17/S18	24
MATH151 Calculus I	R	4				F17/S18	29
Social Science Elective e.g. PSYC101 Intro. to Psychology*	SE			3		F17/S18	98
1st YEAR: SPRING							
EGEE125 Digital Fundamentals	R		4			S17/S18	27
EGNR140 Linear Algebra & Numerical Appl'ns for Engineers	R		2			F17/S18	28
ENGL111 First-Year Composition II	R			3		F17/S18	24
MATH152 Calculus II	R	4				F17/S18	20
Social Science Elective e.g., SOCY101 Intro. to Sociology*	SE			3		F17/S18	53
2nd YEAR: FALL							
EGEE250 Microcontroller Fundamentals	R		4			F16/F17	16
EGEE280 Introduction to Signal Processing	R		4			F16/F17	23
MATH251 Calculus III	R	4				F17/S18	27
PHYS231 Applied Physics for Engineers & Scientists I	R	4				F16/F17	49
2nd YEAR: SPRING							
EGEE210 Circuit Analysis	R		4			F17/S18	22
EGNR265 C Programming	R		3			F17/S18	22
MATH310 Differential Equations	R	3				F17/S18	24
PHYS232 Applied Physics for Engineers & Scientists II	R	4				S17/S18	40
Humanities Elective e.g., HUMN251 Humanities I*	SE			3		F17/S18	61

3rd YEAR: FALL							
EGEE310 Network Analysis	R		4			F14/F16	8
EGEE370 Electronic Devices	R		4			F16/F17	10
EGNR340 Numerical Methods for Engineers	R	1				F17/S18	14
EGNR346 Probability & Statistics Lab for Engineers	R		1			F16/F17	8
MATH308 Probability & Mathematical Statistics	R	3				F16/F17	28
EGNR261 Energy Systems and Sustainability	SE		3			F15/F17	10
EGNR361 Energy Systems and Sustainability Lab	SE		1			F15/F17	4
3rd YEAR: SPRING							
EGEE345 Fundamentals of Engineering Electromagnetics	R		3			S15/S17	6
EGEE475 Power Electronics	R		4			S17/S18	6
EGEM220 Statics	R		3			F17/S18	14
Cultural Diversity Elective e.g. SOCY 103 Cultural Diversity*	SE			3		F17/S18	48
Concentration Elective, **e.g. EGEE 411 Power Distribution & Transmission***	SE		3			S16/S18	6
4th YEAR: FALL							
EGEE330 Electro-Mechanical Systems	R		4			F15/F17	11
EGNR491 Engineering Design Project I	R		3✓			F16/F17	39
EGRS460 Control Systems	R		4			F16/F17	22
COMM101 Fundamentals of Speech Communication	R			3		F17/S18	24
4th YEAR: SPRING							
EGNR495 Engineering Design Project II	R		3✓			S17/S18	39
Hum. Elec. e.g., HUMN255 World Mythology*	SE			3		S16/S18	93
Concentration Elective, e.g. EGME337 Thermodynamics*	SE		3			S17/S18	17
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		32	69	24			
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM							
PERCENT OF TOTAL		26%	55%	19%			
Minimum Semester Credit Hours (Total must satisfy either credit hours or percentage)		32 Hours	48 Hours				
Minimum Percentage (Total must satisfy either credit hours or percentage)		25%	37.5 %				

*Example courses used for illustration.

Table 5-3: Curriculum: EE w/Digital Systems Conc.

Electrical Engineering: Digital Systems Concentration 126 credit hours (minimum possible)

Course (Department, Number, Title) List all courses in the program by term starting with first term of first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective	Subject Area (Credit Hours)				Last Two Terms the Course was Offered	Maximum Section Enrollment for the Last Two Terms the Course was Offered
		Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other		
1st YEAR: FALL							
CHEM115 General Chemistry	R	5				F17/S18	75
EGNR101 Introduction to Engineering	R		2✓			F16/F17	54
ENGL110 First-Year Composition I	R			3		F17/S18	24
MATH151 Calculus I	R	4				F17/S18	29
Social Science Elective e.g. PSYC101 Intro. to Psychology*	SE			3		F17/S18	98
1st YEAR: SPRING							
EGEE125 Digital Fundamentals	R		4			S17/S18	27
EGNR140 Linear Algebra & Numerical Appl'ns for Engineers	R		2			F17/S18	28
ENGL111 First-Year Composition II	R			3		F17/S18	24
MATH152 Calculus II	R	4				F17/S18	20
Social Science Elective e.g., SOCY101 Intro. to Sociology*	SE			3		F17/S18	55
2nd YEAR: FALL							
EGEE250 Microcontroller Fundamentals	R		4			F16/F17	16
EGEE280 Introduction to Signal Processing	R		4			F16/F17	23
MATH251 Calculus III	R	4				F17/S18	27
PHYS231 Applied Physics for Engineers & Scientists I	R	4				F16/F17	49
2nd YEAR: SPRING							
EGEE210 Circuit Analysis	R		4			F17/S18	22
EGNR265 C Programming	R		3			F17/S18	22
MATH310 Differential Equations	R	3				F17/S18	24
PHYS232 Applied Physics for Engineers & Scientists II	R	4				S17/S18	40
Humanities Elective e.g., HUMN251 Humanities I*	SE			3		F17/S18	61

3rd YEAR: FALL							
EGEE310 Network Analysis	R		4			F14/F16	8
EGEE370 Electronic Devices	R		4			F16/F17	10
EGNR340 Numerical Methods for Engineers	R	1				F17/S18	14
EGNR346 Probability & Statistics Lab for Engineers	R		1			F16/F17	8
MATH308 Probability & Mathematical Statistics	R	3				F16/F17	28
COMM101 Fundamentals of Speech Communication	R			3		F17/S18	24
3rd YEAR: SPRING							
EGEE345 Fundamentals of Engineering Electromagnetics	R		3			S15/S17	11
EGEE475 Power Electronics	R		4			S17/S18	6
EGEM220 Statics	R		3			F17/S18	14
Cultural Diversity Elective e.g. SOCY 103 Cultural Diversity*	SE			3		F17/S18	48
EGEE355 Microcontroller Systems*	SE		4			S16/S18	25
4th YEAR: FALL							
EGEE330 Electro-Mechanical Systems	R		4			F15/F17	11
EGNR491 Engineering Design Project I	R		3✓			F16/F17	39
EGRS460 Control Systems	R		4			F16/F17	22
EGEE320 Digital Design*	SE		4			F16/F17	27
4th YEAR: SPRING							
EGNR495 Engineering Design Project II	R		3✓			S17/S18	39
Hum. Elec. e.g., HUMN255 World Mythology*	SE			3		S16/S18	93
EGEE425 Digital Signal Processing*	SE		3			S15/S17	12
General Technical Elective, e.g. EGRS385 Robotics Engineering*	SE		3			S17/S18	23
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		32	70	24			
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM							
PERCENT OF TOTAL		25%	56%	19%			
Minimum Semester Credit Hours (Total must satisfy either credit hours or percentage)		32 Hours	48 Hours				
Minimum Percentage (Total must satisfy either credit hours or percentage)		25%	37.5 %				

*Example courses used for illustration.

Table 5-4: Curriculum: EE General

Electrical Engineering: General (i.e., no named concentration) 125 credit hours (minimum possible)
(showing here, example technical elective choices that just minimally satisfy the required totals: 13 credits of {EGME225 or higher} and/or EGET310 and/or {MATH215 or higher} and/or any course from concentrations)

Course (Department, Number, Title) List all courses in the program by term starting with first term of first year and ending with the last term of the final year	Indicate Whether Course is Required, Elective or a Selected Elective	Subject Area (Credit Hours)				Last Two Terms the Course was Offered	Maximum Section Enrollment for the Last Two Terms the Course was Offered
		Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other		
1st YEAR: FALL							
CHEM115 General Chemistry	R	5				F17/S18	75
EGNR101 Introduction to Engineering	R		2✓			F16/F17	54
ENGL110 First-Year Composition I	R			3		F17/S18	24
MATH151 Calculus I	R	4				F17/S18	29
Social Science Elective e.g. PSYC101 Intro. to Psychology*	SE			3		F17/S18	98
1st YEAR: SPRING							
EGEE125 Digital Fundamentals	R		4			S17/S18	27
EGNR140 Linear Algebra & Numerical Appl'ns for Engineers	R		2			F17/S18	28
ENGL111 First-Year Composition II	R			3		F17/S18	24
MATH152 Calculus II	R	4				F17/S18	20
Social Science Elective e.g., SOCY101 Intro. to Sociology*	SE			3		F17/S18	55
2nd YEAR: FALL							
EGEE250 Microcontroller Fundamentals	R		4			F16/F17	16
EGEE280 Introduction to Signal Processing	R		4			F16/F17	23
MATH251 Calculus III	R	4				F17/S18	27
PHYS231 Applied Physics for Engineers & Scientists I	R	4				F16/F17	49
2nd YEAR: SPRING							
EGEE210 Circuit Analysis	R		4			F17/S18	22
EGNR265 C Programming	R		3			F17/S18	22
MATH310 Differential Equations	R	3				F17/S18	24
PHYS232 Applied Physics for Engineers & Scientists II	R	4				S17/S18	40
Humanities Elective e.g., HUMN251 Humanities I*	SE			3		F17/S18	61

3rd YEAR: FALL							
EGEE310 Network Analysis	R		4			F14/F16	8
EGEE370 Electronic Devices	R		4			F16/F17	10
EGNR340 Numerical Methods for Engineers	R	1				F17/S18	14
EGNR346 Probability & Statistics Lab for Engineers	R		1			F16/F17	8
MATH308 Probability & Mathematical Statistics	R	3				F16/F17	28
COMM101 Fundamentals of Speech Communication	R			3		F17/S18	24
3rd YEAR: SPRING							
EGEE345 Fundamentals of Engineering Electromagnetics	R		3			S15/S17	11
EGEE475 Power Electronics	R		4			S17/S18	6
EGEM220 Statics	R		3			F17/S18	14
Cultural Diversity Elective e.g. SOCY 103 Cultural Diversity*	SE			3		F17/S18	48
General Technical Elective e.g., EGRS365 Programmable Logic Controllers*	SE		3			F17/S18	13
4th YEAR: FALL							
EGEE330 Electro-Mechanical Systems	R		4			F15/F17	11
EGNR491 Engineering Design Project I	R		3✓			F16/F17	19
EGRS460 Control Systems	R		4			F16/F17	22
General Technical Elective, e.g. EGRS430 System Integration & Machine Vision*	SE		4			F16/F17	27
4th YEAR: SPRING							
EGNR495 Engineering Design Project II	R		3✓			S17/S18	39
Hum. Elec. e.g., HUMN251 World Mythology*	SE			3		S16/S18	93
General Technical Elective, e.g. EGEE411 Power Distribution & Transmission*	SE		3			S16/S18	6
General Technical Elective, e.g. EGRS385 Robotics Engineering*	SE		3			S17/S18	23
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		32	69	24			
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM							
PERCENT OF TOTAL		26%	55%	19%			
Minimum Semester Credit Hours (Total must satisfy either credit hours or percentage)		32 Hours	48 Hours				
Minimum Percentage (Total must satisfy either credit hours or percentage)		25%	37.5%				

*Example courses used for illustration.

5-A.2 Curriculum Alignment to PEOs

There are, four stated educational objectives for the programs; these are described in Criterion 2, above. The curriculum aligns with and supports these, as explained in the following.

5-A.2.1 *Program Educational Objective I*

The first PEO calls for alumni to *apply knowledge* from the discipline in solving *problems within the profession.* Most importantly, the curriculum is there to supply the knowledge base which is to be applied; secondarily, the curriculum practices problem-solving skills which are generalizable to the application of other knowledge that may be later obtained, as well as skills in design and software that are tools in professional problem solving.

The curriculum fulfills the primary function described, furnishing the knowledge base, by its development of breadth across the discipline and the engineering sciences. The development of problem solving skills, in parallel with subject knowledge, will be evidenced in the course-specific display materials at the time of the visit.

5-A.2.2 *Program Educational Objective II*

The second PEO requires the practice of design or research within realistic (economic, societal, etc.) constraints. The curriculum has a number of courses which impart design experience, constrained by realistic specifications; these are expected to develop an early-stage experience in the student which should facilitate the transition to design work in the profession. The courses checked in Table 5-1 through Table 5-4 have particularly significant design projects.

5-A.2.3 *Program Educational Objective III*

The third PEO says that alumni set goals, experience professional growth, and engage in on-going learning / professional-development. Accordingly, the curriculum is so constructed as to provide the *tools* and facilitate the development of the *attitude* necessary to engage in continued learning.

The primary *tool* is the coherence of knowledge, in the sense that advanced and/or applied knowledge (upper-level engineering sciences, and capstone/design experiences) is rooted in fundamentals and derived from first principles; the development of first principles (e.g., voltage-current relationships for circuit elements, Kirchoff's circuit laws, and Laplace transforms) into advanced principles (e.g., design of analog filters and control systems) within the curriculum instills the ability to see the larger picture and interconnectedness within the discipline, and the ability to extrapolate and develop competencies that go beyond the knowledge obtained directly from the curriculum. The deep prerequisite structure of the curriculum, and also the structure and philosophy of individual courses, i.e., emphasizing the linkages of "first principles" to advanced results, develops this tool.

The *attitude* promoting life-long learning is instilled, especially, by exposure to experiences that are interdisciplinary, e.g., the senior (capstone) project and the Introduction to Engineering project. The interdisciplinairity is suggestive to the student of how the need can arise, in authentic engineering design and development scenarios, to synthesize knowledge beyond that obtained directly in the student's own coursework.

Concerning professional growth, the EGNR-101 Introduction to Engineering course introduces students to the LSSU student chapters of professional societies, notably the Institute of Electrical and Electronics Engineering (IEEE) and the Society of Women Engineers (SWE) for ECE students especially. Sustained extracurricular involvement in these societies is expected to be a factor promoting professional growth, particularly to the extent the association with the corresponding national organizations continues after graduation.

5-A.2.4 Program Educational Objective IV

The fourth PEO says that alumni will be, furthermore, societally-beneficial as individuals.

The curriculum contributes to this objective by providing competencies that are of use to society, most directly manifested by the various concentration courses which show industry-specific applications, to the energy and automation industries in particular (for the Sustainable Energy Systems and Robotics & Automation concentrations, respectively). But of course, the broader core of Electrical Engineering is versatile in its applications to a great many industries, as well as to government, academia, and the non-profit sector.

5-A.3 Curriculum Support of Student Outcomes

There are eleven Student Outcomes established for the program; these are described in Criterion 3 above, and coincide exactly with the ABET (A) – (K) criteria. The courses comprising the core part of the curriculum support these, as illustrated by the mapping of Table 5-5.

The table, firstly, serves as a mapping, indicating which courses are intended to contribute in some way to attainment of which Student Outcomes, by virtue of cells being filled when that is the case at the intersection of the course-row with the objective-column. For instance, in the EGEE-310 row, the cell in column C is occupied and that in column D is not; accordingly, EGEE-310 can be expected to contribute something to outcome C (design of a system), but not by design (although perhaps incidentally, and inconsistently if so) to outcome D (multidisciplinary teams).

But the table also provides, secondly, an indication of the *degree* to which each course contributes. The number of check marks, from one to three, increases as contribution increases. As the legend below the table shows, a single check mark would suggest a fairly secondary contribution, mere “exposure” without any especial stress in the course; this might be the case if, for example, a single or few assignments, adding up to a small portion of the course grade and effort expended, were to exercise the student outcome concerned. Two checks indicate that the student outcome is, instead, *stressed* in the course, such as would be the case if it corresponded to a course objective. Three checks would suggest that the class is largely focused on contributing to that objective, for example if multiple course objectives contribute to it.

Table 5-5: Mapping of Courses to Student Outcomes

Course	Cores	A	B	C	D	E	F	G	H	I	J	K
EGEE-125	CE,EE	✓✓✓ m	✓ *	✓✓ *	✓ *	✓✓ *		✓✓ *	✓ *	✓ *	✓ *	✓✓✓ *
EGEE-210	CE,EE,ME	✓✓ m,S,E	✓ *	✓ *	✓ *	✓ *		✓ *				✓ *
EGEE-250	CE,EE	✓✓ m		✓ *	✓ *	✓✓ *		✓ *				✓✓ **
EGEE-280	CE,EE	✓✓ M				✓✓ *						✓✓ *
EGEE-310	EE	✓✓✓ M,E		✓✓ [illegible]		✓ *		✓ **				✓ **
EGEE-330	EE	✓✓ m,S,e	✓ *									✓✓ **
EGEE-345	EE	✓✓✓ M,S				✓✓✓ **		[illegible]	[illegible]	✓ *		
EGEE-370	CE,EE	✓✓ m,s,e	✓ **		✓ *	✓✓ **		✓✓ *				✓✓ *
EGEE-475	EE	✓✓ m,s,E	✓ *		✓ *	✓✓ **		✓✓ **	IP	IP	IP	✓ **
EGEM-220	EE,ME	✓✓✓ m,E						✓ *				✓ *
EGNR-101	CE,EE,ME	✓ e		✓✓ *	✓✓ *	✓ *	✓✓ *	✓✓ *	✓ *	✓ *	✓ *	✓✓✓ *
EGNR-140	CE,EE,ME	✓✓ m,e				✓✓ *		✓ *				✓✓✓ *
EGNR-265	EE,ME	✓ m,s		✓ **		✓✓ **		✓ *		✓ *		✓✓✓ **
EGNR-340	CE,EE,ME	✓✓ M,e	✓ *			✓ **						✓✓✓ **
EGNR-346	CE,EE	✓✓ M,e	✓✓ **	✓ *				✓✓ **				✓✓ **
EGNR-491	CE,EE,ME	✓ E		✓✓✓ ***	✓✓✓ **	✓✓✓ **	✓✓ *	✓✓✓ ***	✓ *	✓✓ **		✓✓ ***
EGNR-495	CE,EE,ME	✓ E	✓✓ **	✓✓✓ ***	✓✓✓ ***	✓✓✓ **	✓✓✓ **	✓✓✓ ***	✓✓ **	✓✓ **	✓ *	✓✓ ***
EGRS-460	EE,ME	✓✓✓ M,s,E	✓ *	✓ *		✓✓✓ ***		✓ **				✓ *

▨	evaluated for EE
▨	evaluated for EE and CE

▨	evaluated for EE and ME
▨	evaluated for CE, EE, and ME

✓	exposure (for instance, one graded assignment)
✓✓	stress (for instance, one course objective)
✓✓✓	focus (for instance, multiple objectives or course title)

*	foundational – ready for further developments
**	developed – prepared for practical application
***	high – approaching that of a practicing engineer

IP	incorporation into course is "in progress"

m(M)	basic-level (advanced-level) mathematics
s(S)	basic-level (advanced-level) science
e(E)	basic-level (advanced-level) engineering

(A) an ability to apply knowledge of mathematics, science, and engineering
(B) an ability to design and conduct experiments, as well as to analyze and interpret data
(C) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(D) an ability to function on multidisciplinary teams
(E) an ability to identify, formulate, and solve engineering problems
(F) an understanding of professional and ethical responsibility
(G) an ability to communicate effectively
(H) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(I) a recognition of the need for, and an ability to engage in life-long learning
(J) a knowledge of contemporary issues
(K) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

The table, thirdly, indicates the expected level of development, with regard to that outcome, to be displayed by students performing satisfactorily. The number of asterisks, for all outcomes except A, correlates to the level of development; for A in particular, the letters m, s, and e are instead used to distinguish the math, science, and engineering aspects, respectively, of the outcome, with the lower case – upper case distinction to indicate level of development (lower case implying lower development and upper case higher). Thus, a single asterisk in B – K means a *foundational* level, i.e., an outcome at the very initial stages of development; two asterisks implies some readiness for practice; and three a level comparable to a practicing professional. Lower case m indicates the application of basic mathematics (through univariate calculus), and upper case M a more advanced mathematics (e.g., multivariate calculus, differential equations); the s vs. S and e vs. E distinctions are analogous for application of natural sciences and engineering sciences respectively.

Fourthly, and finally, the table indicates from which courses evidence is purposefully collected in order to assess the attainment of Student Outcomes via the curriculum, i.e., "program assessment" evidence. This is understood to be evidence that sheds light on the workings of the whole curriculum, not merely the course from which the evidence is extracted, towards the outcome concerned. Cells with color highlighting are those indicating an evidentiary source; the course corresponding to the cell's row provides evidence of attainment of the objective corresponding to the cell's column. The color chosen for highlighting furnishes the additional information as to whether any distinction is made, or not, between EE students and other Engineering students. Thus, blue means EE students exclusively, whereas green implies grouping with Computer Engineering students, red implies grouping with Mechanical Engineering students, and orange with *all* Engineering students (ME, EE, CE).

To return to the EGEE-310 example, the faculty had noted that the circumstance that column C was occupied implied some contribution of that course to outcome C (design of a system). In fact, the table also tells us, by two checks, that the design component is *stressed* in the course, and the three asterisks that the expectation for students is *approaching that of a practicing engineer* in their design of a system in that course. Finally, the blue highlighting means that the department collects and evaluates evidence from that course (one would have to consult the course or program assessment reports for specifics) for purposes of evaluating the program's attainment of outcome C, and that such evidence is (unlike that from, say, EGNR-495 for the same objective) not confounded with that of students from other Engineering disciplines.

Note that the technical electives of the concentrations (or general) also support the Student Outcomes, but to varying degrees and varying distribution; accordingly, these are *not* included in the table, but the respective course assessment reports may be consulted for the same kind of information for those technical electives as supplied here for the core courses.

5-A.4 Prerequisite Structure

Figure 5-1, below, shows direct prerequisite and co-requisite relationships between the core courses of the curriculum (omitted are the technical electives in the concentrations, as well as those elective general education courses typically requiring no prerequisites).

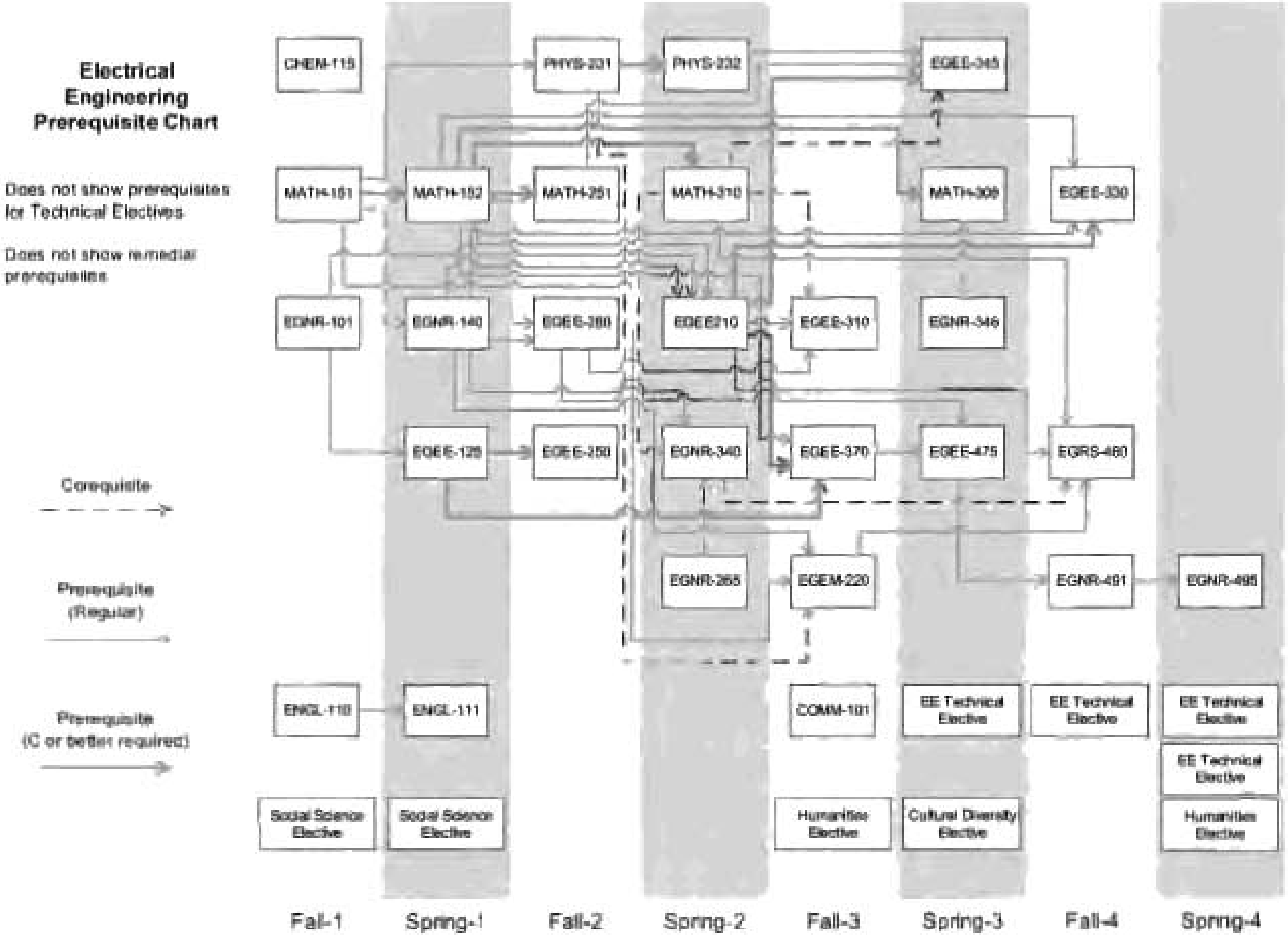


Figure 5-1: Prerequisite Structure for the Electrical Engineering Curriculum

The prerequisite chart, as it is broken down at the course level, is useful to illustrate a few key features of the Electrical Engineering program:

- That there is a significant *depth* developed throughout the curriculum; the final capstone course, EGNR-495 *Senior Design Projects II*, is so much as *sixth* in a chain of prerequisites, and there are several courses that are four or five layers deep;
- Certain courses, such as MATH-152 *Calculus II* or EGEE-210 *Circuit Analysis*, are the *knowledge base* of a large part of the subsequent core curriculum, as can be seen by the *divergence* of many lines from those courses to the right;
- Certain other courses, such as EGEE-310 *Network Analysis* and EGRS-460 *Control Systems*, *synthesize* knowledge obtained from across the discipline, as is evident by the *convergence* of many lines towards them from the left.

To enforce compliance with the prerequisite structure outlined above, the University's registration system is designed to disallow enrollment in courses for which students lack the prerequisites or have not already enrolled in co-requisites. In recent years, furthermore, the Registrar has also adopted the practice of flagging and dis-enrolling students who could preliminarily enroll in a course while in the process of completing a prerequisite course, but who then subsequently do not successfully complete that prerequisite requirement (by withdrawing, failing, or not attaining a C in cases that require such). To provide some redundancy in ensuring compliance, furthermore, students, at the beginning of any course, are also asked by the Engineering instructor to complete and sign a statement that testifies to their having satisfactorily completed any prerequisite courses, and having enrolled in (or already completed) any co-requisite courses. Waivers for prerequisites must be approved by the ECE Coordinator, and a departmental policy statement (Appendix F) exists to provide guidance for frequently-occurring cases, while not restricting the discretion of the advisor and coordinator. Appendix K also contains example prerequisite forms.

5-A.5 Depth in Subject Areas

As indicated in Table 5-6, the program consists of at least 125 credits; insofar as these are semester credits, this is in accordance with the standard for total semester credits of at least 124. The distribution of these credits by subject area is as follows:

Table 5-6: Component of Curriculum

Subject Area	Credits	
Mathematics	19	
Instructed by Math Department		18
Instructed by School of Engineering & Technology		1
Basic Sciences	13	
General Education	24	
Engineering Sciences (core courses)	50	
Senior Sequence (capstone)	6 min.	
Technical Electives	13 min.	
Total	**125 min.**	

These various components, and their relation to Criterion 5, will be discussed in detail in the following subsections.

5-A.5.1 *Mathematics and Basic Sciences*

Criterion 5 requires that the curriculum include a minimum of 32 credits of mathematics and basic sciences (or a quarter of the total credits). The program meets that requirement by virtue of the courses listed in Table 5-7 below.

Table 5-7: Mathematics & Basic Sciences Component of Curriculum

Course	Credits
CHEM-115 General Chemistry I	5
EGNR-340 Numerical Methods	1
MATH-151 Calculus I	4
MATH-152 Calculus II	4
MATH-251 Calculus III	4
MATH-308 Probability and Statistics for Engineers	3
MATH-310 Differential Equations	3
PHYS-231 Applied Physics for Engineers and Scientists I	4
PHYS-232 Applied Physics for Engineers and Scientists II	4
Total	**32**

Some students entering the Electrical Engineering program do not possess a sufficient mathematical background to be placed in MATH-151 at the outset. These students are instead placed in lower level Mathematics courses, as appropriate to their initial preparation. Academic credit at the University is certainly received for such courses (except for any below the 100-level), and the grade point average does account for them, but they do not apply towards any degree requirements of the Electrical Engineering program, and stand outside of the program's minimum 125 required credits.

The Engineering-instructed course EGNR-340 *Numerical Methods* is regarded, for present purposes, as essentially a mathematics course rather than an engineering science course. It not only introduces numerical methods related to mathematics concepts from other courses (e.g., numerical integration, eigenvalue analysis, etc.), but also original mathematics content (e.g., partial differential equations) not introduced in the MATH listed courses of the curriculum.

It is also noteworthy that the program criterion calls not merely for *inclusion* of the Mathematics in the curriculum, but also for its *application* ("…to apply… mathematics"). Accordingly, many of the Engineering courses do make application of the Mathematics content, all the way from lower mathematics through topics from multivariate calculus and differential equations as the criterion specifies. As examples from the core, EGEE-345 Electromagnetics makes use of multivariate calculus. Technical elective courses such as EGRS-385 Robotics Engineering (using multivariate calculus for kinematic analyses) also contribute substantially to the application of mathematics.

The Mathematics portion of the curriculum, and its use to serve subsequent Engineering Sciences courses, is illustrated below in Figure 5-2. Grayed out courses are not formally parts of the program, but may be needed by some students before beginning Calculus I, if underprepared in mathematics. Note that for Figure 5-2 and Figure 5-3, unlike in Figure 5-1, there is no distinction made between prerequisite courses and pre-/co-requisite courses.

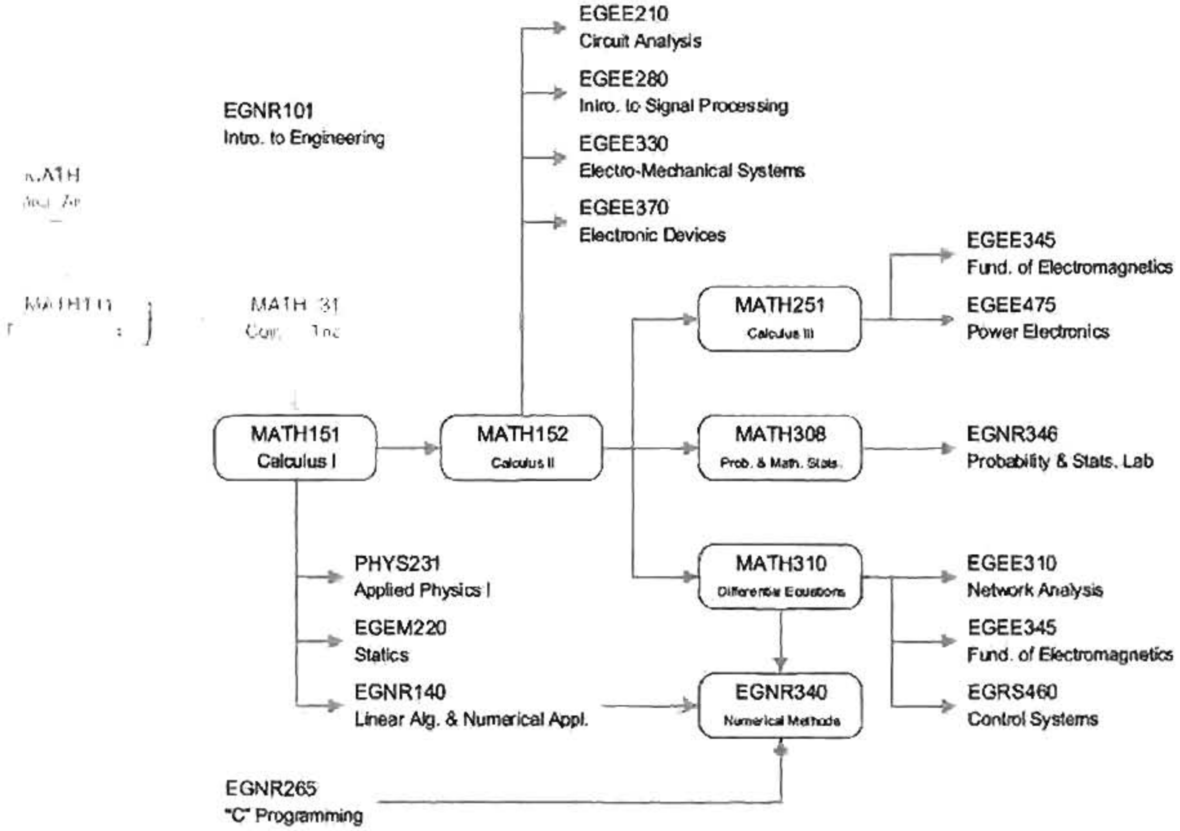


Figure 5-2: Mathematics Component as Related to Subsequent Courses

Consistent with the criterion 5 requirement that some basic science courses include experimental experiences, all three of the courses in natural sciences (CHEM-115, PHYS-231, and PHYS-232) have a laboratory component; these are 3 hours/week for CHEM-115, and 2 hours/week for each of PHYS-231 and PHYS-232.

The structure of the natural sciences portion of the curriculum, its mathematics prerequisites, and the Engineering Sciences courses which it serves are shown below in Figure 5-3.

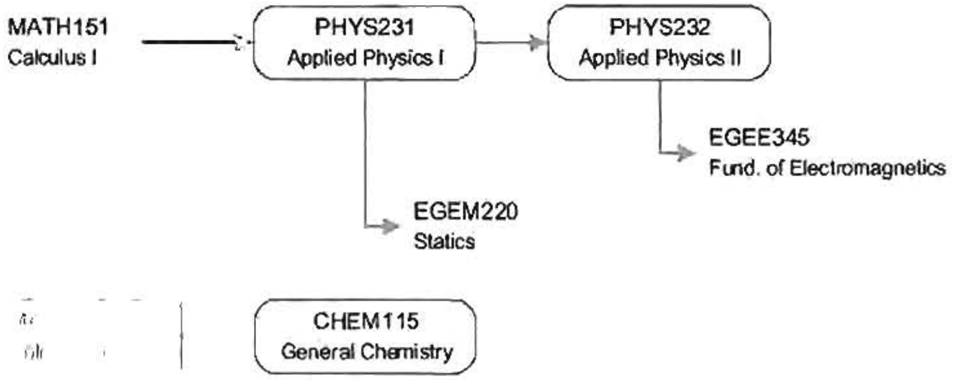


Figure 5-3: Science Component as Related to Subsequent Courses

5-A.5.2 *Engineering Courses*

Criterion 5 requires 48 credits (one-and-a-half years) of engineering topics, which are comprised of engineering science and engineering design. Indeed, the Electrical Engineering program at LSSU provides at least 56 such credits and typically 69 such credits when the technical electives are considered.

The core of the program provides 50 credits in engineering topics, as shown below in Table 5-8.

Table 5-8: Engineering Core Component of Curriculum

Course	Credits
EGEE-125 Digital Fundamentals	4
EGEE-210 Circuit Analysis	4
EGEE-250 Micro-Controller Fundamentals	4
EGEE-280 Introduction to Signal Processing	4
EGEE-310 Network Analysis I	4
EGEE-330 Electro-Mechanical Systems	4
EGEE-345 Fundamentals of Engineering Electromagnetics	3
EGEE-370 Electronic Devices	4
EGEE-475 Power Electronics	4
EGEM-220 Statics	3
EGNR-101 Introduction to Engineering	2
EGNR-140 Linear Algebra and Num Appl for Engineers	2
EGNR-265 "C" Programming	3
EGNR-346 Probability and Statistics Lab for Engineers	1
EGRS-460 Control Systems	4
Total	**50**

Additionally, 6-13 credits of engineering topics are provided through the senior-year capstone experience. Most students choose the EGNR-491&495 *Senior Design Projects* sequence, which has 6 credits of engineering topics, to satisfy the senior-year capstone experience. The other two routes are the EGNR-250-450-451-491 *Cooperative Education* sequence, which has 13 credits of engineering topics, and the EGNR-260-460-461 *Research Projects* sequence, which has 8 credits of engineering topics.

Additional credits of engineering topics are also provided in the options; however, a student may choose to take only advanced mathematics courses via the "General" option and earn only mathematics credits, although this has never occurred. The number of engineering topics credits available through technical electives is 0-13.

Thus, the total number of engineering topics credits in the program ranges from 56 to 69, depending upon which senior-year capstone experience is chosen and which technical electives are selected. This is summarized below in Table 5-9.

Table 5-9: Engineering Topics in the Curriculum

Curricular Component	Engineering Credits Range	Typical
Engineering Core	50	50
Senior-Year Experience	6-13	6
Engineering Technical Electives	0-13	13
Total	**56-69**	**69**

The EAC criterion 5 notes that "The engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering practice on the other." It will be evident from a consideration of Figure 5-1 through Figure 5-3, showing prerequisite structure, that the Engineering Science courses are indeed based upon foundations in Mathematics and the basic Sciences. Finally, the Engineering sciences lead into practice, as is highlighted especially by the senior sequence courses (EGNR-491&495).

5-A.5.3 Advanced Mathematics

The EAC program criterion for degrees named Electrical Engineering specifies, furthermore, that the program "must include advanced mathematics, such as differential equations, linear algebra, complex variables, and discrete mathematics." Accordingly, the program contains substantial amounts of material in these areas, as tabulated below in Table 5-10. Furthermore, the prerequisite structure within these areas is well-developed, giving the depth needed for professional work, as illustrated in Figure 5-1.

Table 5-10: Advanced Mathematics in Engineering Core Curriculum

Course
MATH-310 Differential Equations • Laplace transform introduced
EGEE-210 Circuit Analysis • complex numbers used in phasor description of sinusoidal signals and complex power
EGEE-280 Introduction to Signal Processing • complex numbers used in phasor description of sinusoidal signals • discrete systems covered extensively • frequency response through Fourier transfer introduced
EGEE-310 Network Analysis • Laplace transform of various signals introduced • s domain equivalent of differential equations introduced • transfer function introduced and used extensively • Bode plot approximations of transfer functions introduced
EGEE-345 Fundamentals of Engineering Electromagnetics • differential equations used to develop wave equations for transmission lines and free space
EGNR-140 Linear Algebra and Numerical Applications for Engineers • linear algebra introduced
EGNR-340 Numerical Methods • numeric solutions found to differential equations

EGRS-460 Control Systems
- Laplace transform of various signals introduced
- s domain equivalent of differential equations introduced
- transfer function introduced and used extensively
- Bode plot approximations of transfer functions introduced
- root locus introduced

5-A.5.4 *General Education*

There is a general education component comprising 24 credits (minimum) that are not otherwise called out by the degree program. The General Education mission statement reads as follows:

> *"In a diverse and changing world, college graduates must be prepared for a lifetime of learning in a variety of fields. In order to meet this challenge, general education requirements foster the development of general skills and knowledge that are further developed throughout the curriculum."*

Note that the LSSU University-level perspective is that the General Education component is actually 34 credits minimum, but that definition of "General Education" also includes Mathematics and Natural Sciences courses, which, for present purposes, are not included in what is referred to as "General Education" in this report (since they are fulfilled by specific program requirements). These are broken into 4 blocks:

- *Communications* block, consisting of two English composition courses (ENGL-110, ENGL-111) and a speech course (almost always COMM-101, although alternatives are listed which tend to be impractical for Engineering students). The courses have the objective that students *analyze, develop, and produce rhetorically complex texts, and communicate competently in a variety of contexts.*
- *Humanities* block, consisting of two courses from different disciplines, including humanities, fine arts, or languages. These courses have the objective that students *analyze, evaluate, and explain human aesthetics and its historical development.*
- *Social Sciences* block, consisting of two elective courses from areas such as history, sociology, psychology, geography, etc. These courses have the objective that students *think critically and analytically about the causes and consequences of human behavior.*
- *Diversity* block, consisting of a single elective course. These courses have the objective that students *view the world from cultural perspectives other than their own.*

5-A.6 Major Design Experience

Design is an integral part of the program, and there are numerous courses in the curriculum that provide design experiences. Students begin experiencing design activity in their first engineering course, EGNR-101 *Introduction to Engineering*, and continue to experience it throughout each subsequent semester, culminating in a senior (capstone) sequence. Projects, as a rule, require proof-of-concept and not mere design, usually implying that a prototype be fabricated and tested.

There are three possible paths for students to follow for their senior year capstone experience: *Industrial-path, Coop-path,* and *Research-path*; all of these paths provide a realistic design experience in an academic environment. In recent years, most students have chosen the Industrial-path, with just a few opting for the Coop path. The research path, while remaining available in principle, had been entirely inactive; however, for the first time in many years, three students are now pursuing it, having just completed the initial course in the Spring 2018 semester.

The industrial-path consists of the senior design course sequence EGNR-491&495. The initial course, EGNR-491, has a strong emphasis on team and communication skills during the definition and proposal phase, and initial design phase, of a multi-disciplinary project. Then, in EGNR-495, students continue to work on multidisciplinary teams to implement and engineer, i.e., realize, a final design for an industrial customer.

Alternatively, the Cooperative Education path students may substitute an equivalent design experience during their Co-op internship for the EGNR-495 course (realization phase). They still take the EGNR-491 course for the benefit of its academic content, and also assist one of the full-year (industrial-based) project teams during that semester, in order to gain further project experience. While the Co-op internship is in progress, they take the courses EGNR-450&451, with similar technical writing and oral presentation assignments to those of the industrial path courses.

Finally, the research-path students take, instead, a three-course sequence: EGNR260 – 460 – 461, of which the first (EGNR-260) is largely a literature study and introduction to basic research methodologies, taken in the 2nd-semester junior year; the 460 and 461 courses are largely coincident with the 491 – 495 courses of the industrial sequence, with the same lectures, and participation in the same team / communication skills activities, but the nature of the project differs, being rather an academically-oriented research project under the direction of a faculty member. Rather than a prototype necessarily, a scientific paper (perhaps complemented by a conference presentation or poster display) is the expected tangible outcome.

The Senior Year Experience for all of these paths requires the application of student knowledge and skills acquired in earlier course work to enhance their ability to accomplish required objectives. As described above, for most students (industrial path), the senior design experience at LSSU involves participating in an intensive design project that spans *two* semesters. Students work on multidisciplinary teams (i.e., typically a mix of students from the disciplines MfgET, ME, EE, EET, and CE (Computer Engineering), often 3-7 students depending on the scope. They ordinarily design and build a product or process prototype or proof-of-concept for an industrial customer; some projects, however, are supported directly by LSSU. Typical project budgets are $5,000 - $30,000, but have occasionally fallen out of that range on both ends. Examples of some projects from the past few years which have involved EE students are:

- The design, build, and automation of a prototype CNC milling machine. Team LSA upgraded an existing gantry mill which was originally manually operated. This machine was designed to work in a wide range of applications, could be mounted and operated while in any orientation, and was completely mobile.
- The design and build of an automated prescription dispensing machine designed to assist pharmacy employees. Building off the previous team's proof of concept workcell, Team CVS replaced the FANUC delta robot with a 3D gantry system they designed and built. Along with replacing the robot, Team CVS converted a majority of the control of the system from PLC (Programmable Logic Controller) to Raspberry Pi (mini-computer).
- Team WIS was tasked with researching and developing a system to automate the inspection of automotive rims. The system used an industrial camera and machine vision software to capture an image of a rim and analyze it.

- Team SAGA designed and built a system which utilizes laser measurements to achieve alignment between a robot arm and a steering column. The system replaced the previous manual method of robot alignment at Nexteer and increased the repeatability and accuracy of the testing procedure. The removable system used lasers mounted to the steering column and a target mounted to the robot arm. Together, the tools measured the robot's position and orientation in order to calculate and execute the required movements to achieve proper alignment.
- The design and build of a laser measuring system for Mactech, Inc., that had a vision of incorporating precision measurement tools alongside its on-site services. It was intended to be used to replace traditional dial indicators during the alignment process. The system overcame several obstacles frequently encountered with traditional mechanical indicators, such as visibility, physical manipulation, and size constraints. The device was also modular and wireless so that it could be attached to any machine desired by the operator, its linear adjustability made it compatible with cylindrical objects of a given diametrical range, and allowed Mactech to observe surface quality before and after machining.
- The design and implementation of a robotics workcell to simulate the dispensing of Spikefast, a wood filler product, into railroad ties. A Motoman robot, using custom end of arm tooling and a machine vision system, located the positions of spike holes on railroad ties as they moved by on a continuous conveyor. This project served as a proof-of-concept for future development of a wood product dispensing system in the railroad industry.
- The research-path group which has just completed EGNR260 is working on a project using surface-wave seismic techniques for either obstacle detection, or for detecting oil spills under lake ice layers (of application to the regional problem of monitoring Great Lakes pipelines for winter leaks); the exact direction is still developing.

More information regarding senior design projects, including more extensive descriptions of specific projects, can be found on the School's web site at the URL:

https://www.lssu.edu/school-of-engineering-and-technology/senior-projects

The senior design courses are managed by a multidisciplinary team of faculty called the senior projects faculty board (SPFB). Figure 5-4 depicts the major activities associated with the senior design courses. The display materials available at the time of the visit will also contain portfolios of the design projects.

As is evident from the process illustrated, there are several identifiable phases that put a premium on non-technical skills: multiple presentations (scope, update, final) enhance oral communications skills; written documents such as the project proposal ("project definition & plan") develop technical writing skills; customer meetings, team meetings, design reviews, etc. develop skills in running effective meetings and recording useful minutes; timeline software tools, action items and responsibility charts develop skills in time and resource management; all of these things as well as the project's design and implementation aspects, and various team assignments, all encourage the development of teamwork skills.

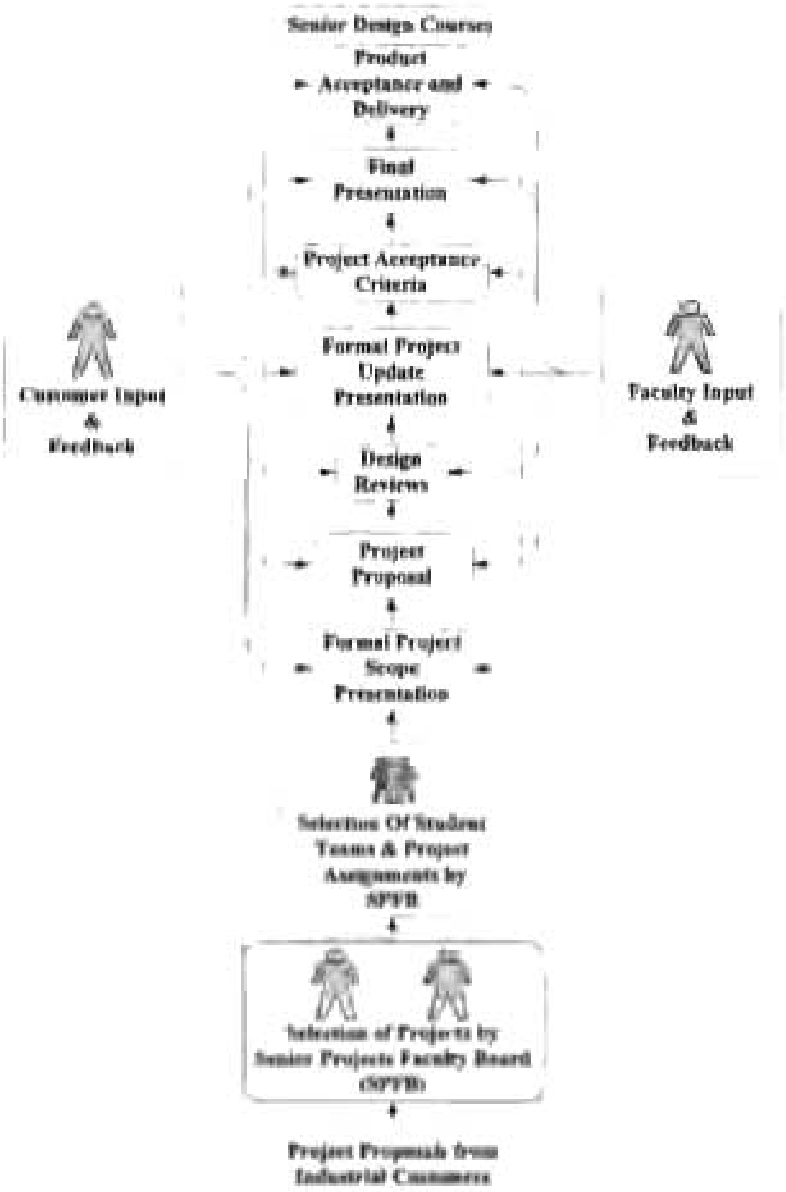


Figure 5-4: Overview of Senior Design Projects

Since, the projects are technical in nature, they require the application of the engineering skills of the student throughout; the required design and implementation tasks are the primary avenues for making use of engineering skills.

Appendix J contains the detailed syllabi for the senior design experience courses EGNR-491 and EGNR-495, and attachments to these.

5-A.7 Cooperative Education

Cooperative education opportunities exist for the engineering and technology students at LSSU. Co-op is not a large part of the curriculum, but the students may use some co-op to replace the second course in the senior (capstone) sequence, as described above. The most basic co-op course (EGNR-250), which is 2 credit hours, requires that a student write a business report describing their work in the engineering field. They must also complete an evaluation of their work experience and submit an evaluation of their work performance from the supervisor.

Students may also elect to use two upper level co-op classes (EGNR-450 and 451, as discussed above with respect to the alternative capstone experience paths) to replace EGNR-495, the second semester of senior projects (as described above). In this co-op experience, the students must complete a project at the co-op site that requires at least 60% of their time over the course of two semesters. The content of the project is approved by the co-op coordinator and the Senior Projects Faculty Board (SPFB). The academic requirements for the projects are very similar to those of the projects completed by the students in the senior design experience on campus, including graded presentations and written reports. The SPFB reviews the major documents submitted by the student to fulfill the course requirement.

5-B Course Syllabi

For more detailed information on specific courses listed in Table 5-1 through Table 5-4, note that all courses have detailed syllabi. Examples of the detailed syllabi of *some* courses are collected, as examples, in Appendix I; such syllabi are updated with each course offering, and electronic copies are kept on the Engineering network (y:/-drive), so that such detailed syllabi, comprehensively for all Engineering courses going at least a dozen years back, are available.

More concise syllabi for *all* courses in the program are provided in Appendix A. Each of these syllabi contain the following elements:

- Course number and name
- Credits and contact hours
- Instructor's / course coordinator's name
- Text book, title, author, and year, and any other supplemental materials
- Specific course information
- Brief description of the content of the course (catalog description)
- Prerequisites and/or co-requisites
- Whether a required, elective, or selected elective course in the program
- Specific goals for the course
- Specific outcomes of instruction (course objectives)
- Which of the student outcomes are addressed by the course
- Brief list of topics to be covered

Criterion 6 FACULTY

The School of Engineering & Technology (SET) contains positions for ten full-time faculty, two laboratory engineers, and a consulting engineers (with one of the lab engineers serving part-time as a second consulting engineer). School and program leadership rests with key faculty members who perform these functions on a release time basis. The School faculty work very well together as a combined team on school-related items. For purposes of program direction and planning, the School faculty members also meet as two separate departments: 1) Department of Electrical and Computer Engineering (ECE), and 2) Department of Mechanical Engineering (ME). The Electrical Engineering program is housed within the Department of Electrical and Computer Engineering, which is comprised of five full-time faculty members, one laboratory engineer, and one consulting engineer. It should be noted that due to the retirement of one of the ECE faculty members, the ECE department has been operating for the 2017-2018 academic year with only 4 full-time faculty members (and the School has been operating with only 9 full-time faculty members. A search is presently in progress to fill the open ECE faculty position.

Because of its small size, the School of Engineering & Technology offers engineering curricula that are significantly impacted by the other engineering disciplines in the School and also receive a significant amount of instruction from the faculty in the Department of Math and Computer Science. By the time they leave LSSU, Electrical Engineering graduates, for example, will have taken classes taught (or team-taught) by most of the ten-person School of Engineering & Technology faculty. Furthermore, much of the continuous improvement process occurs at the School level, in which the entire School of Engineering & Technology faculty participate. Hence, the discussion provided on the faculty in this section will include all members of the School faculty; however, special attention will be paid to the Department of Electrical and Computer Engineering faculty which directly administers the Electrical Engineering program.

LSSU is dedicated to its primary mission as a teaching institution by offering challenging undergraduate programs and services to students. In recognition of this mission, all members of the LSSU faculty are required by the University contract to devote 50-75% of their efforts during the academic year toward student learning activities and an additional 10-20% towards advising/student support activities. The remaining effort is directed towards scholarly and creative activities (5-20%) and service to the institution, profession, and/or general community (10-20%). The emphasis on teaching will come out in the subsequent sections, especially in Faculty Qualifications, Faculty Workload, and Authority and Responsibility of Faculty.

6-A Faculty Qualifications

The Electrical Engineering program at LSSU, like the Computer Engineering and Mechanical Engineering programs, can be characterized as one that emphasizes the fundamentals of engineering, traceability of theoretical results to first principles, applications of theory, and a heavy laboratory component that coordinates with the theoretical content. The faculty members instructing the program, consequently, generally share these philosophical precepts with regards to engineering education.

Consistent with the institution's primary mission of teaching, and the School's philosophy of maintaining an applied emphasis in its engineering and technology programs, the evaluation process employed in the hiring of new faculty accordingly places a greater emphasis on a candidate's philosophy of engineering education, promise as an instructor, and industrial experience, than it does on academic research credentials.

A candidate for the School of Engineering & Technology faculty is generally expected to have some teaching experience (either as faculty member or a teaching assistant) and to possess excellent communication skills. Each candidate is asked to give a sample lecture (on a topic specified by the hiring committee chair and generally kept the same for all visiting candidates) during the on-campus interview. This lecture is ordinarily given to both students and faculty. Feedback is thereafter solicited from those in attendance, and is given much weight in the subsequent hiring decision.

6-A.1 School of Engineering & Technology Faculty

As was noted before, the Electrical Engineering graduates are affected by nearly all the faculty in the SET due to the small size of the School and the interwoven nature of the engineering disciplines. Some faculty primarily teach courses that are required for the program, while other faculty interact with students through their participation in project-based courses such as EGNR-101 Introduction to Engineering or the EGNR-491&495 Senior Design Projects I and II capstone sequence. Background information is therefore presented for all faculty members in the SET below in Table 6-1 with a special note to those that routinely participate in the ECE departmental meetings.

An overview of the nine full-time and four adjunct faculty members of the School of Engineering & Technology in Table 6-1 indicates the following:

- All faculty members have appropriate BS degrees in engineering or engineering technology
- All full-time faculty members have appropriate advanced degrees in CE, EE, or ME to teach courses in the respective programs
- An average of 5.6 years of government and industrial experience
- An average of 14.9 years of teaching experience
- 11% of full-time faculty members are licensed Professional Engineers
- A medium level of professional society involvement
- A medium-high level of professional development
- A medium-low level of consulting and other industrial involvement

Table 6-1. Faculty Qualifications

School of Engineering & Technology

					Years of Experience				Level of Activity[4] H, M, or L		
Faculty Name	Highest Degree Earned - Field and Year	Rank [1]	Type of Academic Appointment[2] T, TT, NTT	FT or PT[3]	Govt./Ind. Practice	Teaching	This Institution	Professional Registration/ Certification	Professional Organizations	Professional Development	Consulting/ summer work in industry
Baumann, David (ECE)	PhD, EE, 1992	P	T	FT	4	25	19	Michigan	L	L	L
Jones, Andrew (ECE)	PhD, ECE, 2002	ASC	T	FT	0	19	13		M	M	H
Moening, Joseph (ECE)	PhD, EE, 2010	ASC	T	FT	0	13	8		M	H	L
Weber, Paul (ECE)	PhD, EE (CE), 2006	ASC	T	FT	1	12	9		M	M	M
King, Jeff (ECE)	BS, EET, 1996	A	NTT	PT	4	20	20		L	M	L
Becks, Eric (ECE)	MS, EE, 1981	A	NTT	PT	37	8	10		M	M	H
Devaprasad, Jim	MS, ME, 1986	P	T	FT	1	32	32		H	H	M
Hildebrand, Robert	PhD, Acoustics, 2001	ASC	T	FT	4	19	13		M	M	L
Leach, David	MS, ME, 2018	I	TT	FT	18	7	7		L	M	H
Mahmud, Zakaria	PhD, ME, 2003	ASC	TT	FT	1	15	4		M	M	L
Zarepoor, Masoud	PhD, ME, 2016	AST	TT	FT	0	2	2		H	H	M
Huff, Jordan	BS, ME, 2017	A	NTT	PT	1	0.5	1		M	M	H
Finley, David (Dean, 2017-2018)	PhD, ChemE, 1996	P	NTT	FT	7	12	6	Indiana	H	H	L
Muller, Kimberly (Dean, Starting Fall 2018)	PhD, Mathematics, 2004	P	T	FT	0	24	14		M	H	L

1. Code: P - Professor ASC – Associate Professor AST – Assistant Professor I = Instructor A = Adjunct O = Other
2. Code: TT = Tenure Track T = Tenured NTT = Non Tenure Track
3. FT = Full Time Faculty or PT = Part Time Faculty, at the institution.
4. The level of activity, high, medium or low, should reflect an average over the three years prior to the visit.

6-A.2 Department of Electrical and Computer Engineering Faculty

As will be demonstrated in this section, the ECE faculty is, furthermore, mutually complementary in their mix of competencies, and, these span the Computer Engineering and Electrical Engineering discipline as traditionally understood. They bring a blend of educational and professional experience. Given below is a brief description of each member of the ECE faculty, including strengths and the faculty member's relationship to curricular areas.

6-A.2.1 Dr. David Baumann, P.E. (ECE Professor)

Dr. Baumann has BS, MS, and PhD degrees in Electrical Engineering and an MS degree in Statistics from the University Wisconsin. As a graduate student he worked under the direction of Dr. R. A. Greiner in the Electro-Acoustics Laboratory. His research involved acoustic monitoring of machinery condition and active attenuation of noise in air ducts. He has four summers of research experience at the Naval Surface Warfare Center involving active vibration control of submerged propellers. He taught for 6 years at Oral Roberts University and has now taught for 19 years at LSSU. He has expertise and teaches courses in the areas of Electromagnetics, Control Systems, Circuits and Signals, Probability and Statistics, and Power Distribution. He served several years as the coordinator of the Senior Projects Faculty Board and the coordinator of the Department of Electrical and Computer Engineering and served the past six years as the Chair of the School of Engineering & Technology.

6-A.2.2 Dr. Andrew Jones (ECE Professor)

Dr. Andrew Jones joined LSSU during the 2005-2006 academic year. He has degrees in Electrical Engineering (BS/MS) and in Computer Engineering (PhD). He previously taught at Purdue University for three years. Dr. Jones has research experience in digital and micro-controller systems as applicable to mobile robotics systems. He primarily teaches courses in robotics, software development, digital electronic and micro-controller areas and was awarded with the LSSU Distinguished Teacher Award in 2010. Dr. Jones has also engaged in applied research activities with entrepreneurs interested in developing electronic products as well as consultations for industrial companies. He is also involved with FIRST with coordinating local FLL (FIRST Lego League) tournaments and mentoring the local FRC (FIRST Robotics Competition) team. He is the advisor for the LSSU chapter of IEEE. Dr. Jones is the coordinator of the Department of Electrical and Computer Engineering.

6-A.2.3 Dr. Joseph Moening (ECE Professor)

Dr. Moening has been at LSSU since the start of the 2010-2011 academic year. He has BS, MS, and PhD degrees in Electrical Engineering from the University of Toledo. His areas of interest include power electronics, renewable energies, semiconductor devices, analog electronics and micro/nano-device fabrication. He primarily teaches courses related to these areas. He has research experience in laser-based micro-structuring of thin films as well as power processing systems. His is the co-advisor for the Engineering House.

6-A.2.4 Dr. Paul Weber (ECE Professor)

Dr. Weber has a BS in Computer Engineering, and MS and PhD degrees in Electrical Engineering from Michigan Technological University. While at Michigan Tech, his primary research was in the area of fault-tolerant distributed control algorithms for safety-critical systems (e.g. fly-by-wire aircraft control). After finishing graduate school, he taught for three years as a Visiting Assistant Professor at University of Minnesota Duluth. During his time there, he also developed research in the areas of energy and engineering education, which he has continued while at LSSU since joining the faculty in the fall of 2009. Dr. Weber's primary teaching expertise is in digital design and embedded systems. He is currently the coordinator for Senior Projects and began serving as the Chair for the School of Engineering & Technology during the Spring 2018 semester.

6-A.2.5 Mr. Eric Becks (ECE Consulting Engineer)

Mr. Becks earned his BS and MS in Electrical Engineering/System Science from Michigan State University. Prior to joining the LSSU Product Development Center (PDC), Eric Becks was involved in industrial and entrepreneurial activities. His work experience ranges from Engineering Manager in a multi-national company to President of a diagnostic equipment manufacturing firm. Mr. Becks was involved in the formation of real estate, retail, internet marketing and manufacturing businesses as well as negotiating a leveraged buy-out. He has designed numerous products including several that have received industry awards. Besides his duties at the PDC, Mr. Becks also serves as Director of Intellectual Property & Economic Development for LSSU and President & CEO of SSMartSM, Inc., the Sault Ste. Marie/LSSU SmartZone. He has also served as a school board member for 14 years; 12 as president.

6-A.2.6 Mr. Jeff King (ECE Lab Engineer)

Mr. King is a full-time laboratory engineer for the School of Engineering & Technology. He has a BS degree in Electrical Engineering Technology from LSSU, and is pursuing a BS degree in Mathematics from LSSU on a part-time basis. He has valuable professional engineering experience in industrial electrical controls and PLCs, and is responsible for the School's electronic and computer systems. He occasionally teaches as an adjunct in the areas of electrical circuits, electronics, and PLC's for the engineering technology programs in the School and has instructed sections of the digital fundamentals laboratory. He also assists significantly in the senior design projects on the PLC and electrical design and implementation aspects.

6-A.3 Faculty Composition in Light of Program Criteria

It will be evident from the descriptions above, that the faculty composition contributes to satisfaction of the curriculum aspects of the program criteria stated below:

A. The structure of the curriculum must provide both breadth and depth across the range of engineering topics implied by the title of the program.
B. The curriculum must include probability and statistics, including applications appropriate to the program name; mathematics through differential and integral calculus; sciences (defined as biological, chemical, or physical science); and engineering topics (including computer science) necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components.
C. The curriculum must include advanced mathematics, typically including differential equations, linear algebra, complex variables, and discrete mathematics.

There is extensive professional experience in each of these kinds of activities when the full set of ECE faculty is considered, and that is further complemented by experience from the Mechanical Engineering faculty (see below).

6-A.4 Department of Mechanical Engineering Faculty

The following faculty members from the ME Department provide teaching and key ancillary support for the CE program:

6-A.4.1 Dr. Robert Hildebrand (ME Professor)

Dr. Hildebrand has research and publication background in the areas of noise and vibrations, vehicle dynamics, and soil dynamics. He has a good mix of industrial, consulting, research and teaching experience, often with a particular emphasis on editing and translating work. Accordingly, he strongly supports the program's emphasis on applications of fundamentals, on laboratory instruction, and on communications. He regularly teaches EGME-275 Engineering Materials, EGME-276 Strength of Materials Lab (co-taught), EGME-310 Vehicle Development & Testing, EGNR-310 Advanced Quality Engineering, EGEM-320 Dynamics, EGME-350 Machine Design, EGNR-340 Numerical Methods, EGME-415 Vehicle Dynamics, and EGME-425 Vibrations & Noise Control, regularly serves as a senior project faculty advisor, and has often team-taught MATH-310 Differential Equations. Dr. Hildebrand is the coordinator of the Department of Mechanical Engineering.

6-A.4.2 Prof. James Devaprasad (ME/MfgET Professor)

Prof. Devaprasad has been a professor in the School of Engineering & Technology at LSSU for 32 years. His areas of teaching emphasis include robotics and automation. He was the Coordinator or Chair of Manufacturing Engineering Technology for much of that time, and has also served as Chair of the School of Engineering & Technology for a time while the Dean position was vacant. He is currently the coordinator of General Engineering and Technology as well as the director of LSSU's Robotics Center.

Prof. Devaprasad has been the leader in developing the robotics laboratory through industrial donations and grants, and has been in key leadership roles nationally in the Society of Manufacturing Engineers (SME) and the Robotics Industries Association. He normally teaches several robotics courses in both the engineering and engineering technology curricula and often serves as the advisor or customer for robotics senior projects. He also supports the Robotics Technology minor available for the Engineering Technology students and Computer Science students. He is a recipient of the Outstanding Young Manufacturing Engineer award from SME and the distinguished faculty award from the Michigan Association of Governing Boards of universities. He serves as the director of the Women in Technology summer camps and the Robotics summer camps that he and his colleague founded over 27 years ago. He also led the successful initiative to create a B.S. in Robotics Engineering during the Spring 2018 semester.

6-A.4.3 Mr. David Leach (ME Instructor)

Mr. Leach started working for the LSSU Product Development Center in 2008, and became a full time faculty member in 2014. He has MS and BS Mechanical Engineering degrees from Michigan Technological University, and is currently enrolled in MTU's doctoral mechanical engineering program, with an expected start date of Spring 2019. Mr. Leach's areas of interest include CNC machining, manufacturing processes, product development, plastics design, lean manufacturing, quality systems, and manufacturing sustainability. David primarily teaches EGME-141 Solid Modeling, EGME-240 Assembly Modeling and GD&T, EGME-110 Manufacturing Processes, EGMT-216 CAM with CNC Applications, EGMT-225 Statics and Strength of Materials, and EGNR-491/495 Senior Projects. He has automotive industry experience in product and quality engineering for Class A exterior plastic trim. Mr. Leach is our cooperative education coordinator and is responsible for our co-op sequence of courses: EGNR-250, EGNR-450, and EGNR-451. David is also the faculty advisor for Tau Kappa Epsilon (TKE), a service fraternity at LSSU.

6-A.4.4 Dr. Zakaria Mahmud (ME Professor)

Dr. Mahmud has a BS in Mechanical Engineering from Bangladesh University of Engineering and Technology (Dhaka, Bangladesh), MS in Sustainable Energy Engineering from The Royal Institute of Technology (Stockholm, Sweden), and PhD in Engineering Science and Mechanics from the University of Alabama (Tuscaloosa, Alabama). After graduation, he taught for one year in Aerospace Engineering Department at Texas A & M University (College Station, TX). He then led NASA SBIR phase II project as Principal Research Engineer at Techsburg Incorporated (Blacksburg, VA). Dr. Mahmud then taught in Mechanical Engineering Technology program at Georgia Southern University (Statesboro, GA). Before joining in LSSU since Fall 2014, he taught for seven years in Mechanical Engineering at North Dakota State University (Fargo, ND). His primary research interests are in the areas of experimental aerodynamics and micro-fluidics. He regularly teaches the following courses at LSSU: EGNR-101 Introduction to Engineering, EGNR-140 Linear Algebra and Numerical Applications, EGME-337 Thermodynamics, EGME-338 Fluid Mechanics, EGME-431 Heat Transfer, and EGME-432 Thermal Fluids Laboratory. Dr. Mahmud is serving as a co-advisor for Engineering house and advisor for the Society of Automotive Engineers (SAE).

6-A.4.5 Dr. Masoud Zarepoor (ME Professor)

Dr. Zarepoor received his BS in Mechanical Engineering from Shiraz University. He pursued his graduate studies by receiving MS and PhD degrees in Mechanical Engineering from Wright State University and Old Dominion University, respectively. His PhD research was focused in the areas of vibrations, nonlinear dynamics, bistable structures, and piezoelectric materials. He joined LSSU in 2016 as an Assistant Professor in Mechanical Engineering, where he teaches Statics, Mechanics of Materials, Vibrations, and Finite Element Analysis courses. He also continues his research works in the area of vibrations and piezoelectric actuation of bistable structures at LSSU and serves as the Faculty Advisor for the ASME student chapter at LSSU.

6-A.4.6 Mr. Jordan Huff (ME Lab Engineer)

Mr. Huff is a full-time mechanical laboratory engineer for the School of Engineering & Technology. He has a BS ME degree from LSSU and has experience in manufacturing as well as vehicle development and testing. Prior to earning his bachelor's degree, he was self-employed and restored vehicles. He supports both mechanical and manufacturing aspects of the program and is active in professional groups such as SAE (Society of Automotive Engineers). Mr. Huff also provides mechanical engineering support for LSSU's Product Development Center and has also served as an adjunct lab instructor for the manufacturing and processes course.

6-B Faculty Workload

The faculty member is understood to have duties in instruction (encompassing teaching, office hours, advising, and student support/mentoring), "professional development" (encompassing research and scholarly work), and service (to the University—including the School and the Department, to the Profession, and/or to the Community as outreach).

The instructional portion, specifically, is fulfilled by instructing coursework amounting to 24 contract hours per year (or an average of 12 per semester), where "contract hours" are defined below. Although faculty members are considered full time if they teach 24 contract hours per year (average of 12 contract hours per semester), professional development and scholarly work are duties that fall outside the 24 measured contract hours.

6-B.1 Definition of Contract Hours

Faculty time commitment is measured contractually in contract hours (also "load hours"), which are *not* identical to credit hours earned by a student. A student earns a *credit* hour for each hour of lecture per week, and an additional credit hour for a 1-3 hour lab. On the other hand, one *contract* or *load* hour is one hour of lecture or 1.5 hours of lab (i.e., the actual lab time is multiplied by 2/3 to generate contract hours).

The time distribution of the faculty member's workload (implied based on proportionality to the contractually allowable weights given in the supervisory evaluation of the faculty member) is 50-75% for the student learning activities (corresponding primarily to the 24 load hours per year), 10-20% "advising/student support activities," 5-20% scholarly and creative activities (including research), and 10-20% University/School/Departmental/Community service. In a few cases, such as very heavy advising loads and special lab/research director appointments, contract load may be given for activities besides courses.

6-B.2 Instructional Workload

The amount of time and energy that faculty are expected to provide to an engineering program greatly influences the general strength of the program. Typical indicators of workload include contract hours, and student-to-faculty ratios (reflective of typical class and lab enrollments). A detailed list of instructional duties of the individual ECE faculty members (the four current full-time ECE faculty members, one ECE laboratory engineer, and one ECE consulting engineer) is shown in Table 6-2 and Table 6-3. A broad overview of the instructional workload broken down by group (regular faculty, lab engineers, etc.) meanwhile is shown in Table 6-4.

Table 6-2: Faculty Workload Summary, Fall Semester

School of Engineering & Technology

Faculty Member	PT or FT[1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to Program[5]
			Teaching	Research or Scholarship	Other[4]	
Baumann, David (ECE)	FT	F2017: EGEE280 (4), EGNR346 (1), EGRS460 (4)	75%		25% SET Chair	75%
Jones, Andrew (ECE)	FT	F2017: EGEE250 (4), EGNR101 (2) Team, EGNR265 (3), EGRS380 (2)	92%		8% ECE Coordinator	100%
Moening, Joseph (ECE)	FT	F2017: EGEE210 (4) Lec, EGEE330 (4), EGEE370 (4) Lab, EGRS365 (3)	100%			100%
Weber, Paul (ECE)	FT	F2017: EGNR261 (3), EGNR361 (1), EGNR491 (3) Lec&Crd, EGRS430 (4)	100%			100%
Becks, Eric (ECE)	PT	F2017: EGNR491 (3) Adv&Lec, EGEE370 (4) Lec	15%		50% PDC Engineer 35% Assoc Dean	85%
King, Jeff (ECE)	PT	F2017: EGNR491 (3) Adv, EGEE210 (4) Lab	10%		90% Lab Engineer	100%
Devaprasad, Jim	FT	F2017: EGRS381 (1), EGRS480 (3), EGRS481 (1), EGRS496 (3), EGNR491 (3) Adv	62%		30% Robotics Center Coordinator 8% Eng. Tech. Coordinator	100%
Hildebrand, Robert	FT	F2017: EGNR340 (1), EGNR491 (3) Adv, EGEM320 (3), EGME350 (4) Team	80%	12% Scholarship	8% ME Coordinator	100%
Leach, David	FT	F2017: EGME110 (3), EGME141 (3), EGNR490 (4) Adv, EGNR491 (3) Adv	100%			100%
Mahmud, Zakaria	FT	F2017: EGNR101 (2) Team, EGNR140 (2), EGME431 (3), EGME432 (2)	100%			100%
Zarepoor, Masoud	FT	F2017: EGEM220 (3), EGME350 (4) Tm, EGMT225 (4), EGNR495 (3) Adv	75%	25%		100%
Hoff, Jordan	PT	F2017: None	10%		70% Lab Engineer 20% PDC Engineer	100%
Finley, David (Dean, 2017-2018)	N/A	F2017: None	0%		100% Dean and Interim Provost	25%
Muller, Kimberly (Dean, Start: Fall 2018)	FT	F2017: MATH111 (3), MATH151 (4)	75%	5%	20% Math & CS Chair	0%

Key: Lec = Lecture Only; Lab = Lab Only; Crd = Coordinator; Tm = Team Taught, Adv = Project Advisor

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the Self-Study Report is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.

Table 6-3: Faculty Workload Summary, Spring Semester

School of Engineering & Technology

Faculty Member	PT or FT[1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to Program[5]
			Teaching	Research or Scholarship	Other[4]	
Baumann, David (ECE)	FT	S2018: EGEE210 (4), EGEE411 (3), EGNR340 (1), EGNR490 (1)	87.5%		12.5% Faculty Senate	87.5%
Jones, Andrew (ECE)	FT	S2018: EGEE355 (4), EGNR265 (3), EGRS215 (2), EGRS385 (4) Lec	92%		8% ECE Coordinator	100%
Moening, Joseph (ECE)	FT	S2018: EGEE475 (4), EGRS365 (3)	100%			100%
Weber, Paul (ECE)	FT	S2018: EGEE125 (4), EGNR495 (3) Crd, EGRS385 (4)Lab	75%		25% SET Chair	75%
Becks, Eric (ECE)	PT	S2018: EGNR245 (3), EGNR495 (3) Adv	15%		50% PDC Engineer 35% Assoc Dean	85%
King, Jeff (ECE)	PT	S2018: EGNR495 (3) Adv	10%		90% Lab Engineer	100%
Devaprasad, Jim	FT	S2018: EGRS385 (3) Lab, EGRS435 (3), EGNR495 (3) Adv	62%		30% Robotics Center Coord. 8% Eng. Tech. Coordinator	100%
Hildebrand, Robert	FT	S2018: EGNR260 (2), EGNR490 (1), EGNR495 (3) Adv, EGME275 (3), EGME276 (1), EGME425 (4)—Team	80%	12% Scholarship	8% ME Coordinator	100%
Leach, David	FT	S2018: EGME110 (3), EGME240 (3), EGNR495 (3), EGMT216 (3)	100%			100%
Mahmud, Zakaria	FT	S2018: EGNR140 (2), EGME337 (4), EGME338 (3)	100%			100%
Zarepoor, Masoud	FT	S2018: EGEM220 (3), EGME225 (3), EGME425 (4) Tm, EGME276 (1), EGNR495 (3) Adv, EGME141 (3)	75%	25%		100%
Huff, Jordan	PT	S2018: EGME110 (3) Lab	10%		70% Lab Engineer 20% PDC Engineer	100%
Finley, David (Dean, 2017-2018)	N/A	S2018: None	0%		100% Dean and Interim Provost	25%
Muller, Kimberly (Dean, Start: Fall 2018)	FT	S2018: MATH152 (4), MATH207 (3)	75%	5%	20% Math & CS Chair	0%

Key: Lec = Lecture Only, Lab = Lab Only, Crd = Coordinator, Tm = Team Taught, Adv = Project Advisor

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the Self-Study Report is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.

Table 6-4: SET Faculty Workload Overview for 2017-2018

	Instruction Only		Instruction + Release	
Instructional Subgroup	Load Hours	Percentage	Load Hours	Percentage
Full-Time Faculty (active)	242.79	89.8%	271.64	90.5%
Full-Time Faculty (on sabbatical)	0	0%	0	0%
Lab Engineers	13.39	5.0%	14.14	4.7%
PDC Engineers	14.03	5.2%	14.43	4.8%
External Adjuncts	0	0%	0	0%
Total	270.21	100%	300.21	100%

Notice that, since most of the courses offered for the Computer Engineering program are included in the Electrical Engineering program, for the purposes of constructing Table 6-2 no attempt was made to parse faculty time between the two programs in the parenthetical ECE notes. Furthermore, due to the highly integrated nature of the School of Engineering & Technology the right-most column of Table 6-2 and Table 6-3 indicates the percentage of time that each faculty member devotes to the School.

For the regular faculty, a full-time teaching load is 12 contract hours (or sometimes "load hours") per semester, with the option to take on up to 6 additional load hours per semester with "overload" compensation at a reduced rate. A faculty member may fall under 12 for a given semester, if compensated in the same academic year by an overload in the other semester, such that 24 contract hours are performed per year. Single semester loads are limited to 18, and annual (excluding summer) loads to 32.

The average School-wide load for the full-time faculty during the 2017-2018 academic year was 15.1 load hours per semester (i.e., an average of 3.1 hours of overload), and about 90% of the instruction was provided by them. Note that the situation was unusual that year, however, because a faculty member retired and the position was not filled immediately (as of the time of this report, the search for a new faculty member is still on-going). In the 2015-2016 academic year, for comparison, the average load had been 13.4 load hours per semester. If the present year's load was divided by 10 full-time faculty members instead of 9, the average load per semester would be 13.6 load hours per semester. Furthermore, the student-faculty ratio for courses in the School of Engineering & Technology in the Spring 2018 semester was approximately 16:1. With faculty research commitments less than is traditional in academia, no supervision of graduate students, and reasonable limits on other non-instructional activities as outlined below, adequate faculty coverage for quality teaching and student interaction is thereby assured.

The teaching load limits, and the general goals of keeping faculty near to the nominal load of 12 hours per semester and of maintaining a healthy student-to-faculty ratio, are intended to allow faculty members time to participate in non-classroom, professional activities as well as provide for quality student interaction and class preparation. Thus, beyond the expectations for teaching, faculty are also expected to hold regular office hours, and to participate in academic advising, student group advising, service activities, and professional development.

6-B.3 Office Hours and Advising

All regular, full-time faculty keep 5 office hours per week, at which they are available to meet students; those teaching less than full-time (e.g., the lab and PDC engineers) have numbers of office hours that are pro-rated by their respective fractions of a full-time teaching load. These office hours permit students to interact with the faculty member to supplement in-class instruction. Some courses have recitation sections, for which faculty provide a one-hour recitation and are accordingly relieved of an hour of office hour burden. Thus, the standard is that the total of recitation hours and office hours add up to 5 per week (note that no faculty currently have so far had more than 1 recitation hour per semester, and exceeding 2 recitation hours per faculty member per semester will be discouraged should that situation ever arise, in order that the number of general office hours will remain adequate).

Academic advising, in its aspect as a service to students, is described above. Concerning, on the other hand, its aspect as a faculty activity and time burden, note that the approximately 180 students enrolled in the School are divided amongst the 9 fulltime faculty members as advisees, so that the average is about 20 advisees per faculty member. The advising duties of the faculty member are to meet with each advisee prior to registration, recommend courses for which to register, and discuss course selection alternatives from the perspectives of progress to degree completion, student interests, and career relevance. As a benchmark, 15 minute advising sessions are used for freshmen students in EGNR-101 *Introduction to Engineering* (for students in that course only, these are scheduled during a specific lab session). Thus, an estimate of 4-5 hours of ordinary advising burden per faculty member per semester is reasonable; there is also some additional burden on the program coordinators and the school chair, specifically, in handling supplemental advising related to course overrides, transfer credit evaluation, and waivers, but this phenomenon is compensated through the release time adjustments to the 12-hour full-time load.

Faculty members also advise senior project teams, which provide a substantial amount of additional interaction with students and their respective industrial sponsor contacts in a realistic professional setting. Certainly, advising of senior projects teams is another time-consuming activity for faculty that resembles some of the out-of-classroom student interaction activities described above, but in principle, since this activity is compensated by teaching load from the EGNR-491 and EGNR-495 courses, it is more properly seen as part of team-teaching those courses.

The office hour and academic advising burdens are implied extensions of the instructional component of the faculty members' duties; they do not generate additional contract hours with the exception of extreme cases where 50 or more advisees are assigned to a single adviser, but are rather understood to be a part of the duties inherent in fulfilling the 24 load hours.

6-B.4 Release Time Assignments

Certain leadership roles within the School or the Departments (school chair, program coordinators) or within team-taught courses (lab section coordinators, senior projects board chair) *do* provide "release time" contract hours which may be counted towards the

24 contract hour per year requirement. These assignments are described in detail in Criterion 0.

6-B.5 Non-Instructional Workload

The 24-load hour requirement, described above, may be understood to comprise (with the exception of release time appointments) the *instructional* part of the faculty member's duties, only. Outside of the 24 load hours fall the additional duties of service and scholarship. As noted previously, this may be up to 40% of the faculty member's workload (scholarship up to 20%, and service up to 20%). This is an adjustment from 6 years ago when 100% of a faculty member's time could be devoted to teaching for a given year, although there was always an expectation of accomplishment in both the service and the scholarship categories by the time of tenure and promotion decisions.

Professional development activities, by their nature, vary considerably in kind and scope from faculty member to faculty member; the reader is referred to the faculty CVs (Appendix B), for specifics.

Service activities also vary in kind and scope among faculty members, especially with regards to service to the general Community. However, many of the other service activities are School-coordinated to such an extent that a rough overview can be given. Faculty members within the School regularly serve on University-wide committees (e.g., curriculum, general-education, student retention, etc.), serve on School committees (e.g., Engineering scholarship awards committee), support the faculty association, and participate in assessment. Each faculty member has a unique, measurable, responsible role in the School's assessment program (e.g., assessing a performance indicator for a specific student outcome). There are also initiatives within the School, and LSSU, to increase new student enrollment, by means such as high school visit and lab tours, each of which represent common service activities of the faculty. Faculty members serve as advisors to student chapters of national professional organizations, including SME: previously the Society of Manufacturing Engineers, SAE: Society of Automotive Engineers, ASME: American Society of Mechanical Engineers, IEEE: Institute of Electrical and Electronics Engineers, and SWE: Society of Women Engineers; serving as such an advisor generally involves overseeing that the clubs operate within their bylaws, recruit, fundraise, manage their budgets, and participate in regional and national events. Faculty members participate, finally, in summer orientations, although the chair has usually undertaken the majority of this particular burden.

6-C Faculty Size

As noted above, in Table 6-2, the 10 faculty (even in the absence of one due to retirement) were able to cover almost 90% of the instructional burden, and with only a moderate amount of overload per semester (3.1 contract hours average) and reasonable class sizes (average around 16). All of these figures are the same or better when the full set of faculty members are present for the full academic year, which is the ordinary situation.

All faculty maintain at least 5 hours of some combination of office hours and recitations (in practice, the latter has never exceeded 1 of the 5 hours for any faculty member).

Senior student exit surveys consistently support the notion that these interactions are not only sufficient in quantity, but also in quality; a consistent theme is that students have excellent and fruitful access to faculty members.

Each student has a faculty member assigned as an academic advisor, and meet with the faculty member at least once per semester. As noted above (section 6-B), there is an average of around 20 student advisees per faculty member, suggesting a situation in which sufficient attention can be given to each.

University service and professional development activities are discussed in Criterion 6-B and 6-D, respectively.

The faculty have, finally, opportunities to interact with industrial and professional practitioners in a variety of contexts, including senior projects and cooperative education projects (see Criterion 5-A), PDC-sponsored projects (see Criterion 6-D), IAB meetings (see Criterion 2-D), sabbaticals (although in practice this has not been done in this 6 year cycle, and would require significant planning given the size of the faculty and teaching loads) and summer internships (e.g., see CV for Andrew Jones for the latter).

6-D Professional Development

All of the School faculty members have pursued professional development activities over the past five years. These include grant writing, consulting, research, publication of scholarly articles and texts, conference presentations, and attending teaching development training seminars, but the level of these activities is, consistent with the focus of the LSSU mission on teaching, less than is traditional elsewhere in academia. The major activities for School of Engineering & Technology faculty are listed below in Table 6-5. A detailed list of each faculty member's activities can be found in the CVs in Appendix B.

Table 6-5: Summary of Faculty Development Activities

Activity	Number of Active Faculty[1]	Comments
Industrial Consulting	11	Industrial training, consulting through PDC, external consulting, Senior Project support for external industrial customers
Journal/Conference Papers	7	Over 25 papers over a six year period.
Grants and Fundraising	8	Approximately $0.76M over a six year period.
Research	7	Internal projects, external projects, and government projects.
Attendance of Conferences and/or Professional Workshops	12	Over 55 conferences and/or workshops attended over a six year period.
Peer Review for Journals/Conferences	5	Peer review of sets of papers for over 40 journals and/or conferences.

[1] The number of faculty in this table can be greater than the present number of faculty in some cases due to the fact that some faculty members are counted here that are no longer employed at LSSU but worked here within the last 6 years.

Faculty have also had the opportunity to become involved in consulting projects through the Product Development Center (PDC), established in 2008 (see organizational structure in Background, section D). "Center" is to be understood here, not so much a facility (although there is capital equipment associated, and a building in progress), but as a team of one full-time engineer and one part-time engineer that accept a range of consulting projects from industry and entrepreneurs to design or improve engineered products. The concept is that the engineers can pass on some work to promising student employees, and also more specialized work to faculty as experts. While some members of the faculty have indeed carried out work in such projects, most of that was at the end of the previous 6 year cycle with only one faculty member working for an external company with the support of the PDC several years ago within this present 6 year cycle.

Many members of the faculty also regularly serve on the Senior Projects Faculty Board (SPFB). The SPFB oversees all senior year experiences within the School of Engineering & Technology. As many projects are sponsored by industry, *senior projects provide good opportunities for faculty to work closely with industry*. This interaction has resulted in faculty providing training for industrial-based engineers, occasional summer employment opportunities for faculty, and general faculty professional development due to the close industrial ties.

6-E Authority and Responsibility of Faculty

6-E.1 Leadership Structure

The leadership structure within the School of Engineering & Technology consists of a School Chair as well as program coordinators for ECE (EE and CE), ME, and the engineering technology programs. All of these fall under the administration of the dean who is, in turn, under the provost. The latter two have approval/veto authority. Further information about this can be found later in the "Leadership Responsibilities" portion of this subsection.

6-E.2 Establishing policy

This subsection addresses the faculty's role, and those of administrators, in defining the program's curriculum, continuous improvement process, educational objectives, and student outcomes. For all of these areas, it is the faculty that are the primary authority over all of these areas and who plan and originate curricular change proposals, but administrators have approval/veto authority relative to curriculum, specifically.

Curricular matters for the program, including prerequisite structure and the detailed course requirements comprising the program, are planned at the departmental level. The ECE departmental faculty regularly meet (weekly during the academic year), with the ECE coordinator setting the agenda. It is in this forum that the curriculum (among other business) is addressed in detail, and in which any action to change it originates; i.e., administration does not generate its own curricular change proposals. The department ordinarily operates by consensus, although a formal majority vote is, in principle, required to adopt any change; such a vote could be undertaken in the unlikely event there was not clear consensus and a decision could not be forestalled. A change so approved by the ECE faculty is then proposed to the entire School faculty, and a formal vote taken at that level, usually after discussion in a School faculty meeting (discussion may be foregone in the case of minor changes, e.g., prerequisite issues related to courses not common to the ME discipline). Upon School faculty approval, the Dean must approve, after which the proposal proceeds to a University-wide Curriculum Committee, a committee consisting primarily of faculty, but also of administration and student representatives, and in which the School is represented by a single voting faculty member. If approved at that level, it must, finally, receive approval by the Provost, usually after advisory discussion in the Provost Council (a body comprised of the Deans and Associate Provost).

The student outcomes and PEOs for the program, which are provided in Criterion 2 and Criterion 3, and the continuous improvement process outlined in Criterion 4, are defined and revised by the entire faculty of the School of Engineering & Technology (i.e., both ECE faculty and ME faculty collectively). Regular occasion is provided for this by the meetings which review the student outcome and PEO evaluation reports. Of course, external advice, such as that from the IAB, Dean, and others may at times be sought as well, but this is always at the initiative of the School faculty. The Dean and higher administrative instances (Provost, etc.) have no formal approval, veto or other role in the process concerning student outcomes and PEOs, although the atmosphere is collaborative and their input is welcomed and respected.

Thus, all the regular faculty of the entire School has some kind of a role in the program. This includes establishing its student outcomes, PEOs, continuous improvement process, and thereby the general direction of the program. By virtue of the wide involvement of faculty in the assessment process for all of the School's programs, and the similarity in the assessment process for all of the engineering programs, the entire School faculty is in a well-informed position concerning interpreting assessment results for the Computer Engineering program. Minutes of assessment meetings concerning the program student outcomes and PEOs (available for review) demonstrate that the entire faculty, regardless of academic rank or other factor, regularly attends and participates in the deliberations. They also show that ample time is taken in these deliberations such that all perspectives are thoroughly heard and considered, and consensus obtained; accordingly, formal votes are unusual.

In summary, the faculty has autonomy with regard to defining and revising student outcomes, PEOs, and continuous improvement. However, the input of other constituents regarding curriculum is an important part of the process. The former (student outcomes, PEOs, continuous improvement) is addressed by the School faculty collectively, while the latter (curriculum) is primarily planned by the Departmental faculty (with later School faculty discussion and approval).

6-E.3 Implementation of Policy

Implementation of curricular decisions, PEOs, student outcomes, and the continuous improvement process is now addressed.

Curricular decisions, once all approvals are obtained, are ultimately realized by the Registrar (in ensuring that a student completes all curricular requirements before awarding a degree) and the faculty (by virtue of their offering the courses with the intended, as-approved content, and in an effective way).

PEOs are "implemented" by virtue of their dictating a consistent set of student outcomes that support them. The student outcomes, in turn, are implemented by each of the following mechanisms:

- Alignment of the curriculum (i.e., program requirements) to the student outcomes
- Content in specific courses (e.g., to include a design project in a course)
- Sponsorship of student organizations

Regarding the curriculum piece, there must be a process to ensure consistency and quality of the courses, and their inclusion of the elements dictated by the student outcomes. That process is aided by the mutual consent of the faculty in defining the student outcomes, as discussed above. Since all faculty members have had a voice in the student outcomes (which the faculty agreed to align directly with the ABET student outcomes A-K), there is a common commitment to including the elements of the student outcomes in the courses. The process itself has two aspects:

1) Ensuring that each of the qualities specified by the student outcomes is incorporated throughout the curriculum, by identifying sets of courses, each of which supports some element of a student outcome in some way;
2) Ensuring that each course, individually, is both well-taught by the faculty member and that it adequately addresses its course objectives (which ultimately address some elements of the student outcomes, even if indirectly).

To satisfy point 1) of the process, i.e., to be sure that the student outcomes are reflected throughout the curriculum, deliberate planning of the curriculum is necessary; for the Electrical Engineering program, this is largely the province of the ECE department, and deliberations on the curriculum are indeed well-represented in the minutes of that body (available for review).

As an example of PEO and student outcome implementation, notice that PEO-I calls for, among other things, an experienced graduate to "...solve problems in their professions." Clearly, solving problems as a professional requires an ability to identify, formulate, and solve problems.

Therefore student outcome E supports PEO-I as it specifically calls for "an ability to identify, formulate, and solve engineering problems". Student outcome E is then supported by various courses within the curriculum that have graded activities related to solving engineering problems. The ECE Department regularly reviews a list of courses (available for review) that should incorporate such assignments. As each course is also separately assessed, there is an opportunity to ensure that such assignments are incorporated into the course syllabus and that grade performance respective to the assignments is tracked. In summary, a process of curriculum planning, reflected most notably in the minutes of the ECE department, as well as a process of course-level assessment, is practiced to satisfy point 1).

To satisfy point 2), a further distinction is necessary between, on the one hand, quality of instruction, and, on the other, faithfulness of the course to its objectives (which will somehow, however indirectly, support the student outcomes and ultimately the PEOs).

The process of ensuring quality of instruction (typically referred to as "evaluation" at LSSU) is the province of the Dean rather than that of Chairs or other faculty. The Dean, however, does utilize faculty members' expertise as peer evaluators during the process of evaluation. The Dean evaluates the instructional performance of faculty, taking account of confidential questionnaires filled-in by students at the end of a course, by visitations to faculty lectures, and by review of samples of course materials. This evaluation is evidently prejudicial for the prospects of the faculty concerned in the annual renewal, tenure and promotion processes.

The process of ensuring faithfulness of the course to its objectives (typically referred to as "course assessment" at LSSU, as opposed to "evaluation") is, on the other hand, the province of the faculty themselves, but collectively. Thus, the practice amongst the department is that each faculty member, during the last week of classes, carries on a discussion with the students about their confidence levels in the various course objectives, adequacy of prerequisites, adequacy of course materials, and other factors relating to the course save the quality of instruction. The students also complete a questionnaire regarding the same topics. The discussion comments and questionnaires, together with grade data broken down by course objective, are then tracked for each course and serve as a basis to ensure faithfulness of the course to its objectives.

Finally, it is worthy of note that yet another factor contributes to quality in the courses (part of point 2) – namely, the many team teaching scenarios. These often pair more experienced faculty with less experienced ones in the same course, which provides for a kind of informal mentoring in teaching that ultimately also contributes to the overall quality of the courses in the program.

The continuous improvement process is implemented, primarily, through curricular change informed by the assessment process and consistent with the student outcomes and PEOs. This process, to function, requires some amount of leadership within the School and the Departments. This leadership is provided by the coordinator (at the Department level) and the Chair (at the School level), and is described in Criterion 8-A.

Criterion 7 FACILITIES

7-A Offices, Classrooms and Laboratories

The program is housed within the School of Engineering & Technology, which is located entirely in the Center for Applied Science and Engineering Technology (CASET) Building. Built in 1980, the three-story structure is home to the areas of Engineering, Engineering Technology, Mathematics, Computer Science, and Fire Science. Two additional non-academic facilities associated with Information Technology are also located in the building: Enterprise Application Services and University Support Services.

The School of Engineering & Technology has approximately 30,000 sq. ft. of usable space, which includes offices, storage areas, labs, and work areas. Details of the classrooms, laboratories, and offices follow.

7-A.1 Classrooms

The CASET building has five classrooms and one lecture room that are assigned by the Registrar's Office, with engineering, engineering technology, mathematics, computer science, and fire science courses receiving the highest priority. Room size and capacity are shown in the Table 7-1 below.

Table 7-1: University-Allocated Classrooms in CASET Building

Room	Type	Size (sq.ft.)	Capacity
CAS-119	Classroom	880	48
CAS-205	Classroom	1,010	40
CAS-207	Classroom	690	30
CAS-210	Classroom	1,100	56
CAS-211	Classroom	585	27
CAS-212	Lecture Room	1,265	76

The School of Engineering & Technology also has three dual use laboratories/classrooms for additional lecture space when needed. These are shown below in Table 7-2.

Table 7-2 Engineering-Allocated Classrooms in CASET Building

Room	Type	Size (sq.ft.)	Capacity
CAS-106A	Classroom/Lab	1,140	22
CAS-310	Classroom/Lab	1,320	30
CAS-311	Classroom/Lab	1,320	24

All classrooms are equipped with a whiteboard or chalkboard, a computer, a document camera, a projector, and a screen. The rooms are arranged in a typical fashion with desk and chairs arranged in rows. The lecture room has fixed desks and chairs arranged in a stepped fashion. Since most engineering courses have enrollments with less than 40 students, the classroom facilities within the building are adequate, and nearly all engineering classes take place in the CASET building. Elsewhere on campus, several large classrooms with capacities up to 165 students are available within a five-minute walk of the engineering facilities.

7-A.2 Laboratories

Laboratory experiences are a central component of the engineering curriculum at LSSU. Most technical courses contain labs. The chemistry and physics labs are located in Crawford Hall; the remainder of the lab facilities used in the engineering program are located in the CASET building. Table 7-3 shows a summary of the lab facilities available to all engineering and engineering technology students, with those used within the program are denoted as such.

Table 7-3: Laboratory Facilities in the School of Engineering & Technology

Room	Name	Size (sq. ft.)	Capacity	EE
CAS-105	Data Acquisition / Microscopy Lab	370	12	
CAS-106A	Materials Testing Lab	1,140	22	
CAS-106B	Engineering Design Center	1,140	30 (6 Teams)	☒
CAS-106C	Thermal Fluids Lab	900	10	
CAS-120	Machine Shop	5,180	20	
CAS-120A&B	Welding Lab &Foundry	1,760	10	
CAS-122	Plastics Molding Lab & Senior Projects Construction Area	2,240	20	☒
CAS-124	Vehicle Testing Lab & Surface Mount Assembly Lab	1,200	8	☒
CAS-125	Robotics and Automation Center	2,600	16	☒
CAS-209A&B	Computer Lab	1,100	28	☒
CAS-304	Digital Electronics Lab	1,080	14	☒
CAS-306	Analog Electronics I Lab	1,175	16	☒
CAS-309	Analog Electronics II Lab	1,175	16	☒
CAS-310	Electro-mechanical Systems Lab	1,320	30	☒
CAS-310A	Rapid Prototype Center	580	4	☒
CAS-311	Programmable Logic Controllers Lab	1,320	24	☒

The School of Engineering & Technology provides the necessary hardware and software tools required in the teaching of engineering and engineering technology students. Unlike more research-oriented institutions, LSSU labs are nearly all intended for use by the undergraduate engineering and engineering technology students for instructional purposes. All laboratory facilities are available to students during regular school hours, when they are not in use for lab instruction. Computer labs and some labs with security cameras are available for extended hours. Special access arrangements through University Security are regularly used to permit student access to labs during evening and late night hours. In general, laboratory section sizes are typically 16 students or fewer. If student enrollment in a section exceeds the suitable lab size, then multiple lab sections are provided.

7-A.2.1 Data Acquisition / Microscopy Laboratory (CAS-105)

The Data Acquisition / Microscopy lab (CAS-105) is contiguous to CAS-106A, and the two often serve together as a single large lab oriented towards various kinds of materials testing.

It includes microscopes and photographic equipment to support materials characterization, strain gauge mounting and data acquisition equipment, dynamic data collection systems (for acoustic and vibration measurement), ultrasonic and other NDT test equipment, and plastics properties testing equipment. This lab is used primarily for ME and MfgET courses. Students in the relevant courses have access to this lab from 8am-5pm but must be let in by a faculty/staff member.

7-A.2.2 Materials Testing Laboratory (CAS-106A)

The Materials Testing Lab (CAS-106A) contains equipment for tensile and compression testing, hardness testing, and fatigue testing of materials, as well as for polishing and etching in metallographic specimen preparation. Specifically, this laboratory houses a 400,000 lb. Tinius-Olsen compression/tensile testing machine, specimen mounting presses, belt sanders, microscopy polishers, and microscopes. This lab is primarily used for ME and MfgET courses. Students in the relevant courses have access to this lab from 8am-5pm but can only operate the Tinius-Olsen with faculty/staff present.

7-A.2.3 Engineering Design Center (CAS-106B)

The Engineering Design Center (CAS-106B) is a carpeted office space containing eight cubicles, each equipped with chairs, a computer, a phone, a whiteboard, and typical office desk furnishings. The room has a printer common to all cubicles, as well as a large conference table and chairs, a projector and screen for practice presentations, and a collection of supplier catalogs. All senior project teams are assigned their own cubicle where they work on their projects, keep their records, organize their information and make vendor communications (via e-mail or phone). The teams typically hold meetings, which may include the company contacts, suppliers and faculty advisors, at the conference table. This laboratory provides the Senior Project students with office space and conveys the look and feel of working in industry. All typical office supplies are provided. This lab is used exclusively for the senior Engineering Design Projects sequence EGNR-491&495. These students have 24-hour access to this lab via LSSU public safety.

7-A.2.4 Thermal Fluids Laboratory (CAS-106C)

The Thermal Fluids Lab (CAS-106C) contains equipment for examining thermodynamic principles as well as fluid flow. The main equipment are two thermal-fluid trainers with which students can explore the operation of turbines, heat exchangers, and centrifugal pumps. One of these trainers was updated by a 2017-2018 senior project team to provide more capabilities and automate the data acquisition. There is also a wind tunnel, wave tank, and refrigeration cycle trainer. This lab is primarily used for ME courses, but frequently serves as an overflow meeting room for senior project students as well, particularly since it has a large conference table and a telephone set-up for conference calls. Students in the relevant courses have access to this lab from 8am-5pm, senior project students can access this room from CAS-106B after hours.

7-A.2.5 Machine Shop (CAS-120)

The Machine Shop (CAS-120) contains a variety of manual manufacturing processing equipment (benches, hand tools, vises, drill presses, numerous lathes, mills, grinders, saws) and computer automated CNC machines (two lathes, two mills, a plasma torch). An adjacent computer lab is mainly used for CAM software (Creo) programming. The Machine Shop is also connected to various labs, a tool room, and other storage space. This lab is primarily used for ME and MfgET courses, but also provide facilities that the senior Engineering Design Projects sequence (EGNR-491 & 495) can use to fabricate components. Students have access to this lab from 8am-5pm but can only operate the equipment with faculty/staff present.

7-A.2.6 Welding Laboratory and Foundry (CAS-120A&B)

The Welding Lab (CAS-120A) contains arc welders, MIG welders, a TIG welder, Oxy-Acetylene torches, eight arc welding booths, and ten torch welding booths, all of which are well-ventilated. The Foundry (CAS-120B) includes furnaces for melting and heat treating metals, mold benches, flasks, a metal pouring bench and numerous hand tools. This lab is primarily used for ME and MfgET courses, but also provide facilities that the senior Engineering Design Projects sequence (EGNR-491 & 495) can use to fabricate components. Students have access to this lab from 9am-5pm but can only operate the equipment with faculty/staff present.

7-A.2.7 Plastics Molding Laboratory and Senior Projects Construction Area (CAS-122)

The Plastics Molding Lab and Senior Projects Construction Area (CAS-122) includes three different plastics manufacturing machines, and benches. This room is primarily used as a build area for the senior Engineering Design Projects sequence (EGNR-491 & 495), but is also used as a work area for the SAE mini baja vehicle. Students have access to this lab from 9am-5pm but can only operate the equipment with faculty/staff present. Senior project students assigned to this area are given 24-hour access via LSSU public safety.

7-A.2.8 Vehicle Testing Lab & Surface Mount Assembly Laboratory (CAS-124)

The Vehicle Testing Lab (CAS-124) contains a two-wheel vehicle chassis dynamometer. This computer-controlled dynamometer can oppose the drive wheels with up to 268 hp and allows continuous operation at up to 100 mph. The data acquisition system allows for measurements of the tire torque and rpm as well as access to vehicle CAN network used for vehicle speed-torque (or speed-power) mapping, drivetrain vibration studies, vehicle on-board sensor monitoring, simulated towing load / drawbar / hill climb studies, etc. The lab contains comprehensive safety interlock system (CO shut down, thermal shut downs, ventilation shortfall shutdowns, etc) along with belt vehicle restraints with chain back-up help ensure safe operation. This lab is primarily used for ME courses. For safety reasons, students only have access to this lab with faculty/staff present.

The Surface Mount Assembly Lab (CAS-124) was equipped between 2009 -2010 through a Michigan Economic Development Corporation 21st Century Jobs Fund grant. Additional funding through the Michigan Initiative for Innovation and Entrepreneurship grant in 2013 augmented the facility with the establishment of the Electronic Products Innovation Center (EPIC). The lab is outfitted with two Surface Mount Technology robotic assembly machines. APS CS40 has a component placement rate of 2100 components per hour handling parts down to EIA 0603 (0.060" by 0.030") while the APS L40 handles EIA 0201 (0.020" by 0.010") components at a rate of 4800 per hour. Both accommodate boards up to 13.5" by 22". Supporting equipment includes 2 SPR-25 stencils and GF12HC reflow oven. Other equipment includes manual hot air rework stations and fluid dispenser for adhesives and solder paste. This lab is primarily used by PDC workers.

7-A.2.9 Robotics and Automation Center (CAS-125)

The Robotics and Automation Center (CAS-125) consists of four industrial robotic lines estimated to be worth about two million dollars. In all there are 15 industrial robots (equipped with multiple end-of-arm tooling options), 2 conveyor lines with pallets, 4 rotary index tables, 1 linear conveyor system, 4 Programmable Logic Controllers (PLC's), 7 vision systems, 18 computer stations, as well as numerous sensors and pneumatic devices. Essentially there are four types of flow lines with robot systems: 1) a big rotary index table with four FANUC industrial robots with an Allen Bradley PLC and HMI, 2) an oval line that uses a Bosch Rexroth Varioflow conveyor, housing 4 Staubli robots integrated with an Allen Bradley PLC, 3) an oval line that uses a Bosch pallet transfer conveyor with 4 FANUC robots integrated with an Allen Bradley PLC and HMI, and 4) a work cell that contains 3 KUKA robots and uses a liner conveyor and a rotary table integrated with an Allen Bradley PLC and HMI. The oval line with the FANUC robots and the work cell with the KUKA robots have vision systems integrated in all of the robots and also different tool change stations and end-of-arm tooling for the robots.

During the 2016-2017 and 2017-2018 academic years, a new robotics work cell was added to the lab. This work cell consists of 3 Kuka KR5-R1400 robots with multiple end-of-arm tooling options, a rotary index table, and a linear conveyor system. In addition it has 3 Cognex 7802 vision systems along with an Allen Bradley PLC and HMI. This work cell also implements safety systems commonly found in industry including 2 Keyence light curtains and a SICK area scanner to detect when a person enters the work cell. Students can program the cell via 3 computer stations. This new system and the rest of the robotics lab will help LSSU maintain the industrial robotics niche in its undergraduate engineering and engineering technology programs.

During the 2015-2016 academic year, the robotics lab went through a major upgrade. The FANUC oval line system was fully updated except for the Bosch conveyor. The oval line system incorporates 4 M10/iA FANUC robots that run on the latest R30iB controller platform, 4 FANUC iRVision 2D Vision systems, a FANUC 3DL Vision system, a FANUC force/torque system, two robot line tracking systems, an Allen Bradley PLC controller with ethernet configuration, 4 SCHUNK robot tool changers, several robot end-of-arm tools (grippers, suction cups, etc.), 4 Dell computers, and several sensors. 10

seats of the Roboguide robotics simulation software was also purchased. The entire system (engineering, hardware, software and installation) is estimated at $750,000.

During the 2009-2010 academic year, the robotics lab also went through a major upgrade. The Staubli oval line system was newly installed. The system incorporates 4 Staubli robots that run on the latest CS8 controller platform, a new Bosch conveyor system (Varioflow system with 8 pallet location stations), 4 Cognex Vision systems, an Allen Bradley PLC5 controller with device net configuration, 4 robot tool changers, several robot end-of-arm tools, and several sensors. The entire system (engineering, hardware, software and installation) was estimated at $500,000.

The Robotics and Automation Center is utilized by all Engineering and Engineering Technology degrees. Students in the relevant courses have access to this lab from 8am-5pm but can only operate the equipment with faculty/staff present.

This lab also used extensively for demonstrations for members from business and industry, K-12 students, visiting faculty, and the community. The Robotics and Automation Center is also the key facility that serves as the home for the summer Robotics Camps and Women in Technology programs. These programs that have been offered every summer since 1991 and each year have attracted between 50 to 100 gifted and talented middle school and high school students from Michigan, Ontario, and beyond. The programs have served well to attract bright young individuals to the engineering and technology fields.

7-A.2.10 Computer Laboratory (CAS-209B&C)

The Engineering Computing Labs (CAS-209B-209C) have 33 current PC-type workstations, two common printers, full network access, and all software that is taught in the curriculum. Computers Dell Optiplex 3020 computers with Intel i5 quad-core CPU, 8GB of RAM, a Quadro P600 GPU, and network access. Specialized software installed on these computers includes Creo, MATLAB, RoboGuide, Ansys Fluent, Arduino, and Witness. This lab is the primary computing lab for engineering and engineering technology students. Students from programs outside of the School of Engineering & Technology are not granted access to this room. Students have 24-hour access to this lab via LSSU public safety, except when it is being used for instruction (even then, it is divisible into two halves by an accordion wall, and only one half is ordinarily used for courses, leaving the other half available for open student use).

7-A.2.11 Digital Electronics Laboratory (CAS-304)

The Digital Electronics lab (CAS-304) has a fixed workbench in the center of the room with five computers and space for student circuit development. Additionally, this room has eight smaller workstations located around the perimeter of the room. Available in the room are, digital multi-meters, digital trainers, logic analyzers, FPGA evaluation boards, and portable oscilloscopes are available as needed. In addition, this lab also serves as an alternate computer lab with 13 computer stations. This lab is primarily used for CE, EE, and EET courses. All engineering and engineering technology students have access to this lab from 8am-5pm, students in the relevant courses have may receive additional after-hours access as needed.

7-A.2.12 Analog Electronics I Laboratory (CAS-306)

The Analog Electronics I Lab (CAS-306) has 8 work stations. Each station contains a power supply (Agilent/HP E3620), multimeter (Keithley 2110), signal generator (Keysight 33210A), oscilloscope (Keysight DSO-X2004A), and computer with LTSpice. This lab is primarily used by the introductory electronics courses for all engineering and engineering technology degrees. All engineering and engineering technology students have access to this lab from 8am-5pm, students in the relevant courses have may receive additional after-hours access as needed.

7-A.2.13 Analog Electronics II Laboratory (CAS-309)

The Analog Electronics II Lab (CAS-309) has 7 work stations. Each station contains two power supplies (Agilent/HP E3620 and BK Precision 1665), multimeter (Fluke 8846A), signal generator (Keysight 33210A), oscilloscope (Keysight DSO-X2004A), and computer with LTSpice. There is an additional "instructor station" that contains additional equipment including a programmable power supply (BK Precision 9201), a DC electronic load (BK Precision 8600), and a power analyzer (Tektronix PA1000). This lab is primarily used by the advanced electronics courses for all engineering degrees. All engineering and engineering technology students have access to this lab from 8am-5pm, students in the relevant courses have may receive additional after-hours access as needed.

7-A.2.14 Electro-mechanical Systems Laboratory (CAS-310)

The Electro-mechanical Systems Lab (CAS-310) has 5 Hampton electrical machine trainers and accessories. These trainers include AC and DC power supplies as well as AC and DC voltage, current, and power meters. The accessories include induction machines, synchronous machines, wound-rotor machines, single-phase machines, DC machines, resistive load banks, inductive load banks, capacitive load banks, torque meters, tachometers, and power analyzers. This lab is primarily used by EE and EET courses, some of which are also available to CE students in the sustainable energy concentration. For safety students are only allowed to use the equipment when faculty/staff are present. The lab is also used as a classroom when needed as it can hold 30 students.

7-A.2.15 Rapid Prototype Center (CAS-310A)

The Rapid Prototype Center (CAS-310A) is overseen by the Product Development Center (PDC) and serves as a laboratory for both PDC projects and Senior Project teams (EGNR-491 and EGNR-495). The majority of the equipment in the lab, with the notable exception of the Stratasys Dimension RP machine, was purchased by the PDC through a Michigan Economic Development Corporation 21st Century Jobs Fund grant. The equipment purchases occurred between 2008 and 2010.

A Stratasys Dimension 3D printer was purchased in late 2015 with donations largely from the IAB. Using ABS+ plastic, the printer can produce parts up to a size of 10"x 10"x12" using Fused Deposition Modeling. The printer is used in a variety of engineering courses (notably, making sample parts for assembly mock-ups in EGNR-491 and EGNR-495), as well as for projects from industry.

A Roland MDX40, a desktop milling machine, purchased in 2009, is used for many of the same activities as the RP machine. It serves as a virtual printer to the 3D CAD software. This device can mill woods, plastics, and soft metals other than aircraft aluminum and steel. This has a serviceable area of 12x12x4 inches and has a rotary axis as well. Prototype parts requiring materials other than ABS can be made on this machine.

A 2013 Michigan Initiative for Innovation and Entrepreneurship grant provided 10 seats of EAGLE Pro Circuit board development software used for creating schematics and printed circuit board artworks for electronic projects. Two licenses are in use by PDC and 8 are located in the computer LAB 209B.

A Next Engine 3D HD Laser Scanner purchased in October, 2009 is used to scan existing parts into a cloud-of-points and from there to 3D CAD. EGNR-491 and EGNR-495, along with the PDC, make use of this machine to scan parts that have no engineering drawing so that modifications or documentation can be made.

These major tools are supplemented by Dremel grinding, drilling and polishing tools and various hand tools. Two computer stations which are set up for CAD and engineering activities are also located in the lab. This lab is primarily used by the PDC workers.

7-A.2.16 Programmable Logic Controller (PLC) Laboratory (CAS-311)

The Programmable Logic Controller Lab (CAS-311) has eight work stations around the outer edge. Each station has a computer, an HMI (Allen Bradley PanelView 600) and a PLC (Allen Bradley ControlLogix L16) training station. There are also project machines (four "mixing stations" and four "part checkers") designed to provide students with more intense programming experiences similar to what they would encounter in industry. This lab is used primarily by EET, MfgET, and ME degrees. The lab is also used as a classroom when needed (mainly for the lecture portion of the PLC course). Students in the relevant courses have 24-hour access to this lab via LSSU public safety.

7-A.3 Other Facilities

The CASET building has 27 dedicated office spaces for use by students, faculty, support staff, and the administration. Some of these offices are used to house student engineering groups or for storage. Additionally, the Engineering House, a living-learning community for approximately 30 students, is located about 100 yards from the CASET building and the SSMart Zone building is located about 1 mile north of campus. These areas are discussed in the following sections.

7-A.3.1 School Office

The School of Engineering & Technology office suite, has four specialty office spaces that include reception, conference room, photocopy/scan equipment and supplies, and a storage room.

7-A.3.2 Faculty Offices

Faculty offices are furnished with standard equipment that includes a desk and chair, additional chairs for guests, computer, telephone, bookcase(s), and filing cabinet(s).

Offices being used for storage are available to house additional faculty members should enrollment and/or programmatic growth warrant.

7-A.3.3 Conference Rooms

The School of Engineering & Technology utilizes several areas for conference rooms. These common areas are used for faculty and student meetings. Four areas, CAS-106B, CAS-126, CAS-203, and CAS-205, are routinely used for conferences. Room sizes vary and can accommodate 6-15 people at one time.

7-A.3.4 Student Club Offices

Office space has been made available to the engineering student clubs. IEEE is housed in CAS-316. ASME is housed in CAS-309A. SAE is housed in CAS-117. SWE is housed in CAS-127. The Engineering and Technology Honor society and other student groups meet in the conference rooms.

7-A.3.5 Engineering House

The Engineering House is a residence on campus in which a select group of engineering and engineering technology students inhabit. The house is adjacent to a number of other living-learning communities from different academic areas. The house costs the same as traditional dorms, but offers many advantages including larger bedrooms, a kitchen, a laundry facility, as well as common areas where students are able to congregate. The house is open to all engineering and engineering technology students, both male and female (housed on separate floors with separate bathrooms).

There is a good mix of students at different points in their academic careers (from freshmen to senior). Many of the students will be in classes together, allowing them to easily work and study together. The upperclassmen will also have taken many of the same classes, and had many of the same experiences, making them a great resource for help and advice.

In exchange for these additional amenities, the students are required to participate in a group project above and beyond their normal course work. The subject of the project is decided upon by the students themselves, but must be approved by the house advisors. While this project does require some additional work, it is an excellent opportunity to gain experience working in an engineering team.

7-A.3.6 SSMart

LSSU and SSMart, a Michigan Smartzone, have a collaborative use agreement in place that provides access to students and SSMart entrepreneurial clients of the combined equipment owned by the two entities. Specifically SSMart makes available a CNC Lathe (Haas TL-1), a150W Laser cutter/etcher, a consumer grade CUBEX Trio Fused Deposition Modeling 3D printer and high resolution OBJET 30 Pro UV Polymer technology 3D printer.

7-B Computing Resources

Lake Superior State University provides computer, network, and internet services to members of the campus community. These services are intended to assist faculty, staff, and students in the accomplishment of their University responsibilities and duties. The computing resources offered by the University adequately supplement those offered within the School of Engineering & Technology and meet the needs of the students in the program.

7-B.1 University-wide Computing Resources

The library hosts three computer labs. Each lab has 24 Dell computers. All computers are running Windows 10 Pro and have Microsoft Office 2016 installed. The standard software installation is available on all computers. A high-speed black and white LaserJet printer is available in the lab on the main floor. In addition to these labs, the library also provides access to 33 Dell computers in the general Learning Commons area, 29 of which are connected to both color and b/w laser printers. In total, the library provides access to 105 computers for student computing use during the hours listed in Table 7-4.

Table 7-4: Library Hours

Day	Hours
Monday	8am - 12am
Tuesday	8am - 12am
Wednesday	8am - 12am
Thursday	8am - 12am
Friday	8am - 7pm
Saturday	11am - 7pm
Sunday	1pm - 12am

There are 4 Dell computers connected to a black and white laser printer. These computers are running Windows 10 Pro and Office 2016 along with the standard software installation. The Rathskellar is located in the Cisler Student Union and is open all operational hours of Cisler which vary by time of year and events, generally extending well into evening or beyond midnight as demand or events warrant.

7-B.2 Engineering Computing Resources

The primary computer labs used by engineering and engineering technology students are the Engineering Computing Labs (CAS-209B&C). Combined they have 33 current PC-type workstations, two common printers, full network access, and all software that is taught in the curriculum. The computers are Dell Optiplex 3020 computers with Intel i5 quad-core CPU, 8GB of RAM, a Quadro P600 GPU, and network access. Specialized software installed on these computers includes Creo, MATLAB, RoboGuide, Ansys Fluent, Arduino, and Witness.

In addition to the Engineering Computer Lab and the two general LSSU computer labs, there are various computer resources available to students located throughout the laboratories in the CASET building.

7-B.2.1 Engineering Design Center (CAS-106B)

The Engineering Design Center (CAS-106B) is equipped with up to eight computers (one for each senior project team). The computers placed in this room have full network access, engineering software, typically are at least Intel i7 quad-core with at least 12GB of RAM, and are served by a common printer. Students enrolled in EGNR-491 & 495 have 24-hour access to these computers.

7-B.2.2 Robotics and Automation Center (CAS125)

The Robotics and Automation Center (CAS124/125) is equipped with 14 computers. The computers have full network access, are at least Core 2 Duo with at least 2GB of RAM, and are served by a common printer. Numerous software packages and programming languages are used in the Robotics and Automation Center. The Fanuc robots are programmed in the Karel programming language and Teach Pendant language and the Staubli robots are programmed in the VAL3 language. The ladder logic programming for the Allen Bradley PLCs are programmed using the Rockwell software RSlogix. The laboratory also provides access to simulation software packages including RoboGuide and WITNESS. Students in the relevant courses have access to this lab from 8am-5pm, but may receive additional after-hours access as needed.

7-B.2.3 Digital Electronics Lab (CAS-304)

The Digital Electronics Lab (CAS-304) is equipped with 13 computers. The computers have full network access, are at least Intel i5 quad-core with at least 8GB of RAM, and are served by a common printer. Specialized software installed on these computers includes Quartus (digital synthesis), GoLogic (logic analyzer), Code Warrior, Arduino, Creo, and Matlab. All engineering and engineering technology students have access to this lab from 8am-5pm, students in the relevant courses have may receive additional after-hours access as needed.

7-B.2.4 Analog Electronics Labs (CAS-306 and CAS-309)

The Analog Electronics Labs (CAS-306 and CAS-309) are each equipped with 8 computers and a printer. The computers have full network access, and have at least an i5 quad-core with 8GB of RAM. Specialized software installed on these computers includes LTSpice, Arduino, Creo, and Matlab. All engineering and engineering technology students have access to this lab from 8am-5pm, students in the relevant courses have may receive additional after-hours access as needed.

7-B.3 Computing Resources for Faculty

All faculty members have computers and network connections in their offices, and all faculty computers are at least at least Intel i5 dual-core with at least 4GB of RAM. The minimum software package on these computers includes Windows 7 or Windows 10, Office2010 or later and Internet Explorer, Google Chrome, or Firefox. Other software installed on the faculty computers is based on the courses that they teach.

All faculty members have full Internet access as well as Microsoft networking. There is at least one networked laser printer on each floor of the engineering building for faculty to use for printing. There are also several shared network drives for faculty to exchange information amongst themselves and with students.

Several web based packages are available for both faculty and student use:

a. Moodle is a course management system that allows faculty to supplement, or deliver wholly, the courses they are teaching. Students enrolled in courses with a Moodle component have access to support materials posted by the instructor (using syllabi and assignments), links to Web-based materials, videos, handouts, discussion boards and chat rooms, online quizzing, etc.
b. The 'my.lssu' campus portal is beneficial to staff, students and faculty. It allows for single sign-on access to email, calendar, Moodle, Anchor Access (see item c. below) and FASS (student course scheduling systems). It also offers improved e-mail, groups, chat/message boards, course studio, file sharing, targeted announcements and customizable pages. The portal is role-based, hence users have access to tools and announcements related to their role as a student or faculty member.
c. Faculty and students regularly use Anchor Access, a self-serve computer system, accessible through the 'my.lssu' portal. Anchor Access is just one part of Banner, which also handles finance, advancement, financial aid and more. Through it, students are able to view and pay bills online, print copies of their schedules and view and print transcripts. Automated Graduation Verification has been implemented to assist students and staff in confirming the courses needed to complete a program of study. This component is used in tandem with paper-based verification. Notably, it allows students and their advisors to perform a "what if" analysis to see which courses would be required to complete an alternate degree program.

7-C Guidance

LSSU takes great pride in the hands-on learning opportunities provided to its students. To ensure the safe operation of tools, equipment, computing resources, and laboratories, it is standard practice for faculty members to first discuss general safety procedures for a given laboratory in a classroom setting. These procedures are reinforced by demonstrations in the appropriate laboratory. For a particular laboratory exercise, the basics and theory surrounding a specific device or experiment is presented. Best practices for the operation of a particular device are subsequently discussed and demonstrated. Students then work under the tutelage of a faculty member or technician when operating the device for the first time, during which time they may ask questions or request a review of the procedure. A faculty member or technician remains proximate in any laboratory settings where the possibility of bodily harm exists. Once rudimentary mastery of a device has been learned, students are then able to use the equipment with faculty/staff guidance present throughout the rest of their courses. A more detailed example of guidance for a specific settings is provided below.

<u>Example:</u> Preparation for correctly and safely operating equipment in the Manufacturing Lab utilizes the following steps:

1) The safety procedures are covered in class, and again in lab

2) The assignment is explained and given in lab
3) The basics and theory of the experiment or assignment is covered in class (e.g. the cutting speed and rpm calculation for 1010 mild steel being cut with a high speed cutter), and then it is shown in lab as well
4) The operation of the equipment and the actual assignment is then demonstrated
5) The student is then instructed to do the assignment. If the student has any questions, they are to ask the instructor for further explanation, and if needed the procedure is covered again

Similarly, preparation to properly and safely utilize equipment in the Electrical and Computer Engineering Laboratories is summarized as follows:

7-C.1 Equipment

Use of lab equipment is described and demonstrated in the laboratory setting. The students are then required to demonstrate their proper use the equipment to a faculty/staff member. If the equipment poses a low injury risk student can then use the equipment for the remainder of their degree.

7-C.2 Software

LTSpice circuit simulation and Quartus digital design software are both demonstrated in the lab setting. The students are then required to use the software packages to solve and design different circuits using the software packages. LTSpice software is used in the analog circuits courses. Quartus is used throughout the digital course offerings.

7-C.3 Laboratories

The safety procedures are covered in class, and again in lab. In addition, the safety rules for each laboratory are posted by the entrance. An example of these rules is shown below:

- **Always** assume all circuits are energized unless you know with certainty they are not.
- If you know or suspect that an accident has occurred, take immediate steps to de-energize all affected circuits.
- **Never modify an energized circuit.** Turn off the voltage source before modifying the circuit. Use one hand to make connections and **never** work on electrical circuits with wet or moist hands.
- **Do not** work on a cluttered lab bench. It is important for safety reasons for anyone to easily trace out your test circuit.
- **Think out**, ahead of time, the consequences of closing or opening a switch. **Do not** make adjustments to energized equipment unless specified in the lab and you have thought out the consequences. In addition, the circuit should only be energized for the time it takes to perform the measurements.
- Be sure you **understand** how to properly operate the equipment before you use it.
- If you are unsure of anything or have any **questions** make sure to ask the instructor before proceeding with the experiment.

- **Never** touch moving parts of machinery, and **avoid** standing in the plane of rotation of sprockets or belts. **Do not** wear loose fitting clothing or jewelry, that could contact electrical circuits and/or moving parts of machinery.
- **Never** look directly at electrical arcs; strong ultraviolet radiation can permanently damage your eyes.
- **Never work alone.** Always have at least one other person to help in case of an emergency.

7-D Maintenance and Upgrading of Facilities

The University is committed to continually maintaining and improving the educational environment and facilities used to deliver education. Funding for facilities maintenance and improvement are contained in the University General Fund. Grants from NSF, MEDC, Perkins, and industry, along with donations have been instrumental in acquiring new and replacement equipment.

While there is no annual equipment budget, *per se*, for the School of Engineering & Technology, the laboratories are well equipped and receive adequate funding. The two main sources of revenue that support laboratory facilities via the University General Fund are the course fees and program fees that come from students taking engineering and engineering technology courses. Between the two, approximately $200k is generated per year. Equipment, software, and hardware are upgraded on an "as needed" basis, which has been sufficient.

Most courses have a course fee that depends on the cost of maintaining the equipment and software to support the course. In general, courses that have a lab component have higher course fees than those that do not. Approximately $54k was generated in course fees last year. All courses having the "EG" prefix have a differential tuition of $70 per credit hour called a program fee. The portion of program fees allocated to the School of Engineering and Technology last year was approximately $144k.

7-D.1 Recent Upgrades

Major acquisitions made within the last six years are noted below.

7-D.1.1 Microscopy / Data Acquisition Lab (CAS-105)

Year	Item	Quantity	Status
2018	Shore D Durometer testers	2	new
2017	Shore A Durometer testers	2	new
2017	Digital camera for microscope	1	new
2017	Acoustic foam	1	new
2017	DAQ system (sound & vibrations) with anti-aliasing filter	1	new
2017	Lab-grade accelerometer (vibrations) & power supply	1	new

7-D.1.2 Materials Testing Lab (CAS-106A)

Year	Item	Quantity	Status
2018	Metallography Mounting Presses	2	new

7-D.1.3 *Engineering Design Center (CAS-106B)*

Year	Item	Quantity	Status
2014	i7 Desktop Computer	7	new

7-D.1.4 *Thermal Fluids Lab (CAS-106C)*

Year	Item	Quantity	Status
2018	Thermo-trainers	1	upgrade
2017	Fin cooling efficiency test stand	1	New
2016	Fogger for wind tunnel flow visualization	1	new
2016	Material heat conduction measurement test stand	1	New
2015	Fluid jet force measurement test stand	1	New
2015	Refrigeration trainer	1	Upgrade
2014	Pipe flow loss test stand	1	New
2014	Wave tank, and tanker vessel roll stability scale model experiment	1	new

7-D.1.5 *Machine Shop (CAS-120)*

Year	Item	Quantity	Status
2015	HASS CNC Lathe	1	new
2014	HASS CNC Mill	1	new

7-D.1.6 *Robotics and Automation Center (CAS-125)*

Year	Item	Quantity	Status
2012	Staubli RX60 Robot	1	new
2013	Fanuc LR Mate Robot	2	new
2013	Fanuc M1iA Robot	1	new
2013	Dell Computers	4	1 yr old
2013	Allen Bradley Panel View	1	new
2014	Roboguide Robotics Simulation software	10	new
2015	Fanuc M10iA Robot	4	new
2015	Allen Bradley PLC	1	new
2015	Fanuc 2d iRVision Systems	4	new
2016	Roboguide Robotics Simulation Software	5	new
2016	SCHUNK Robotics End-of-Arm Tooling	4	new
2016	SCHUNK Robotics Tool Change System	4	new
2016	Piab Vacuum End-of-Arm Tooling	4	new
2016	Dell Computers	2	new
2016	Fanuc 3DL iRVision System	1	new
2016	Fanuc Line Tracking System	2	new
2016	Fanuc Force/Torque Sensing System	1	new
2016	Allen Bradley Panel View	1	new
2016	Kuka KRS R1400 Robots	2	new
2016	Banner Safety PLC	1	new
2016	SICK 2D Area Scanner	1	new
2016	Keyence Light Curtain	2	new

2017	Kuka KR5 R1400 Robots	1	new
2017	Allen Bradley PLC and HMI	1	new
2017	Cognex 7802 Vision Systems	3	new
2017	Rotary Index Table	1	new
2017	Dell Computers	3	new

7-D.1.7 *Computer Lab (CAS-209B&C)*

Year	Item	Quantity	Status
2015	i5 computers	30	new
2017	i5 Computers	3	new
2017	256GB SSD	33	new
2017	Nvidia Quadro P600 GPU	33	new

7-D.1.8 *Digital Electronics Lab (CAS-304)*

Year	Item	Quantity	Status
2013	Corobot - mobile robot	1	new
2013	Optiplex 745 – DELL PC	5	used
2013	Optiplex 780 – DELL PC	8	used
2014	Altera DE1-SoC boards	10	new
2014	Altera Cyclone V GX Starter Kit	1	new
2014	Acute TL2118E – Logic Analyzers	10	new
2015	Optiplex 3010 – DELL PC	5	used
2017	Dell Computers	13	new

7-D.1.9 *Analog Electronics I Lab (CAS-306)*

Year	Item	Quantity	Status
2017	Keysight DSO-X2004A oscilloscope	10	new
2017	Keithley 2110 Digital Multimeter	10	new
2017	Keysight 33210A Function Generator	10	new
2017	Dell Computers	8	new

7-D.1.10 *Analog Electronics II Lab (CAS-309)*

Year	Item	Quantity	Status
2015	Keysight DSO-X2004A oscilloscope	10	new
2017	Dell Computers	7	new
2017	Tektronix PA1000 Power Analyzer	1	new
2017	BK Precision 8600 DC Electronic Load	1	new
2018	BK Precision 9201 DC Power Supply	1	new

7-D.1.11 *Electro-mechanical Systems Lab (CAS-310)*

Year	Item	Quantity	Status
2017	3-Phase Variable Frequency Drives	2	new

7-D.1.12 Rapid Prototype Center (CAS-310A)

Year	Item	Quantity	Status
2013	EAGLE Pro Circuit Board Development Software	10	new
2015	Stratasys Dimension 3D Printer	1	new

7-D.1.13 Programmable Logic Controller Laboratory (CAS-311)

Year	Item	Quantity	Status
2013	Core 2 duo computers	8	new
2013	PLC Trainers, Desktop	10	new
2013	PanelView Trainers, Desktop	6	new
2013	Part Checkers	3	upgrade
2013	Mixing Stations	3	upgrade
2016	Additional PLC Trainers, Desktop	2	new
2016	Additional PanelView Trainers, Desktop	2	new
2016	Additional Mixing Station	1	new
2016	Additional Part Checker	1	new
2016	Additional Computer	2	used

7-E Library Services

The Kenneth J. Shouldice Library and Learning Commons provide the core research materials needed to support the academic curricula offered by the University. The Library is headed by Marc Boucher, Director of Library Services.

In the fall of 1997, a 35,000 square-foot expansion and remodeling of the existing structure to the University Library was formally opened and full resources made available for faculty and student use. The facility includes ample space for study; over 32 personal computer stations with access to specialized library resource databases and the Internet; small and large study and conference rooms; a small art gallery; the campus's center for testing, tutoring, mentoring and the Faculty Center for Teaching.

7-E.1 Collections

The collection consists of over 140,000 volumes and 850 periodical subscriptions (including both electronic and print), as well as 75,000 microforms. The library uses Ex Libris' Voyager integrated library system for physical item discovery.

7-E.2 Reference and Instructional Services

Reference service provided by professional librarians, is available every day and evening the Library is open, other than weekends. Information literacy and research instructional sessions are not only provided to University students, but local K-12 students, students from Sault Ste. Marie, Ontario, and the surrounding intermediate school district areas such as Paradise, St. Ignace, and Pickford. All research databases are accessible to the general public while on campus, and off campus access restricted databases are provided to all campus students, faculty and staff.

7-E.3 Resource Sharing

Resource sharing has always been a prominent aspect of library operations at Lake Superior State University. A unique feature of this library is that it is open to the public (on both sides of the international border) and also offers users a joint library card that serves as both their checkout card for LSSU's library as well as all public libraries in the Eastern Upper Peninsula. Our library catalog is shared with Northern Michigan University. Users can locate materials by specific library or collectively. If patrons find materials that are not available at the campus library, library staff will locate it through Interlibrary Loan.

7-E.4 Resources, Special Facilities, and Services

Resources available to students include access to the Internet from any of the computers located in the Library; but more importantly, over 100 research databases (including Science Direct and Applied Science and Technology Full Text) which index thousands of resources, many of which provide full text access to scholarly journals. All of these research databases are available off-campus through the library's proxy server. There are many group study rooms located throughout the library and the main floor also serves as a space for group interaction through the intentional layout of comfortable furniture and accessible technology to enable group engagement. Throughout the year the library hosts several lectures that are open to the entire campus and community.

7-E.5 Reserve

The Library offers both physical and electronic reserves service for faculty to ensure availability of materials for their classes. This allows all students to access materials that are of limited availability. Faculty determine the loan period (one hour, in library use only, overnight, etc.). In most cases, materials are removed from reserve at the end of each semester.

7-E.6 Government Publications

The Library is a selective federal government depository library which means it does not receive all publications from the Government Printing Office (GPO), but select publications that are chosen in addition to those required by the GPO. Currently, the items selected represent about 16 percent of the total items available to us as a selective government depository, and are selected based on relevance to LSSU's academic programs.

7-E.7 Information Literacy Instruction

Library instruction is conducted in a variety of smart classrooms located throughout the Library. Students learn how to access and search the many electronic resources available through the library in addition to a wide variety of information literacy topics such as copyright, proper citations and intellectual property. While general instructional sessions are offered, most instruction targets access and databases that directly relate to the faculty members' special class needs. When not being used for information literacy instruction, these labs are open for general student use.

7-F Overall Comments on Facilities

The School of Engineering & Technology currently has the facilities necessary to meet its program educational objectives and student outcomes. However, the addition of the Robotics Engineering degree program will require additional facilities and equipment when students presently entering the program reach the upper-level courses.

Criterion 8 INSTITUTIONAL SUPPORT

8-A Leadership

As described in Criterion 0, decisions on the overall direction of the program are indeed the province of the entire faculty of the School of Engineering & Technology (SET), but the primary responsibility for detailed oversight of the program rests with the five faculty members comprising the Department of Electrical and Computer Engineering.

The School of Engineering & Technology is comprised of only ten faculty members and there are two departments (ECE and ME) and five programs (CE, EE, ME, EET, and MfgET). As a result, the curricula are intertwined and there is considerable overlap in the leadership responsibilities for the various programs. Rather than attempting a somewhat artificial distinction between the various leadership roles that affect the Electrical Engineering program, the de facto duties of each the ECE coordinator and the SET chair, relative to the program, are enumerated below. It has been practice that the ECE coordinator takes on the following responsibilities:

- Lead the department in evaluating the student outcomes
- Coordinate course assessment for engineering courses specific to the program
- Ensure all students in the program are assigned an advisor from the department
- Coordinate the mentoring of new department faculty in their advising roles
- Maintain and update all degree audit forms and plans of study forms for the program
- Recommend course substitutions, course waivers, and transfer credit evaluations
- Interview all graduating seniors within the program
- Oversee the program by setting the agenda for and running departmental meetings
- Advise the department concerning curricular matters
- Prepare course or program change proposals and present them at the University level
- Represent the needs of the program at weekly "Chair" meetings (dean, chair, program coordinators)
- Plan the departmental faculty instructional assignments and load distribution
- Assist the School chair in course scheduling and assigning instructors
- Organize and coordinate hiring committees for faculty vacancies in the department
- Lead discussion relevant to the program at the Industrial Advisory Board meetings

The SET School Chair has taken on the following responsibilities:

- Coordinate the overall accreditation efforts for the programs of the School
- Coordinate evaluation of student outcomes and PEOs
- Coordinate the periodic review of the PEOs as well as school mission and goals
- Coordinate course assessment for courses common to engineering programs
- Serve as an approval authority for course substitutions and waivers, and transfer credit evaluations

- Advise all SET freshman and transfer students at orientation
- Write "program review" reports for all SET programs on a five-year cycle
- Establish and maintain transfer equivalency ("articulation") agreements with community colleges
- Lead discussion relevant to the entire School of Engineering & Technology at the Industrial Advisory Board meetings
- Set the agenda and run the meetings of the School of Engineering & Technology
- Set the agenda and run weekly "Chair" meetings (dean, school chair, program coordinators)
- Represent the School of Engineering & Technology at monthly "Deans and Chairs Leadership Group" meetings
- Facilitate scheduling of course offerings and assign instructors
- Provide leadership in School-level long-term planning
- Prepare, recommend, and administer the School budget
- Collect and provide feedback regarding tenure and promotion decisions (for the School's, not the Dean's portion of this)

Note, furthermore, that in contrast to what may be typical of "chair-level" positions at other institutions, duties related to faculty supervision are *not* part of either of these positions. Firstly, in accordance with concepts of academic freedom affirmed by the faculty-LSSU collective bargaining agreement (attached as Appendix N), neither of these positions involves supervision of instruction. Secondly, pursuant to that same agreement, since both positions are occupied by faculty, and as such, members themselves of the collective bargaining unit, neither position may involve responsibility for performance evaluation (besides in an advisory role as a peer evaluator) or for personnel decisions regarding other faculty.

There is a Dean position for the College of Innovation and Solutions of which SET is a part (shared with other Schools, as described in Section 0 below). With respect to the Electrical Engineering program, this position serves as a final approval authority on course scheduling (and changes to instructor, time, or room), course substitutions/waivers, and, budget matters and purchases. The Dean also serves as an approval stage for curricular proposals (new courses, course changes, program changes, etc.) prior to submission to the University-wide Curriculum Committee and thence the Provost's office for final approval. The Dean is also the formal supervisor for all faculty and staff within the SET, carrying out performance evaluations, and serving as an approval stage for hiring decisions recommended by Search committees.

The position of Associate Dean for the College of Innovation and Solutions was put in place for the 2017-18 academic year. This action was taken recognizing the additional duties of the Dean in serving as interim Provost and VP of Academic Affairs. The Associate Dean performed several functions that affected the program such as participation in school meetings, course scheduling, course substitutions/waivers, budget matters and purchases, and curricular proposals. The Dean, by virtue of his role as interim Provost, retained final approval for many of these actions. The position of Associate Dean will be discontinued July 1, 2018 as the newly hired Provost/VPAA begins his duties. Please see Appendix D for changes related to this new structure.

8-B Program Budget and Financial Support

The Chair of SET prepares budgets related to the school and submits them to the Dean. The Dean reviews the budgets from the schools within the College of Innovation and Solutions and in turn submits a budget for the college to the Provost/VP of Academic Affairs for approval. Ultimately the combined Academic Affairs budget is submitted to the VP of Finance.

The Vice President of Finance receives department/school budget requests (one of which is for the SET) and prepares the overall General Fund Budget and Auxiliary Budget summaries. Recommendations are taken to the Senior Management Team for review and finalization prior to presentation to the Board of Trustees for approval.

Recurring LSSU funding for the School of Engineering & Technology, broken down by source, is shown in Table 8-1.

Table 8-1: Summary of SET Funding, Recent Years

Allocations	2014-15	2015-16	2016-17	2017-18
Base Operation	$33,984	$33,984	$33,984	$33,984
Carry Over	$27,332	$89,017	$90,253	$131,390
Course Fees	$47,970	$57,180	$60,255	$54,345
Program Fees	$134,191	$152,216	$154,980	$143,640
Total Allocation	$243,477	$332,396	$339,359	$363,359

The program receives funding from three University sources (base operation allocations, course fees, and program fees), represented by rows in the table. When bona-fide plans for expenditure are articulated to the CFO, funds not utilized in the previous academic year are carried over to the next year, that amount is also shown as a row.

CSSM funds are LSSU allocated funds for the basic operation of the unit. These basic operations would include paper, phones, office supplies, copying, travel, small office related equipment, and other similar items.

Students enrolled in Engineering or Engineering Technology courses also pay course fees and program fees, which the SET receives. The course fees vary from course to course but range from $10-$100, with a median of $60 (for those courses that have *some* course fee); these are set for each course considering the extent of that course's usage of laboratory equipment and expendables, large-volume printing (handouts), and/or renewable license software. The program fee is $70 per credit hour for courses beginning with an EGxx prefix. The School can adjust course fees yearly. Program fees and course fees are adjusted in consultation with the Provost, and require Board of Trustee approval.

As is evident from Table 8-1, the Base Operation component has been stable from year-to-year. On the other hand, course and program fees received are subject to change based upon enrollment.

As noted earlier, all degree programs are closely related, sharing all resources. Funding is not partitioned by program, but the School Chair and Program Coordinators work closely with the Dean to review the needs for each program and make appropriate allocations and purchases.

In addition, not shown in Table 8-1, but consistent enough to regard as "recurring", LSSU is annually eligible to receive a Perkins Voc-Ed Grant. Most years, SET receives $10K; every fourth year, however, SET receives $30K.

Regarding non-recurring, or irregularly recurring, sources of income, there have been equipment sell-offs and donations. Over the last several years, a few thousand dollars have been raised by selling retired equipment on e-bay. Several pieces of donated equipment have been utilized in our labs, including robots for instance.

Occasional targeted donations have been received. For instance, a $10k donation in 2013 donation paid for new PLC trainers. As another example, a fundraising campaign by the IAB in 2015 paid for a 3D printer. In addition, through a collaboration with the Smartzone, SET houses and has access to both a Haas TL-1 CNC Lathe and an Objet 30 Pro high resolution 3D printer.

8-B.1 Teaching Support

Teaching is supported by the occasional use of student assistants, and by the availability of teaching workshops, both on-campus and nationally.

Student class assistants are used, occasionally, in some workshop and computer lab courses. Their roles have included assisting students during the labs with accomplishing the lab work (EGNR-101, EGME-141, EGNR-140, EGEE-125), or in recitation/additional help hours (EGNR-265). These would be students who had previously taken the course, and done well enough to satisfy the current instructor.

More exceptionally, two student "graders" were provided in the Spring 2016 offering of the lecture course EGME-275 Engineering Materials, which had a large enrollment (38 initially), to check/"pre-grade" homework (give comments and tentative scores to worked problems for the instructor's review). This may serve as a precedent henceforth, and the Dean had verbally-stated that it would be dependent upon enrollment numbers in courses. To some extent, the student workers in EGNR-140 have also reviewed and commented on homework.

Teaching workshops exist on campus, via the title-III grant-initiated "Faculty Center for Teaching"; three current SET faculty members have presented at these workshops but the full extent of participation by SET faculty connected with the program has not been monitored. There are usually teaching-related workshops during the development week preceding the Fall semester; as classes are not yet underway at that time, attendance is relatively straightforward for most faculty members.

External workshops are also supported. Jaskirat Sodhi (2014) (no longer with LSSU) and Zakaria Mahmud (2015) each attended the NETI (National Effective Teaching Institute) workshop sponsored by ASEE. Andrew Jones attended (2013) "Enhancing Student Success through a Model 'Introduction to Engineering' Course", Carson, CA. David Leach (2016) attended an ABET IDEAL (Institute for the Development of Excellence in Assessment Leadership) workshop. David Baumann and Robert Hildebrand (2013) attended a one-day ABET workshop (Program Assessment Workshop). David Leach (2016) and Jordan Huff (2017) attended a NIMS (National Institute of Metalworking Skills) CNC training and welding certification. David Leach and Joe Moening will be attending the basic NETI workshop in the summer of 2018 while Zakaria Mahmud will attend the advanced NETI workshop. Masoud Zarepoor is attending an engineering education workshop at Bucknell in the summer of 2018.

Finally, in indirect support of teaching, the University maintains a variety of student services, including counseling, library, placement, admissions, registrar, a learning center (instructing academic success strategies), and tutoring.

8-B.2 Infrastructure Support

Both course and program fees are used for major equipment purchases, computers, lab supplies, equipment maintenance, software, and other related items. Table 8-2 provides a summary of the expenses categories denoting how funds have been spent for the last few years.

Table 8-2: Expense categories and spending

AccountNumber	AccountDescription	Actual 2014	Actual 2015	Actual 2016	Actual 2017	YTD 2018
7001	Supplies-Office	4,198.61	3,622.33	1,134.21	3,022.28	3,328.12
7002	Reference Books	238.99	905.31	624.81	586.29	-
7003	Central Stores	1,958.00	1,700.00	2,200.00	1,184.25	1,433.00
7004	Supplies-Lab	22,477.06	21,372.44	18,254.11	21,058.71	12,507.32
7005	Supplies-Aud Visual	1,190.25	428.46	14.95	2.00	-
7006	Supplies-Photo-Print	-	-	-	-	-
7010	Awards-Plaques	395.61	493.09	374.45	347.94	789.80
7015	Supplies-LSSU Name-Logo Items	334.56	1,290.79	558.00	2,881.87	1,498.70
7020	Supplies-Other	5,295.99	16,490.33	5,495.88	19,635.19	31,490.73
7030	Copies	13,448.32	20,913.56	14,878.96	8,792.28	7,709.80
7031	Printing	1,399.99	1,134.52	3,056.32	2,026.82	2,155.98
7032	Photographic Service	-	-	-	61.60	-
7040	Postage	180.79	1,355.92	1,144.19	199.60	64.47
7050	Telephone	4,291.85	5,204.88	4,894.54	4,680.00	3,900.00
7055	Fax	-	-	-	-	-
7060	Software	-	57.90	5,000.00	204.16	3,120.00
7061	Software Licenses and Maintenance	19,217.45	15,076.84	5,238.00	11,195.00	17,321.95
7065	Computer Hardware	3,953.03	3,392.87	13,237.42	164.84	3,863.88
7070	Equipment <2500	21,040.30	12,034.77	26,497.60	23,588.26	22,883.23
7101	Travel In State	6,356.25	3,883.37	5,911.77	4,323.16	5,671.60
7102	Travel out of State	5,833.01	10,891.48	8,750.95	13,633.78	5,382.37
7103	Travel Students	53.00	-	-	828.05	8,844.57
7110	Meetings-Luncheons	5,128.36	4,864.81	10,776.89	7,988.62	12,082.72
7111	Guest Lodging-Meals	14.73	-	100.70	775.28	137.80
7112	Conferences	2,710.00	5,168.87	3,270.00	2,359.50	3,240.00
7130	Recruitment--Employee	-	-	-	235.05	-
7131	Recruitment--Student	302.88	244.19	1,473.30	1,062.06	52.76
7210	Rental-Media	-	-	-	-	200.00
7211	Rental-Equipment	-	-	1,300.00	3,738.60	4,338.41
7225	Rental-Other	-	-	2,536.50	-	-
7230	Product Development Center Services	-	-	-	-	-
7252	Honorariums	-	-	-	75.00	53.85
7253	Contracted Services	-	200.00	45,000.00	-	-
7261	Equipment Mtnce and Repair	4,078.26	550.00	-	10,831.00	3,984.94
7271	Legal	-	-	-	-	-
7272	Accreditation	-	-	-	348.06	-
7290	Linen Service	-	292.50	292.50	-	265.50
7320	License-Permits-Fees	-	-	539.50	6,748.00	-
7340	Memberships	2,923.00	2,671.00	3,041.04	5,843.44	4,995.00
7341	Subscriptions-Magazines	-	-	-	-	-
7345	Advertising	-	77.55	-	-	309.00
7365	Professional Development	619.47	1,928.50	5,447.00	5,873.36	550.00
7395	Miscellaneous	92.08	-	-	42.29	90.69
7520	Haz Material Dispose	-	-	1,406.58	957.27	-
7960	Capitalized Equipment Purch	55,900.00	22,470.90	41,990.08	42,787.72	39,876.59
Grand Total		183,581.64	148,717.18	234,440.25	208,081.33	202,142.78

8-B.3 Resource Adequacy for Teaching and Infrastructure

The budget has also allowed the School of Engineering & Technology to sufficiently meet the teaching needs of the program. Although teaching assistants or graders are rarely used, funding has been adequate for the occasional instances in which they were necessary.

The budget has also allowed the School of Engineering & Technology to sufficiently meet the equipment needs of the program. Although no comprehensive five or ten year equipment replacement plan exists, the ECE department has created an equipment need prioritization list within the last few years where present and future needs are included to help with planning. This document contains budgetary information (e.g. how many devices are needed and at what cost) as well as a ranking of the priority as high, medium, or low. Funding has been adequate for critical and necessary upgrades as well as needed maintenance activities.

8-C Staffing

The staffing of the School of Engineering & Technology is described in the following, in terms of compensated positions (full or part time; salaried, release-time, or stipend assignments); evidently, as is typical in academia, much additional work is also available in the form of service activities by faculty members. All of the positions described have some responsibility, to varying degrees, for the program (as well as other programs).

8-C.1 Clerical Staff

Throughout most of the last 6-year cycle, support staff (for the School of Engineering Technology) has included 1-1/2 full-time positions, i.e., a full-time Academic Assistant, and a half-time administrative assistant. However, the half-time position discontinued as of June 2016.

The Academic Assistant provides clerical support to the faculty and Dean, manages day-to-day activities in the School's office, processes purchase requisitions and manages faculty cardholder accounts, organizes special events (e.g., annual School banquet), provides coordination support for Summer programs (camps for high-school-age and younger), and pursues various other duties as well.

The half-time administrative assistant position had provided assistance for marketing and recruitment, implementation of Engineering admissions policies, and maintenance of assessment and accreditation records. These various duties have been shifted to the full-time Academic Assistant and the chair with some duties discontinued at the SET level (e.g. marketing moving to the university marketing personnel) or discontinued entirely.

Furthermore, there has continuously been a part-time student assistant in place to help the Academic Assistant, including during the summertime.

8-C.2 Administrative Staff

8-C.2.1 Dean

The School was administered by a Dean (see Criterion 8-A above for the Dean's role) whose responsibilities has been divided with the Lukenda School of Business under the auspices of a combined college. Beginning July 1 (the date of this report), a reorganization will place the SET together with both School of Mathematics and Computer Science and the Lukenda School of Business within the College of Innovation and Solutions under a solitary Dean. The current Chair of the School of Mathematics and Computer Science will assume the role of Dean for the College; whether the Dean will continue to also maintain Chair duties for the School of Mathematics and Computer Science is yet to be finalized.

8-C.2.2 Chair

The Chair (see Criterion 8-A above for his/her role) is a 3-release load hour (1/4-time) appointment, plus the equivalent of 3 load hours converted to a stipend each for the fall and spring semesters (in the 2012 self-study, these were 3 actual load hours), and a $2,000 Summer stipend. That has been consistent during the entire 6-year cycle, except for the Summer stipend, which has varied from $1,000 in summer of 2012 to $2,000 currently, with Summer 2017 having been calculated at 2 load hours (slightly less than $2,000).

8-C.2.3 Coordinators

During some early portions of the 6-year cycle, Coordinators (see Criterion 8-A above for their respective roles) received 2 release hours (out of 12 for full time) per semester, i.e., these were 1/6 time assignments. During the majority of the cycle the ME coordinators received 2 release hours per semester resulting in 1/6 time assignment and the ECE coordinator (as well as the Engineering Technology coordinator) received 1 release hour (1/12-time). Note that the release time for the ECE coordinator has been reduced from the 2 release hours mentioned in the previous self-study report from 2012.

8-C.2.4 Director of Robotics

There is a 3-release hour (1/4-time) assignment for running the Robotics laboratory of the SET. Note that courses such as EGRS-215, EGRS-381, EGRS-385, EGRS-430, EGRS-435, and EGRS-481 make extensive use of this laboratory. The director develops the robotics laboratory through industrial donations and grants, and plays key leadership roles nationally in the Society of Manufacturing Engineers and the Robotics Industry Association.

8-C.3 Academic Staff

8-C.3.1 Instructional Staff

The ten full-time faculty positions (all tenured or tenure-track) have already been detailed in Criterion 6.

In addition, some usage is made of adjunct faculty. In particular, the two Laboratory Engineers frequently act in this capacity, and the courses they typically instruct (or co-instruct) courses including the lab components of EGET-110 *Applied Electricity*, EGEE-210 *Circuit Analysis*, EGME-110 *Manufacturing Processes*, and EGET-175 *Applied Electronics*, and occasionally both the lecture and lab components of EGRS-365 *PLC's*. More directly related to the program is their role as project advisor in the capstone EGNR-491-495 sequence.

The PDC (Product Development Center) of the larger College also employs a full-time Engineer, and has employed two during the early portion of the 6-year cycle; these have sometimes served as adjuncts for EGNR-491-495 sequence course topics and team advising, EGEE-370 *Electronic Devices*, EGME-141 *Solid Modeling*, EGNR-245 *Calculus Applications for Technology*, and EGET-310 *Electronic Manufacturing Processes*.

8-C.3.2 Technical Staff

Two-full time Laboratory Engineers are assigned to the School of Engineering & Technology. An Electrical/Computer Laboratory Engineer is responsible for the maintenance and operation of all electrical and computer equipment in the laboratories. A Mechanical Laboratory Engineer is similarly responsible for the maintenance and operation of all mechanical equipment in the laboratories. Both Laboratory Engineers design and manufacture equipment for use by faculty in the laboratory and/or the classroom. These positions are full-time, twelve month appointments.

8-C.4 Resource Adequacy for Clerical, Administrative, and Academic Staffing

The School of Engineering and Technology has had sufficient clerical staffing to meet the critical needs of the program. The loss of the half-time administrative assistant in 2016, however, has resulted in some diversion of teaching, administrative, and marketing resources away from the day-to-day needs of the academic programs.

Similarly, budgetary allocations are sufficient to meet the *immediate* administrative staffing needs of the program, but may not be sufficient to ensure the long-term sustainability and/or growth of the program. Although the School chair receives 25% release time supplemented plus the equivalent of 3 load hours converted to a stipend each for the fall and spring semesters and the equivalent of 2 load hours in stipend for the summer, that position encompasses administrative leadership for all 6 programs in the School; furthermore the release time for the ECE departmental coordinator (and the engineering technology program coordinator) has been reduced within the last 6 year cycle from 2 load hours per semester to 1 load hour per semester such that the amount of release time is not high enough to reflect the amount of time needed to fulfill the responsibilities of the position..

The School of Engineering and Technology currently has sufficient instructional and technical staffing to meet the needs of the program, provided the ten positions remain filled. Currently there is a search to replace the ECE faculty member last taught in the spring of 2017 (although the effective retirement date was December 2017). At the completion of that search the ten regular faculty members, supplemented by the aforementioned adjunct instructors, are able to deliver all the courses that are required to support the program. Furthermore, the two full-time laboratory engineers have the resources to maintain all equipment and facilities used by the program.

8-D Faculty Hiring and Retention

8-D.1 Faculty Hiring Process

The reader is referred to Appendix N, the contract between the faculty and the University, wherein its Appendix B (Appendix B of the Faculty Agreement within Appendix N of this document) provides a detailed description of the procedure for formation and conduct of a faculty hiring committee. This is a University-wide procedure to which the School adheres (in fact, this procedure for the whole University was modelled after our longer-standing practices in the School of Engineering & Technology), but it does not address some of the specific additional practices that have developed for, and the philosophy for the conduct of, searches in within the School of Engineering & Technology. There is one search in progress conducted to replace a retired ECE faculty member. There have been six searches for ME/MfgET faculty during the previous six years.

Consistent with the institution's primary mission of teaching, and the School's philosophy of maintaining an applied emphasis in its engineering and technology programs, the evaluation process employed in the hiring of new faculty accordingly places a greater emphasis on a candidate's promise as an instructor and on industrial experience than it does on academic research credentials (although the latter *is* also a factor of lesser weight). A faculty candidate is generally expected to have some teaching experience (either as faculty member or a teaching assistant) and to possess excellent communication skills.

After initial screening of CVs, the search committee typically extends invitations for phone interviews to up to a dozen candidates. These are contacted by a committee member, by phone, at which time, as a matter of transparency, the salary (presently about $65,000-$70,000 for these openings, which is considered low on the market) is related, as well as something of the geographical and climatological features of the region (rural and wintery), and the nature of the position (heavy teaching loads with little research emphasis). One or more of these factors may cause some of the candidates to withdraw at this point, saving them and the committee needless time expenditure. The remaining phone interview candidates then speak with the entire committee on the telephone for about 20 minutes to half-an-hour, at which time the search committee questions them on teaching interests, inclinations to teach laboratories, capstone projects, etc. Up to 3 of those candidates, whichever are most promising (if enough are), are then selected for campus visits.

During the campus visit, candidates give a sample lecture (on a topic specified by the hiring committee chair and generally kept the same for all visiting candidates); this lecture is ordinarily given to both students and faculty (including those not participating in the search committee). Feedback is thereafter solicited from the students and faculty in attendance, and is given much weight in the subsequent hiring decision. Besides the guest lecture, consideration is also given to the candidate's performance in an informal research (or professional) presentation, to collegiality as observed at interactions throughout the day, including meals and one-on-one interviews (including with HR, the Provost, and sometimes the President, who convey their respective feedback), and to feedback from the candidates' references. However, it remains the guest lecture that most often proves decisive.

Historically (and into the early phases of the 6-year cycle), the search committee would select the best candidate, and also rank the other candidates in case of an offer being declined (as happens fairly frequently). The Dean and Provost then had formal authority to negotiate and hire, but tended to support the committee decisions. More recently, the search committees have been discouraged from selecting and ranking, in favor of merely indicating "qualified" or "not qualified."

8-D.2 Faculty Retention

Retention of qualified faculty is partially a matter of correct selection in the search and hiring process, i.e., by identifying a "good fit" faculty hire for the SET. The optimal faculty hire, given the relatively high instructional load, should be committed to instruction, rather than exclusively to research, as well as adaptable to the geographical and climatological particulars of Michigan's Eastern Upper Peninsula (i.e., relative remoteness in a wintery setting). Moreover, while such a person may well be a subject matter expert, the willingness to function as a generalist, and with bonafide laboratory and project skills, is ideal. Given these attributes, a faculty member is likely to find a degree of satisfaction in the work that is conducive to retention.

A School-specific PD fund (beyond that of the University), to bolster faculty retention, has also been available during the 6-year cycle, and still continues in more restricted form. In 2012, subsequent to the EAC of ABET visit which had cited the various engineering programs for issues of faculty retention, the SET committed to provide a fund for workshops/conferences, summer stipends for scholarly endeavors, and other PD activities. Accordingly, for a portion of the cycle, these funds have been available for the purposes described, and may be allocated to Engineering Technology-related PD just as well as to Engineering-related. In the last three years, however, stipends have been discontinued, so that the fund is now limited to travel reimbursement and materials/equipment.

Retention has not been an issue for the ECE Department, having retained all faculty members over the past six years aside from the one retirement. However, it has been an issue for the ME Department, which has hired and lost six (one due to retirement) faculty members in the past six years, and has impacted the ECE faculty workload somewhat.

8-E Support of Faculty Professional Development

The "Agreement" (Appendix N) between Lake Superior State University and the Faculty Association provides each faculty member with $1000 per academic year for professional development; at the beginning of the 6-year cycle (through 2013), this level was at $800, so it has undergone a $200 annual increase during the cycle. A faculty member's professional development fund can carry over from academic year to academic year, but not to exceed $4,000 (unchanged). Expenditures from professional development funds must be related to the faculty member's professional development or teaching objectives. In addition, faculty members, who are officers of professional organizations or presenters at national conferences, have received additional support to travel to workshops and conferences from departmental and/or Dean's budgets.

Note also the additional SET PD fund described in Criterion 0. For a couple of years during the 6-year cycle, this provided stipends for scholarly work, as well as travel and materials reimbursement. Although the stipends have been discontinued, the funding continues to exist for travel and materials.

The "Agreement" between Lake Superior State University and the Faculty Association also provides a total of up to three semesters of sabbatical leave at full pay per academic year (it had been four, through 2013). A tenured faculty member is eligible for a Sabbatical Leave after five (5) academic years of employment as a faculty member at the University, so long as s/he has not had a Sabbatical Leave within the previous five (5) years. A Sabbatical Leave Committee comprised of two Deans, appointed by the Provost, and six faculty members elected by the faculty consider the applications for sabbatical leave and make recommendations to the Provost. No engineering faculty member has been awarded a sabbatical during the last 6-year cycle. The last sabbatical award to an engineering faculty member was a full-time sabbatical for the 2011-2012 academic year, that being just prior to this 6-year cycle.

PROGRAM CRITERIA

The EAC of ABET program criteria for Electrical Engineering programs state that:

A. The structure of the curriculum must provide both breadth and depth across the range of engineering topics implied by the title of the program.
B. The curriculum must include probability and statistics, including applications appropriate to the program name; mathematics through differential and integral calculus; sciences (defined as biological, chemical, or physical science); and engineering topics (including computer science) necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components.
C. The curriculum must include advanced mathematics, typically including differential equations, linear algebra, complex variables, and discrete mathematics.

The LSSU Electrical Engineering program meets all of these criteria. This has already been demonstrated in previous sections of the self-study report. This section will provide the appropriate references to those other sections.

Program Criteria (A)

That the Electrical Engineering curriculum provides breadth and depth across the range of electrical engineering topics may be seen in Criterion 5-A.4 *Prerequisite Structure*, particularly in Figure 5-1: *Prerequisite Structure for the Electrical Engineering Curriculum*, and in Criterion 5-A.5 *Depth in Subject Areas*.

Program Criteria (B)

That the Electrical Engineering curriculum includes probability and statistics, including applications appropriate to the program name may be seen in Criterion 5-A.5 *Depth in Subject Areas*, particularly in Table 5-7: *Mathematics & Basic Sciences Component of Curriculum* (probability and statistics) and Figure 5-2: *Mathematics Component as Related to Subsequent Courses* (application of probability and statistics).

That the Electrical Engineering curriculum includes mathematics through differential and integral calculus may be seen in Criterion 5-A.5 *Depth in Subject Areas*, particularly in Table 5-7: *Mathematics & Basic Sciences Component of Curriculum*.

That the Electrical Engineering curriculum includes sciences may be seen in Criterion 5-A.5 *Depth in Subject Areas*, particularly in Table 5-7: *Mathematics & Basic Sciences Component of Curriculum*.

That the Electrical Engineering curriculum includes engineering topics necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components may be seen in Criterion 5-A.5 *Depth in Subject Areas*, particularly in Table 5-8: *Engineering Core Component of Curriculum* and *Table 5-9: Engineering Topics in the Curriculum*, and in Criterion 5-A.6 *Major Design Experience*.

Program Criteria (C)

That the Electrical Engineering program includes advanced mathematics topics may be seen in Criterion 5-A.5 *Depth in Subject Areas*, particularly in *Table 5-10: Advanced Mathematics in Engineering Core Curriculum.*

APPENDICES

The remainder of the document contains the following appendices:

Appendix A	Course Syllabi
Appendix B	Faculty Vitae
Appendix C	Equipment
Appendix D	Institutional Summary
Appendix E	University Organizational Chart
Appendix F	Policy for Substitutions and Waivers
Appendix G	Student Outcome Evaluation Reports
Appendix H	Senior Exit Survey Results
Appendix I	Syllabi for Sample Courses
Appendix J	Course Assessment Summaries for Sample Courses
Appendix K	Pre-Requisite Forms for Sample Courses
Appendix L	Plans-of-Study
Appendix M	Degree Audits
Appendix N	Faculty Association Contract

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**School of Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**Degree Audit Form – BS-EE (F2018)** **Plan of Study Form – BS-EE (F2018)** **Flowchart of EE Courses (New Draft Plan of Study)**
This documentation is relevant to Question number:	**15**
Briefly summarize the content of the file and its value as evidence supporting program review:	**These documents describe the program curriculum and advising tools for it.**

School of Engineering and Technology

BS Degree in Electrical Engineering

(For Students Entering in the 2018-2019 Academic Year)

Student Name: ______ Advisor Approval: ______ Date: ______

Student ID: ______ ECE Coordinator Approval: ______ Date: ______

Intended Month of Graduation: ______ SET Chair Approval: ______ Date: ______

All information below should be from the student's most recent transcript and/or transfer evaluation.

GENERAL EDUCATION REQUIREMENTS

Communication (6 credits required)

ENGL110 - 3 ______

ENGL111 - 3 ______

Humanities (6 credits; different disciplines; see catalog)

Elective ______ - __ ______

Elective ______ - __ ______

Social Science (6 credits; different disciplines; see catalog)

Elective ______ - __ ______

Elective ______ - __ ______

Computational Literacy [Mathematics] (3 credits)

(fulfilled by departmental requirements)

Natural Sciences (7 credits)

(fulfilled by departmental requirements)

Diversity (3 credits; see catalog)

Elective ______ - __ ______

Communication Skills (3 credits)

COMM101, 201, or 225 COMM____ - __ ______

☐ **GEN-ED Requirements met by MTA or MACRAO**

Students must satisfy all of the following minimum requirements for graduation:

- ☐ 2.0 overall GPA
- ☐ 2.0 General Education GPA
- ☐ 2.0 departmental GPA
- ☐ 124 total credits (minimum)
- ☐ 32 credits from Mathematics (including EGNR340) and Natural Science
- ☐ 30 credits earned at LSSU
- ☐ 24 credits 300/400 level in major earned at LSSU

DEPARTMENT REQUIREMENTS

Complete the Electrical Engineering Core (82 credits required)

CHEM115 - 5 ______

EGEE125 - 4 ______
(C or better required)

EGEE210 - 4 ______
(C or better required)

EGEE250 - 4 ______

EGEE280 - 4 ______
(C or better required)

[1]EGEE310 - 4 ______

[1]EGEE330 - 4 ______

[1]EGEE345 - 3 ______

EGEE370 - 4 ______

EGEE475 - 4 ______

EGEM220 - 3 ______

EGNR101 - 2 ______

EGNR140 - 2 ______

EGNR265 - 3 ______
(C or better required)

EGNR340 - 1 ______

EGNR346 - 1 ______

EGRS460 - 4 ______

MATH151 - 4 ______
(C or better required)

MATH152 - 4 ______
(C or better required)

MATH251 - 4 ______

MATH308 - 3 ______

MATH310 - 3 ______
(C or better required)

PHYS231 - 4 ______
(C or better required)

PHYS232 - 4 ______

Complete One of the Senior Year Experiences (6-13 credits required)

Industrial Project	Cooperative Project	Research Project
EGNR491 - 3 ______	EGNR250 - 2 ______	EGNR260 - 2 ______
EGNR495 - 3 ______	EGNR450 - 4 ______	EGNR460 - 4 ______
	EGNR451 - 3 ______	EGNR461 - 2 ______
	EGNR491 - 3 ______	

Complete Technical Electives (13 minimum credits required)

Technical Elective** ______ - __ ______

Robotics & Automation Concentration

Complete the following:

EGRS385 - 4 ______*

EGRS430 - 4 ______*

EGRS435 - 3 ______*

Sustainable Energy Concentration

Complete all of the following:

EGNR261 - 3 ______*

[1]EGNR361 - 1 ______*

[1]EGEE411 - 3 ______*

And any one of the two below:

[1]EGNR362 - 3 ______*

EGME337 - 4 ______*

Digital Systems Concentration

Complete all of the following:

[1]EGEE320 - 4 ______*

[1]EGEE355 - 4 ______*

[1]EGEE425 - 3 ______*

General Technical Electives

** ______ - __ ______

** ______ - __ ______

** ______ - __ ______

** ______ - __ ______

* (C or better is required for all courses within a concentration)

** EGEE320 or higher, EGME225 or higher, MATH215 or higher, EGRS365, EGRS461, EGEM320, EGET310, or any course from the concentrations.

---

[1] Theses courses may be offered only every other year

12-Jun-18

School of Engineering and Technology
BS Degree in Electrical Engineering
(For Students Entering the Program in the 2018-2019 Academic Year)

Freshman Year – Fall Semester

CHEM-115 General Chemistry (4,3)	5
EGNR-101 Introduction to Engineering (1,2)	2
ENGL-110 First-Year Composition I (3,0)	3
MATH-151 Calculus I (4,0)	4
Social Science Elective (3,0)	3
	17

Freshman Year – Spring Semester

EGEE-125 Digital Fundamentals (3,2)	4
EGNR-140 Linear Algebra and Num Methods for Engineers (1,3)	2
ENGL-111 First-Year Composition II (3,0)	3
MATH-152 Calculus II (4,0)	4
Social Science Elective (3,0)	3
	16

Sophomore Year – Fall Semester

EGEE-250 Microcontroller Fundamentals (3,2)	4
EGEE-280 Introduction to Signal Processing (4,0)	4
MATH-251 Calculus III (4,0)	4
PHYS-231 Applied Physics for Engineers and Scientists I (3,2)	4
	16

Sophomore Year – Spring Semester

EGEE-210 Circuit Analysis (3,2)	4
EGNR-265 C Programming (3,0)	3
MATH-310 Differential Equations (3,0)	3
PHYS-232 Applied Physics for Engineers and Scientists II (3,2)	4
Humanities Elective (3,0)	3
	17

Junior Year – Fall Semester

[1]**EGEE-310** Network Analysis (4,0)	4
EGEE-370 Electronic Devices (3,3)	4
EGNR-340 Advanced Numerical Apps for Engineers (0,2)	1
EGNR-346 Probability and Statistics Lab for Engineers (0,2)	1
MATH-308 Probability and Mathematical Statistics (3,0)	3
Communication Elective (3,0)	3
	16

Junior Year – Spring Semester

[1]**EGEE-345** Fundamentals of Engineering Electromagnetics (3,0)	3
EGEE-475 Power Electronics (3,3)	4
EGEM-220 Statics (3,0)	3
Cultural Diversity Elective (3,0)	3
Concentration/Technical Elective / Engineering Option	4
	17

Senior Year – Fall Semester

[1]**EGEE-330** Electro-Mechanical Systems (3,2)	4
EGNR-491 Engineering Design Project I (2,3)	3
EGRS-460 Control Systems (3,3)	4
Concentration/Technical Elective / Engineering Option	4
	15

Senior Year – Spring Semester

EGNR-495 Engineering Design Project II (1,6)	3
Humanities Elective (3 or 4 cr)	4
Concentration/Technical Elective / Engineering Option	4
Concentration/Technical Elective / Engineering Option	3
	14

Total Credits: 128

General Technical Electives (14 cr)

EGME-225 or higher
EGET-310
MATH-215 or higher
Any course from concentrations

Robotics & Automation Concentration (14 cr)

EGRS-385 Robotics Engineering (3,3)
EGRS-430 Sys Integration and Machine Vision (3,3)
EGRS-435 Automated Manufacturing Systems (2,3)
General Technical Elective

Digital Systems Concentration (14 cr)

[1]**EGEE-320** Digital Design (3,3)
[1]**EGEE-355** Microcontroller Systems (3,3)
[1]**EGEE-425** Digital Signal Processing (2,2)
General Technical Elective

Renewable Energy Concentration (14 cr)

EGNR-261 Energy Systems (3,0)
[1]**EGNR-361** Energy Systems Lab (0,3)
[1]**EGEE-411** Power Distribution & Trans (3,0)
[1]*__EGNR-362__ Vehicle Energy Systems (2,3)
*__EGME-337__ Thermodynamics (4,0)
*= must take one of the two
General Technical Elective

[1]=course offered only every other year

Electrical Engineering

Core Courses

See reverse side for details about the available degree concentrations.

Course
Semester (Credit)

Pre / Co-requisite

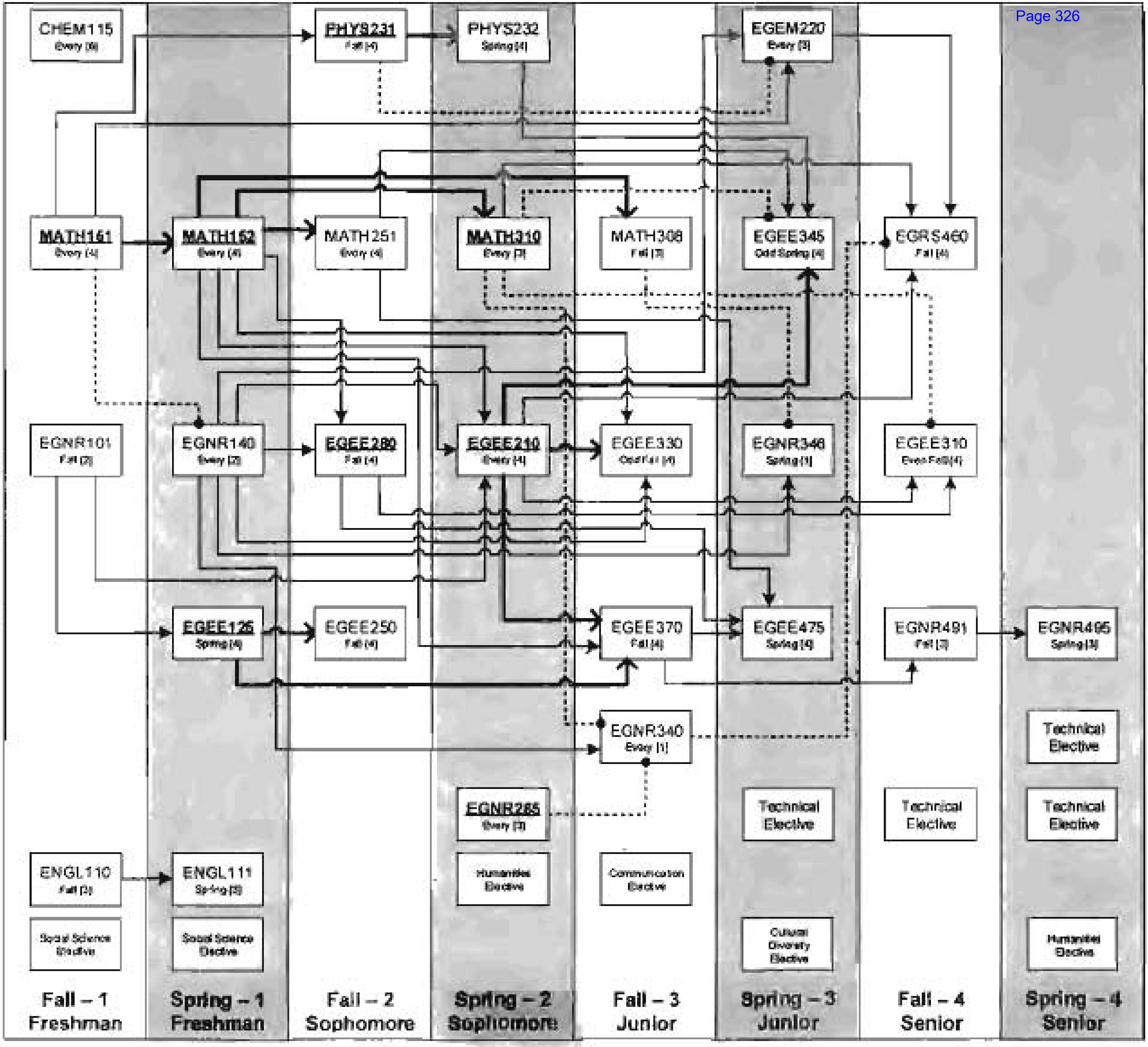
Pre-requisite
(D- or better required)

Pre-requisite
(C or better required)

Courses that are bolded and underlined, such as **EGEE210**, require a grade of C or better to graduate.

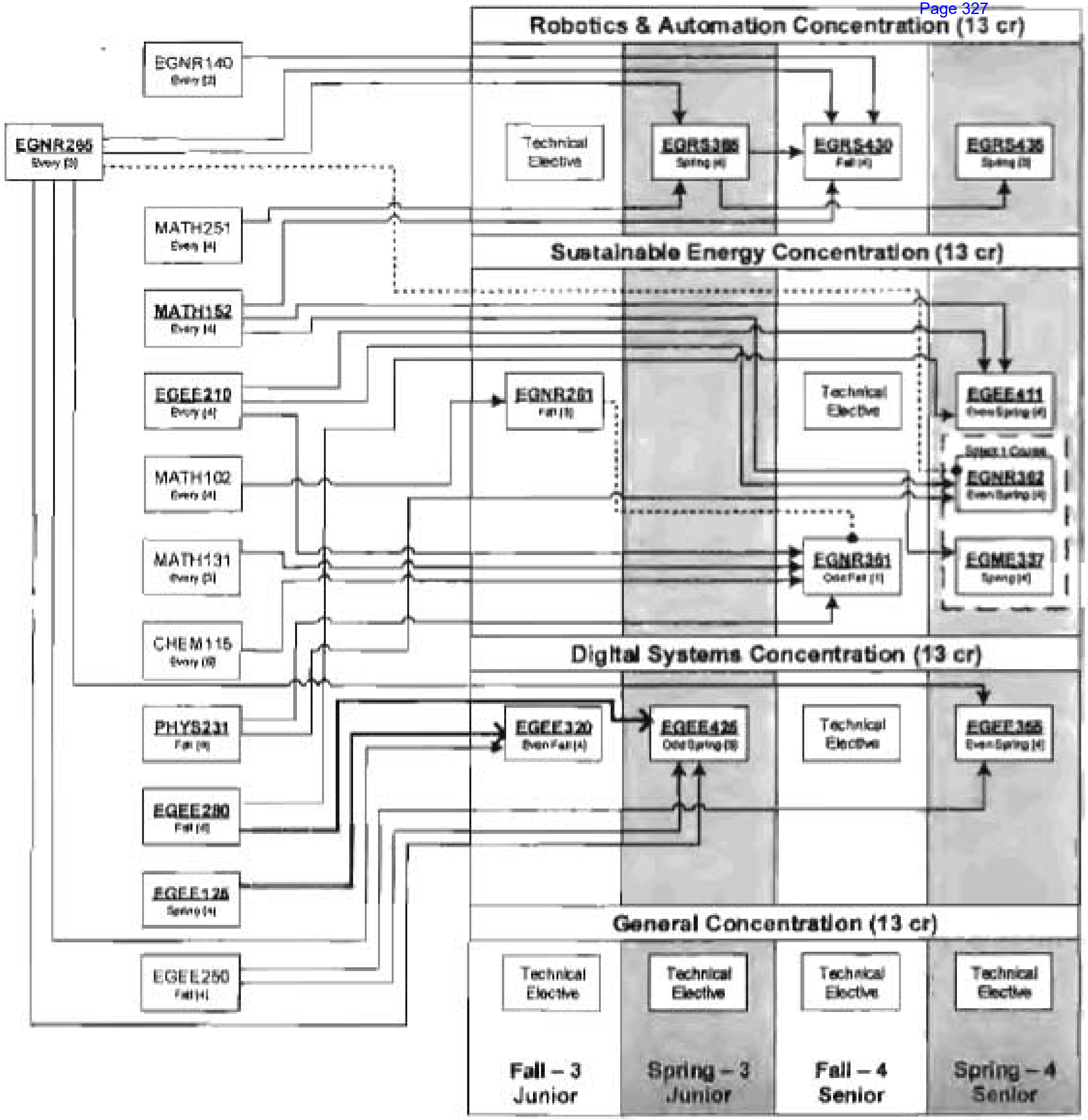
This chart assumes you have the required prerequisites or tested into MATH151 Calculus.

Revised: 13NOV18



Electrical Engineering

Technical Electives



Course
Semester (Credit)

Pre / Co-requisite

Pre-requisite
(D- or better required)

Pre-requisite
(C or better required)

Courses that are bolded and underlined, such as **<u>EGEE210</u>** require a grade of C or better to graduate.

Technical Elective List

EGEE320 or higher
EGEM320
EGME225 or higher
EGET310
EGRS366
EGRS461
MATH215 or higher
Any course from concentrations

Appendix Cover Sheet

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering and Technology**
Document Title (if attached) or Filename (if emailed):	Senior Project Posters
This documentation is relevant to Question number:	**16**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Provides example(s) of projects involving students in this major.**

Project Statement

The purpose of this project was to update one of the two thermal trainer units currently used in EGME 432 (Thermal and Fluids Lab), and housed in CAS-106C. More specifically, Team STS integrated both software and hardware upgrades, particularly to do with the Programmable Logic Controller's control of the system. In addition, the team converted the system with National Instruments data acquisition systems for all data collection and recording. Major stakeholders were the engineering students, both current and future, enrolled in Thermal and Fluids Lab as well as the involved faculty.

Two of the five laboratory exercises supported by the thermal trainer unit explore the efficiency of what is known as a Pelton turbine (pictured on the left) at variable loads. The system enables a user to select the number of nozzles they would like to use to expel water toward the turbine's cupped fins and, in addition, supports several different nozzle sizes. As this pressurized water strikes the turbine's fins, it causes the turbine to rotate, generating harnessable electricity. The turbine's efficiency can then be calculated using either angular velocity and torque or voltage and current output to a load.

Project Benefits

The thermal trainer's increased functionality now supports a total of five independent laboratory exercises. Each of these exercises fosters the study of unique principles in areas such as the characteristics of centrifugal pumps, turbine efficiency, cooling effects of forced convection, multi-stage energy conversion, and pump performance in single, series, and parallel configurations. The product enables students to quickly and easily configure the system to extract the data necessary to perform these studies at the push of a button.

STS

LAKE SUPERIOR
STATE UNIVERSITY

2017-2018

The Team

[redacted]
EE
ME
EE
MfgET
ME

Mr. Jeff King Faculty Advisor
Dr. Zakaria Mahmud Industrial Customer

3D Model:

Video at:

YouTube

Project Challenges

As with most projects, the biggest obstacle was completing all tasks and objectives within the confines of the timeframe. All team members had to maintain a balance between this project and other time commitments. Additionally, learning and successfully implementing the LabVIEW software used for data acquisition proved to be a unique challenge in that it is not widely used within LSSU's engineering and technology department. This lack of a local knowledge and resource bank pushed key team members to learn the software via experimentation and alternate means.

NATIONAL INSTRUMENTS LabVIEW

PTC Creo

Allen-Bradley

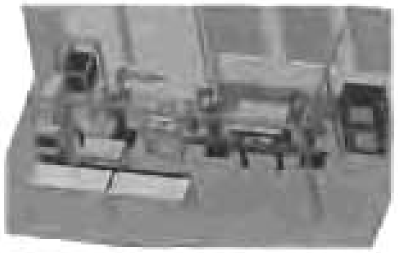
The Product

This new and improved training unit features a current generation Allen Bradley PLC used in conjunction with a full-sized color Human Machine Interface. Multiple National Instruments data acquisition cards provide the platform needed for a dedicated computer to employ a software known as LabVIEW. This is done in order to capture and timestamp a plethora of incoming data streams generated by an army of sensors and transducers that monitor dozens of pressures, flow rates, velocities, torques, and temperatures, each contributing to the data required to complete lab exercises in key areas of thermal and fluid studies.

Project Summary

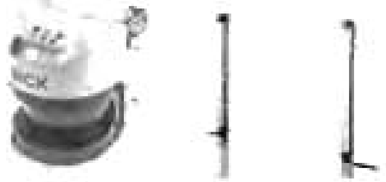
Team KUKA Roboline Upgrade (KRU) has implemented a third KUKA robot to the pre-existing two-robot KUKA workcell in LSSU's Robotics Lab. In addition to updating the workcell's controls, vision, and safety systems, Team KRU installed a rotary index table used to transport work pieces between two robots, a worktable, and end-of-arm tooling for the third robot. Team KRU also updated all documentation for the workcell and created two new lab exercises. Finally, a synchronized robotics motion project and a robotic deburring project were completed to demonstrate the capabilities of this workcell.

The KUKA Robotics Workcell



The fully completed robotics workcell now contains:

- 3 KUKA KR6 R1400 robots
- A rotary index table and a linear conveyor system
- Multiple end-of-arm tooling for the each robot
- Automatic tool-change capability
- Ethernet/IP communications
- 3 Cognex vision systems
- Allen Bradley PLC (Programmable Logic Controller) with HMI (Human Machine Interface)
- 3 new computer stations
- Safety system with a SICK area scanner and 2 Keyence light curtains (shown below)



K.R.U.

KUKA ROBOLINE UPGRADE

Senior Projects 2017-2018

Faculty Advisor
Jim Devaprasad

Team KUKA Roboline Upgrade
[redacted]

Industrial Contacts
Eric Becks
Ron Bergamin

Vision System

Team KRU installed a Cognex 7802 vision system for each of the three robots. The vision system includes several advanced capabilities such as autofocus, integrated lighting and on-board processing. An image of the camera can be seen below.

Project Benefits

The main project benefits are:

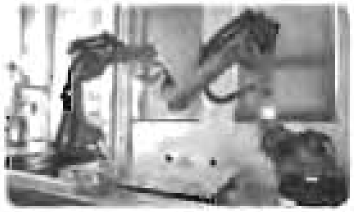
1) Addition of a new robotics platform to LSSU's Robotics Lab
2) Future LSSU engineering students can get lab experience on KUKA robots and Cognex vision software
3) New project demonstrations created to highlight LSSU Robotics capabilities to visitors
4) New platform for future senior and research projects
5) Experience for Team KRU members on robotics system integration.

Synchronized Robotic Motion

Team KRU developed a piano demonstration using Autodesk's Maya software in conjunction with the Mimic software plugin and KUKA's EntertainTech software. Maya is a 3D computer animation software that uses time-based programming and has been used extensively in the production of films and video games. The Mimic plugin allows for time-based animation of KUKA Robots. Mimic then exports data as a program file which can be executed using KUKA's EntertainTech software package. These technologies allowed the three robots to play two pianos in sync. An image of the robots playing the pianos is shown below

Robotic Deburring

Team KRU developed a demonstration that simulates the deburring process of marine boat propellers. The process utilizes a deburring tool manufactured by ATI. The RoboTeam software package was used to traverse the complicated geometry of the propeller blades. RoboTeam has many features including program and motion synchronization, collision avoidance, and operation of multiple robots from a single SmartPAD. An image of the robots performing the deburring sequence can be seen below.



Project Made Possible By:

KUKA
SCHUNK
LAKE SUPERIOR STATE UNIVERSITY
COGNEX
TEXTRON AVIATION

CORNING

AUTOMATION OF A PARTICULATE FILTER REPAIR STATION

2017-2018 Senior Projects

LAKE SUPERIOR STATE UNIVERSITY

Project Contributors

SMC

FASTENAL

Industrial Customer

The industrial customer (IC) for this project is Corning Incorporated. Headquartered in Corning, New York and founded in 1851 they are responsible for some of the most advanced glass technologies. Boasting 107 locations in 24 countries they are truly a global company. Special thanks to Gail Dyer (LSSU Alumna) for her guidance on this project.

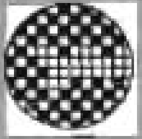
Project Benefits

- Tested feasibility of automating the current manual process
- A small but safe work cell near high traffic areas
- More precise, consistent process achieved through use of automation
- Improved cycle times
- Learning experience for students

Project Statement

Team Automated Repair Cell (ARC) was charged by Corning to create an automated robotic cell which integrates machine vision with a collaborative robot. The project automated a previously manual process at Corning of repairing ceramic diesel particulate filters. The vision system identified the imperfections in the filters and a custom built end of arm tool (EOAT) performed repairs on the filters. The EOAT punched out unwanted caps and filled in unwanted holes repairing the filter matrix which restored the perfect checkerboard pattern of holes and caps in the filter.

Perfect filter



Filter missing caps

Filter missing holes

What is a Collaborative Robot?

Standard industrial robots require additional safety equipment such as light curtains, fencing, and area scanners in order to follow industry standard guidelines. Corning has provided the team with a FANUC Collaborative Robot that features contact stop capabilities. The FANUC CR-7iA/L robot automatically stops when unexpected contact is made. This allows the robot to be used without additional safety equipment while still following industry safety standards.

Team Members

[redacted]

ARC

Faculty Advisor:
Eric Becks

Industrial Customer
Gail Dyer

Project Outcomes

Custom end of arm tooling was developed for the robot to complete both types of repair operations on the filter. The work cell utilizes an extremely high resolution camera to detect errors in the filter and validate proper repair of the filter. An Allen Bradley Programmable Logic Controller (PLC) was used to manage communications within the work cell.

Light Inspection System

(2017-2018)

AUTOMOTIVE LIGHTING AND VISION SYSTEMS

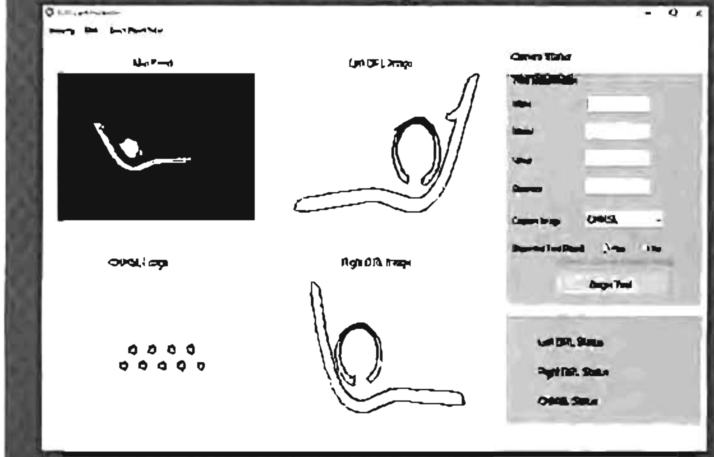
Project Statement

Team Automotive Lighting and Vision Systems (ALVS) was responsible for researching and developing a machine vision system to automate the inspection of light elements during automotive assembly. The project includes a high resolution machine vision camera, mobile test cart, light assembly stands, and a graphical user interface.

Graphical User Interface

The main focus in developing the user interface was to create a simple, user-friendly environment to interact with the hardware and vision software. The team designed a graphical user interface (GUI), and implemented the vision system software functionality directly into the code. With this interface, plant operators can set up configurations for new vehicle models and conduct tests on both the front headlight assemblies, and the rear center high-mount stop light while viewing all of them on the same basic screen. The program stores all of the information from each test and exports it into an external data file. Failed test results can be viewed easily within the interface via the error log tab in the toolbar. This feature will help manufacturers swiftly locate vehicles with faulty components in the assembly line.

GUI Layout



Team Members

[redacted]

Industrial Contact
Mark Compton

Faculty Advisor
David Leach

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Check us out
on YouTube!

ESYS AUTOMATION

Esys Automation is an engineering and manufacturing systems integration firm located in Auburn Hills, Michigan. The company specializes in turnkey solutions that serve the automotive and manufacturing industries.

Project Result

The Team researched and tested several potential vision techniques and methods prior to creating the algorithm that determines whether the lights are functioning properly. The end product is a fully adjustable vision system that can be easily adapted for use in different environments with different car models.

Setup and System Design

Fixtures were designed to be fully adjustable to accommodate a diverse range of testing scenarios. The team created fixtures to hold the light assemblies as well as the camera and laptop. The camera fixture was made to be mobile so it can move relative to the three light positions.

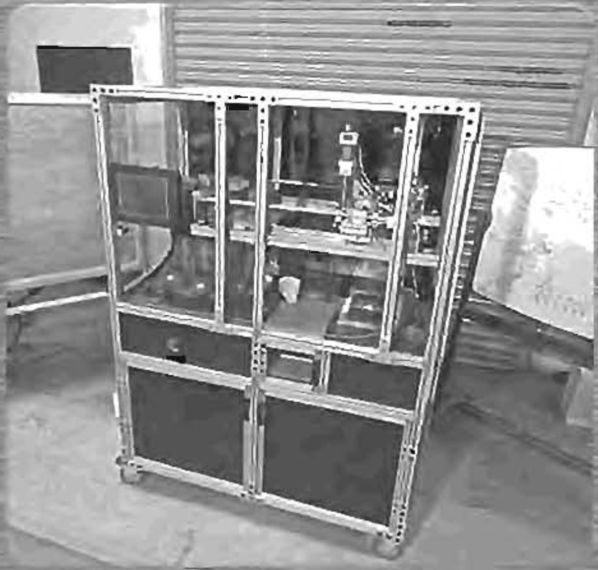
Test Equipment

CVS

Controls and Vision Systems

Project Description: *Pharm-Assist*

The *Pharm-Assist* project is an automated prescription dispensing machine designed to assist pharmacy employees and increase the time they are available for customer service. Team CVS was tasked with Phase 2 of the *Pharm-Assist* project, where the main goal was to reduce the cost of the workcell. Building off the previous team's proof of concept workcell, team CVS designed and built a 3D gantry system which replaced the FANUC delta robot that was used in the previous iteration. Along with replacing the robot, team CVS converted a majority of the control of the system from PLC (Programmable Logic Controller) to Raspberry Pi (mini-computer). The main focus of Phase 2 was to build and test a rigid gantry design that would be reliable and fast (30 pills per minute). Other areas of focus for the project included reducing noise and vibration from the previous year's design, improving the security of the cell, and converting the power of the cell from 240 Volts to 110 Volts.



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Controls and Vision Systems
Engineering Senior Project 2016-2017

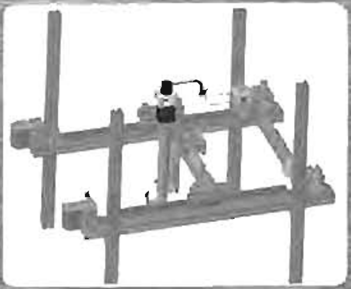
Team Controls and Vision Systems:

[redacted]

Dr. Joseph Moening (Faculty Advisor)

Gantry Design:

The team chose a "Core XY" design for the gantry system, as seen pictured below. This design allows the motors that drive the X & Y movement of the gantry to be stationary and mounted on the frame rather than having to move with the carriage. This reduces the weight that the motors need to move and therefore increases the maximum speed at which the XY plane of the gantry can move.



4D SYS

Company Background:

4D Systems, LLC. sponsored Phase 1 and Phase 2 of this senior project. 4D Systems is an automation integration company that automates production processes for their clients, as well as providing software and software services to the engineering community. This company is located in Flint Township, Michigan and has been open since 2011. Mr. Jean Pierre Rasaiah is the president and founder of the company. Mr. Rasaiah and Mr. Brett Newill, both alumni of Lake Superior State University, were the industrial contact for the project.

Project Benefits:

With the completion of Phase 2 of this project, many people will benefit. The team members of team CVS will benefit from working with 4D Systems and completing their senior project. This will allow them to gain valuable real world engineering experiences. 4D Systems will benefit by having a prototype which they can expand upon and eventually market to pharmacies and nursing homes. The users of the workcell will benefit by being able to spend more time with the customers, increasing customer service.

Project Outcomes:

- Designed, built, and tested rugged 3D gantry system
- Speed of pill dispensing: 30 pills per minute
- System delivers correct prescriptions 95% of the time
    - Accomplished by detecting if a pill is dropped from the End of arm tooling (suction cup)
- Total cost of project was under $10,000
- Improved security from previous iteration
    - Accomplished by the use of electronic locks and a fingerprint scanner
- The cell produces less than 65dB of noise (slightly louder than office conversation)
- Vibrations were reduced 25% from the previous iteration

WHEEL
INSPECTION
SYSTEMS

Rim Quality Inspection via Vision Senior Project 2016-17

LAKE SUPERIOR
STATE UNIVERSITY

Sponsored By:

ESYS AUTOMATION

Industrial Contact:
Mark Compton

Wheel Inspection Systems:

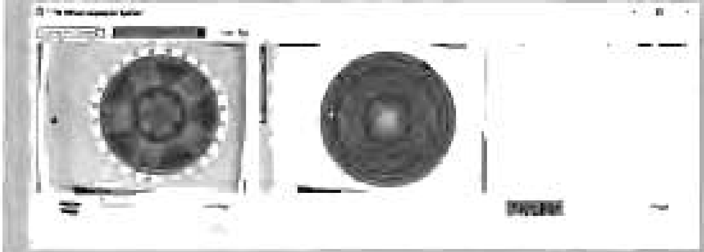
Team Members:

[redacted]

Faculty Advisor:
David McDonald

GUI Interface:

The picture below shows the user interface of the vision system. Here, users can set up and run tests on automotive rims. The user can acquire an image of the rim via a camera, run a live feed from the camera, load a previous test image, reference an ideal image, and run the vision algorithm. The GUI will display the results of the test.



Project Statement:

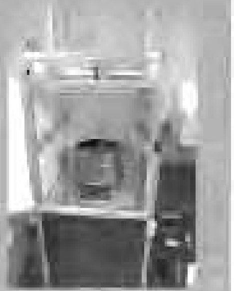
Team Wheel Inspection Systems (WIS) was tasked with researching and developing a system to automate the inspection of automotive rims using an industrial grade camera and machine vision software.

Company Background:

Esys Automation is a robotics integration company located in Auburn Hills, Michigan. The company was established in 1999, and it specializes in turnkey automation for the automotive industry.

System Design:

The pictures to the right show Team WIS's shroud. The shroud is a chamber designed to block outside light and to scatter light inside the shroud. High-intensity bar lights, a high resolution camera , and a rim are mounted in the shroud. This system allows for a controlled testing area of vision algorithms on automotive rims.



Project Result:

The team researched the effect of different lighting positions and intensities on the surface of the rims. Based on the research, the team was able to create an algorithm using a visions system that could inspect automotive rims.

Lake State Automation

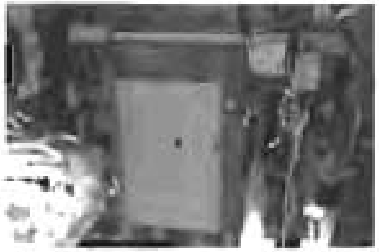
2016 – 2017 CNC Gantry Mill

Project Description

Team Lake State Automation has been sponsored by Mactech On-site Machining Solutions to design, build, and automate a prototype CNC milling machine. The project came about due to the desire for increased flexibility and functionality of the current machine. The project entails an upgrade on an existing gantry mill which was originally manually operated. This machine is designed to work in a wide range of applications from ship maintenance to bridge building. It may be mounted and operated while in any orientation, and is completely mobile.

The prototype machine features increased speed, accuracy and repeatability. New Fanuc hardware has allowed the machine to be operated by software which may be created off-site. Automation of the machine has greatly increased its capabilities and reduced human labor. The prototype design of the CNC milling machine is intended to be replicated by Mactech On-site Machining Solutions in the future. Team Lake State Automation has undertaken this project facing a fixed budget and a need to collaborate with multiple vendors.

Fanuc Controls



Team Members:

[redacted]

Faculty Advisors:

Professor David Leach
Professor Jon Coullard

Industrial Contacts (Mactech):

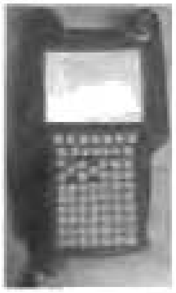
Mr. Joel Wittenbraker
Mr. Chad Peterson

Mactech On-Site Machining Solutions

Mactech was founded in 1974 in order to provide portable stress relieving solutions. The company expanded in 1985 in order to provide portable machine tools and on-site services. Mactech is a world leader in the production of portable machining and heat treating equipment.

iPendant User Interface

- User friendly operation
- Touch screen interface
- Operate machine from more than 30 feet away
- Easily load G&M code programs via USB
- Manual and automatic operation



CNC Gantry Mill

LAKE SUPERIOR STATE UNIVERSITY

MACTECH
ON-SITE MACHINING SOLUTIONS

FANUC

PART 2: Degree-Level Review

Degree Program: B.S. Mechanical Engineering

Explain how the program works to address each of the following questions. For each question, respond with a narrative and supporting evidence.

Assessment (CC 4.B and CC 4.C)

13. Provide evidence that the degree-level program outcomes are clearly stated and are effectively assessed, including the "use of results." Attach the 4-Column Program Assessment Report.

All program outcomes are publicly posted at: https://www.lssu.edu/school-of-engineering-and-technology/accreditation-outcome-reporting/

Refer to Sections 3 (Student Outcomes) and 4 (Continuous Improvement) of the Mechanical Engineering ABET Self-Study Report. Also, refer to the 4-column report from Summer 2018.

14. Explain how results from degree assessments were used to improve the degree program. Include specific examples.

Refer to Section 4 (Continuous Improvement) of the Mechanical Engineering ABET Self-Study Report.

Quality, Resources and Support (CC 3.A)

15. Explain how the program ensures that degree program-level and course-level learning outcomes are at an appropriate level. Attach evidence, including a degree audit for the program.

Program-level outcomes are Student Outcomes A-K specified by ABET. Refer to Sections 3 (Student Outcomes) and 5 (Curriculum) of the Mechanical Engineering ABET Self-Study Report. A degree audit is also attached.

The Lumina Foundation's Degree Qualification Profile (DQP) is suggested as a resource for answering the questions about what students should know and be able to do at each degree level:
http://degreeprofile.org/wp-content/uploads/2017/03/DQP-grid-download-reference-points-FINAL.pdf

Intellectual Inquiry (CC 3.B).

16. Explain what the program does to engage students in collecting, analyzing, and communicating information; mastering modes of inquiry or creative work; developing skills integral to the degree program. Attach examples of undergraduate research, projects, and creative work.

    Refer to 5-A.6 (Major Design Experience) of the Computer Engineering ABET Self-Study Report; this section is written such that it is applicable to all SET bachelor's degrees. Binders with the Senior Project work can be found in the CAS203 cabinets in the 2nd cabinet from the right on the north wall.

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Academic Program Review

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**School of Engineering & Technology**
Document Title (If attached) or Filename (If emailed):	**ABET ME Report - Final**
This documentation is relevant to Question number:	**ME-related reports (multiple questions)**
Briefly summarize the content of the file and its value as evidence supporting program review:	**This file contains the self-study report for the ABET ETAC Fall 2018 visit, including a variety of information that is useful for the assessment of the ME program.**

ABET
Self-Study Report

for the

Mechanical Engineering Program

at

Lake Superior State University

Sault Ste Marie, Michigan, USA

June 29, 2018

CONFIDENTIAL

TABLE OF CONTENTS

Program Self-Study Report
for
EAC of ABET
Reaccreditation of Mechanical Engineering at
Lake Superior State University, Sault Ste Marie, MI, USA

BACKGROUND INFORMATION

A. Contact Information

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Sault Ste Marie, MI 49783
+1 (906)635-2139, FAX (906)635-6663
rhildebrand@lssu.edu

B. Program History

The Mechanical Engineering program is administered by the Department of Mechanical Engineering, which is part of the School of Engineering and Technology. A brief historical background of the University, the School, and the Mechanical Engineering program follows.

Lake Superior State University

To address the needs of returning World War II veterans and to provide opportunities to the people of the Eastern Upper Peninsula of Michigan, Lake Superior State University was originally founded as a branch of Michigan Technology University (MTU) in 1946. The campus gained autonomy from MTU in 1969 and was renamed Lake Superior State College. University status was granted in 1987 and the institution was finally named Lake Superior State University (LSSU).

LSSU is the smallest 4-year public institution of higher learning in the state of Michigan. LSSU grants Bachelor degrees (Bachelor of Science or Bachelor of Arts) in forty-nine areas, and Associate degrees in twenty-four areas. The enrollment as of Fall 2017 academic year was approximately 2,100 students head count (or about 1,900 full-time equivalent), of which 88% were from the state of Michigan and 7% were from the province of Ontario. The number of full-time faculty in the 2017-2018 academic year was 97. LSSU is accredited by the Higher Learning Commission of the North Central Association of Colleges and Schools.

School of Engineering and Technology

After gaining autonomy from MTU in 1969, three Bachelor of Science degrees in Engineering Technology were eventually introduced. The Mechanical Engineering Technology (MET) program was introduced in 1977, the Electrical Engineering Technology (EET) program was introduced in 1981, and Manufacturing Engineering Technology (MfgET) program was introduced in 1987. The EET and MET programs received continuous TAC of ABET accreditation until their discontinuation in 1999.

In 1994, the engineering technology faculty and constituents (alumni, employers of graduates, Industrial Advisory Board, and area educators) reviewed the three engineering technology programs and reached the decision to discontinue the EET and MET degrees in favor of Electrical Engineering (EE) and Mechanical Engineering (ME) degrees. The decision was based on better serving a larger audience of Michigan's industry and public and on input from alumni. In 2000, a Computer Engineering (CE) degree was added.

The LSSU School of Engineering and Technology now offers Bachelor of Science degrees in Computer Engineering, Electrical Engineering, Mechanical Engineering, Electrical Engineering Technology, and Manufacturing Engineering Technology. The School of Engineering and Technology has developed a reputation for high quality graduates and for its ability to provide an excellent undergraduate education in the area of robotics. With regard to that, the School will be offering a new Bachelor of Science degree in Robotics Engineering starting Fall 2018, which was formally approved this summer.

Mechanical Engineering Program

A plan to convert the MET degree program to an ME degree program was created in 1995 and implementation of the plan began in 1996. Beginning with the 1996 academic year, no MET freshmen were admitted and only ME freshmen were admitted. In subsequent years (sophomore, junior, senior), new engineering curriculum was put into place as the MET curriculum was phased out. By 1999, the completed ME degree program was in place, and the first graduates of the new ME degree program occurred in the 2000 academic year. During the conversion process, the Department of Mechanical Engineering was formed.

Initial accreditation of the Mechanical Engineering program occurred in 2000, and subsequently reaccreditation was awarded in 2007, and most recently 2013, effective until September 30, 2019.

Changes to the Mechanical Engineering department and program, since the last site visit in Fall 2012, include the following:

1. faculty composition turnover:
    a. Herescu replaced Janjua (F'13)
    b. Leach replaced Duesing (S'14)
    c. Mahmud replaced Herescu (F'14)
    d. Sodhi departed (position left vacant) (F'14)
    e. Sinha filled vacant position (S'15)
    f. Zarepoor replaced Sinha (F'16)
    g. Coullard (lab engr) departed (S'17)
    h. Huff filled lab engr position (Summer '17)
2. Increased, Spring 2013, credit count in EGEE280 (appears in all Technical Elective concentrations) from 3 to 4 (2 hours lab and 2 hours lecture became 4 hours lecture, weekly).

3. Increased, Spring 2013, credit count in EGNR450 from 2 cr to 4 cr, and in EGNR451 from 2 to 3 cr (these courses appear in the Cooperative Project alternative of the Senior Sequence block).
4. Added, Fall 2013, EGME240 Assembly Modeling and GD&T (3 cr) as an elective within the Robotics & Automation concentration, i.e., as a 4th alternative in an elective slot from which there had already been 3 choices (EGNR310, EGEE280, EGME310 – this last now called EGMT216). At the same time, made EGME240 *required* in the ME-General, where it had been a choice between EGME240 and EGRS365.
5. Combined, Spring 2014, the two fluid mechanics courses EGME338 (2 cr) and EGME339 (1 cr) into a single course EGME338 (3 cr), with the same prerequisites (Calculus III and Differential Equations) as for EGME339 previously, plus EGEM220 Statics as an additional prerequisite. The course had previously been divided to permit technology students to take the first part (EGME338 for the first 9 weeks), with lower Math prerequisites. However, this was found to overly condense, for the ME students, into the last 5 weeks (EGME339), the more mathematically-intensive material, to their detriment.
6. Increased credit count, Fall 2016, of EGME432 Thermal-Fluids Lab, adding a 1-hour lecture per week to the 3 hours of lab. The lecture hour permits instruction on statistical error analysis in experimentation, and also accommodates the pre-discussion preceding labs which had, previously, taken away lab time. Finally, it accommodates some amount of group oral presentations summarizing lab results and conclusions.
7. Added, effective Fall 2018, a recitation to EGME338 Fluid Mechanics.
8. Replaced, effective Fall 2018, EGNR362 Vehicle Energy Systems (3 cr) in the Vehicle Systems concentration with a choice of either EGME442 Finite Element Analysis (3 cr) or EGRS461 Design of Control Systems (4 cr).
9. Replaced the four "program outcome objectives" (employability, societal awareness, professionalism, and fundamental technical skills), as described in the 2012 self-study, with the eleven Student Outcomes A – K, exactly corresponding to the ABET student outcomes.
10. Split, Spring 2014, the third Program Educational Objective into two (now the third and fourth). The third concerns professional growth and development and the fourth concerns societally-beneficial activity (see ch. 3 for complete statements).

C. Concentrations

The Mechanical Engineering program may be completed, following any of the following technical elective concentrations:

1) ME-General: Assembly Modeling and GD&T (EGME240), plus 14 credits of other eligible technical elective courses, of which 5 credits must be at the 400-level. Eligible are all those courses listed for the other two named concentrations (see below), as well as the courses EGNR261 Energy Systems & Sustainability and EGNR361 Energy Systems & Sustainability Lab. In the interest of this being the most flexible possible route, but not sacrificing rigor, the ME Coordinator is also willing to entertain proposals to substitute 400-level Mathematics or other Engineering courses, upon request of the student and advisor, where a coherent theme to the combined set of technical electives can thereby be pursued.

2) Robotics & Automation Concentration: Programmable Logic Controllers (EGRS365), Robotics Engineering (EGRS385), Systems Integration & Machine Vision (EGRS430), Automated Manufacturing Systems (EGRS435) and one of the following: Quality Engineering (EGNR310) *or* CAM with CNC Applications (EGME312) *or* Signal Processing (EGEE280) *or* Assembly Modeling and GD&T (EGME240).

3) Vehicle Systems Concentration: Assembly Modelling and GD&T (EGME240), Signal Processing (EGEE280), Vehicle Development & Testing (EGME310), Vehicle Dynamics (EGME415), Vibrations & Noise Control (EGME425), and one of the following: Finite Element Analysis (EGME442) *or* Design of Control Systems (EGRS461).

D. Program Delivery Modes

Courses in the Mechanical Engineering program are offered during daytime and evening hours, of regular weekdays only, and using a traditional lecture/laboratory format (the vast majority of it is unavailable at off-campus sites, or through web-based or distance education avenues; presently, only General Education courses are available on-line). A small cooperative education component can be used, at the student's option, however, to satisfy a portion of the senior capstone course; that, of course, largely takes place at an employer site.

E. Program Locations

The program is available, exclusively, at the main campus of Lake Superior State University, in Sault Ste Marie, Michigan.

F. Public Disclosure

For the Mechanical Engineering program, the Program Education Objectives (PEOs), Student Outcomes (SOs), annual student enrollment and graduation data is available at the URL

https://www.lssu.edu/school-of-engineering-and-technology/accreditation-outcome-reporting/

G. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them

The ABET final statement subsequent to the visit of Fall 2012 resulted in the following findings remaining unresolved:

"Criterion 8. Institutional Support This criterion requires that the resources available to the program be sufficient to attract, retain and provide for the continued professional development of a qualified faculty. The program faculty members have very high teaching loads with inadequate opportunities for professional development. Additionally, there is a lack of opportunity for teaching and/or research during the Summer that would address the need for professional development. Since 2005, there have been several successive faculty departures and new hires in the thermofluids area of the program, with the fifth new faculty member being hired in the Fall 2012. This significant turnover in faculty has contributed to the lack of systematic maintenance of the thermofluids laboratory. The program lacks strength of compliance with this criterion because there do not appear to be adequate resources available to attract and retain faculty members and provide for their professional development.

- Due Process Response: The EAC acknowledges receipt of documentation showing that the LSSU Board of Trustees approved a proposal for additional funding for faculty to attend workshops/conferences and provide Summer stipends for scholarly endeavors to help ensure that the faculty has adequate opportunities for professional development. However, additional professional development funding alone might not be enough to retain qualified faculty.

- The weakness is now cited as a concern."

The 30-day response from LSSU to ABET was more detailed than as paraphrased above, concerning the promised PD/stipend support, reading:

> "Specifically, LSSU Engineering program fees will be raised from \$60/semester to \$70/semester, with 75% of these program fees being returned to Engineering versus the current 50% return. These modifications to the Engineering program fees scheme will generate ~\$52,000/yr to be used for professional development activities (~\$21,000/yr) and summer stipends (~\$25,000/yr). A small portion of the generated funds (~\$6,000/yr) will be used to reimburse the LSSU General Fund for Engineering Program Coordinators being at two release hours per semester versus the standard one release hour. This increase of course load release will provide additional time to complete administrative duties, particularly those related to maintaining ABET accreditation. (1 extra hour/coordinator x 3 coordinators/semester x 2 semesters/yr x \$890/hour = ~\$6,000/yr).
>
> "With ten faculty distributed amongst the three accredited engineering programs at LSSU, the new funds will provide ~\$5,000/yr per faculty member for professional development and scholarship."

Developments Since 2012 Visit:
Since the 2012 visit, faculty and staff turnover in ME (from 4 total faculty positions, and 1 lab engineer position) has continued as follows:

a. Herescu replaced Janjua (F'13)
b. Leach replaced Duesing (S'14)
c. Mahmud replaced Herescu (F'14)
d. Sodhi departed (position left vacant) (F'14)
e. Sinha filled vacant position (S'15)
f. Zarepoor replaced Sinha (F'16)
g. Coullard (lab engr) departed (position left vacant) (F'17)
h. Huff filled vacant lab engr position (Summer '17)

The ABET finding cites high faculty loads and lack of professional development opportunities as background to the turnover problem. The latter will be discussed in terms of the PD funding program that sought to address it, below. Concerning the former, faculty load, see section 6.B of this report, in which it is noted that high loads have continued (and are, in fact, higher now than 6 years ago).

The latter circumstance, lack of professional development opportunities, may best be discussed in terms of the status of the action plan to which reference was made in the final statement from

2012. The funding history of that professional development ("PD") and stipend program, cited in the due process response as a mechanism to abate the turnover problem, is provided in Table 0-1, below.

Table 0-1: Funding History of Prof. Develop't / Stipend Funding Promised to ABET in Response to 2012 Criterion 8 Weakness.

Activity Code EPDSR	Engineering Professional Development Summer Research					
				Fiscal Year		
Acct Code	Description	2013-14	2014-15	2015-16	2016-17	2017-18*
	Compensation					
6170	Salary	19,486.00	32,637.00			
6710	FICA	1,467.08	2,467.19			
6722	TIAA Retirement	2,338.32	3,916.44			
	subtotal	23,291.40	39,020.63	-	-	-
	Supplies and expenses					
7002	Reference Books	-	670.61	179.92	-	-
7020	Supplies	576.35	-	255.47	57.25	-
7061	Software Licenses	2,994.00	-	-	-	-
7070	Non-capital Equipment	6,146.56	-	-	87.49	-
7340	Memberships	-	-	99.00	-	-
	subtotal	9,716.91	670.61	534.39	144.74	-
	Travel, conference fees					
7101	Travel In State	-	-	-	502.58	227.60
7102	Travel Out of State	-	-	480.70	1,386.15	2,032.60
7112	Conferences	1,150.00	-	2,000.00	400.00	4,290.00
7365	Professional Development	-	1,928.50	5,447.00	2,620.00	-
	subtotal	1,150.00	1,928.50	7,927.70	4,908.73	6,550.20
	Grand totals	34,158.31	41,619.74	8,462.09	5,053.47	6,550.20

*as of 6-15-18 Banner query

As the table shows, the program was substantially active for the first two years at levels only somewhat short of the commitment, *after which* the program declined dramatically, as explained below. The maximum annual funding peaked at about 80% of the promised ($52 k) figure, during the 2nd year only, the 1st year being somewhat close as well, at about two-thirds of the promised level. Most faculty in SET (School of Engrg & Techn) participated during that time, and stipends were granted on the order of a few thousand dollars per recipient, as well as reimbursements of various other PD-related expenses.

Thereafter, the Dean stipulated new eligibility requirements for participation, namely that there should be *direct* student benefits from any approved activity, but that there should *not* be a direct connection to any specific course. This change ruled out the faculty specialty-area research projects (whereas faculty, widely in academia, would tend to understand the "scholarly endeavors" of the 2012 due process response to include individual faculty research within specialization areas, and not of necessity implying student participation), effectively confining the awards to pedagogy-type research and degree-advancement (tuition/travel/fees expenses towards an MS degree); it also ruled out any of the lab-upgrade types of projects, as those were regarded as tied to specific courses. It has generally proven too difficult to find projects that fall between these two limitations, explaining the lack of projects (and therefore the lack of funding) since, as can be seen in the far lower funding totals for the last 3 years.

Furthermore, the CFO, at the same time (after 2 years) and since, disallowed any use of the funding for stipends or pay of any kind (even though stipends were part of the language of the original commitment), which has made participation significantly less attractive for faculty to pursue, even if projects could somehow be found that fit the now very narrow definition of eligibility. Accordingly, the program has remained largely inactive, with little to no participation in recent years, and funding at levels well below the $52k promised.

Returning, finally, to the EAC statement, it notes "Additionally, there is a lack of opportunity for teaching and/or research during the Summer…". As the research aspects have already been addressed, so it remains to describe the situation concerning teaching opportunities. The only "coursework" offered in Engineering for most Summers has been the Coop-program, with between 1 and 3 students enrolled per Summer (for which there is only a slight faculty involvement at a distance). There has been no Engineering classroom-type coursework to be taught by the faculty, however. In Technology, two Summer courses (EGRS382 and EGRS482) were offered in 2014, taught by the same faculty member to only 2 students (pay prorated accordingly), and one Technology course in Summer 2016 (EGRS381) for only 3 students (same faculty member again). In summary, summertime instruction has been an extremely marginal phenomenon, and it can therefore still be said that Summer teaching opportunities, practically, do not exist.

GENERAL CRITERIA

CRITERION 1. STUDENTS

A. Student Admissions

Most students enrolled in the Mechanical Engineering program are adequately prepared to perform well in the demanding curriculum. The average ACT/SAT score of all students enrolled in the Mechanical Engineering program is shown below in Table 1-1. In 2015, the state of Michigan elected to begin using SAT scores, instead of the ACT scores as in previously, as a standard for high school juniors to take. That change took effect in Spring of 2016, for which reason both ACT and SAT scores are provided. As a comparison, the average ACT/SAT score of *all* students enrolled in *any* degree program at LSSU is also shown in Table 1-1.

Table 1-1: ACT/SAT Scores of ME Students by Academic Year

Year	ACT Scores of ME Students	SAT Scores of ME Students	ACT Scores of LSSU Students	SAT Scores of LSSU Students
2012-2013	24.95	1165	22.4	1034
2013-2014	23.65	1085	22.3	1076
2014-2015	25.21	1080	22.2	971
2015-2016	25.11	1010	22.2	1012
2016-2017	25.23	1170	22.6	1093
2017-2018	23.00	1105	22.5	1092

A.1 Admission of First-Time-in-College Freshmen

LSSU considers any applicant with 19 credits (19 semester hours, or 29 quarter hours) or less of university or college coursework to be a freshman. The following policy applies to them. Those applicants with more than 19 credits of university or college coursework are considered to be transfer students.

The academic background of the applicant must demonstrate an ability to meet the requirements of an engineering program at LSSU. For those students entering directly from high school, admission to the engineering programs is based on high school grade point average and ACT/SAT scores. The admissions standard for admittance into Engineering (incl. Mechanical Engineering), particularly, has changed over the past six years. Prior to 2017, the standard was a high school GPA of 2.75 or above, an ACT composite score of 24 or above, or SAT score of at least 1110. Starting in the fall of 2017, the new admission standard for the admittance into Engineering is the following four criteria (all need to be satisfied):

1. Acceptance into LSSU.
2. Placement into MATH111 (College Algebra) or higher. Currently an ACT Math minimum score of 23 or a SAT Math minimum score of 540.

Applicants not meeting the above criteria but meeting admission requirements for the University will be admitted into AS-General Studies-Engineering major, essentially a place-holder major for those aspiring to Engineering, but not yet qualified to take most early courses in the program; these students receive advising from a liberal arts advisor, as most of their course selections are General Education, so long as they remain in this major.

A.2 Transfer from AS-General Studies-Engineering to Mechanical Engineering (If Necessary)

In order for a first-time-in-college freshman who is in the AS-General Studies-Engineering major (see above) to move into the Mechanical Engineering program, that student must make good academic progress and be prepared to enter Calculus I (MATH151). Specifically, to be admitted to the program, the student must attain a C or better in College Algebra (MATH111) and a C or better in College Trigonometry (MATH131) and earn an overall GPA of 2.0.

B. Evaluating Student Performance

Student performance in a course is evaluated by the course instructor, who assigns, at the completion of the course, a grade on an A-F scale, where F is a failing grade. There are no courses in the Mechanical Engineering program graded on a pass-fail basis. The GPA is monitored by the University on a semesterly basis in order to insure the student is in good academic standing.

B.1 Grading

Pursuant to concepts of academic freedom, which are affirmed by the faculty-LSSU collective bargaining agreement, attached as appendix N, the School of Engineering and Technology (SET) does not mandate any methodology by which instructors are to arrive at grades, nor any distribution of grades, etc. Instead, grading policies are left to the judgment of the individual faculty member; the assurance of quality and consistency in grading is therefore *not directly* by virtue of common policies, but rather *indirectly* by virtue of the care taken in the process of making faculty appointments to ensure that the faculty candidate has a mastery of his/her field and is a person of judgment. (Refer to CRITERION 6: Faculty (Section 6) for discussion of this process). Moreover, the Dean prepares performance evaluations of faculty members, as discussed in Section 6, and issues of fairness and accuracy of grades could be addressed, and feedback given, if necessary.

The student can appeal to the instructor of a course for a grade change, but the instructor's grade cannot be overruled by the Dean, Provost, or even President.

B.2 Monitoring of Grades

To satisfy any course requirement in the Mechanical Engineering program, or for a course to serve as a prerequisite, the student must obtain a passing grade in that course. Additionally, certain fundamental courses (e.g., EGEM220 Statics, the first two Calculus courses, etc.) require a grade of C or better. Furthermore, maintaining an adequate GPA (2.0 or better) is a condition for continued enrollment in the program.

All efforts are made to monitor student performance *during*, and not merely after, a course in order to be in a position to take corrective action, i.e., to encourage better study habits and learning approaches, when appropriate. Thus, instructors are encouraged to submit midterm grades, which not only apprise a student of his/her performance midway through a course, but also alerts the Academic Advisor and academic support units of the University when that student is not performing well. The IPASS (Individual Plan for Student Success) program, in particular, can provide an academic intervention in such a scenario.

B.3 Academic Standing

For a student to remain in good academic standing at the University, he/she must maintain a cumulative GPA of at least 2.0. A student who does not meet this requirement will be placed on probation. Any student who is on probation for two consecutive semesters or a student who has more than 19 credits and has a GPA of less than 1.6 will be dismissed from the University.

Upon dismissal from the University, the student must wait two semesters (Summer may be counted for one semester) to elapse before re-enrollment or may petition the Scholastic Standards Committee for immediate readmission should extenuating circumstances exist.

B.4 Prerequisites

Each engineering course has prerequisites, usually a list of courses, identifying the necessary background a student must have to be successful. The School of Engineering and Technology employs two methods to guarantee that student meet the prerequisites. The first method results from working diligently with the Registrar's office so that a student will not be able to register for a class in the on-line process without having satisfied the prerequisites. Additionally, after grades for the current semester are verified, if a student failed to satisfy any of the prerequisites for an enrolled course, the student is automatically notified and deregistered from the course for the upcoming semester. The second method is the prerequisite compliance form. At the start of the semester each student completes a prerequisite compliance form for each SET course. Samples of these forms are located in Appendix K. The instructor for the course then reviews these submissions. Starting in Fall 2017, some engineering classes (not in Mechanical Engineering yet, however) piloted a new prerequisite compliance form that not only identifies the prerequisite courses but also the specific topics that are needed. Two of these new forms are also found in Appendix K. Mechanical Engineering courses may eventually adopt this practice as well, after proven out in EE.

A student may communicate to the instructor of a course and request an override of a course's prerequisite(s). This occurs frequently when transfer students, or students that have taken Summer classes at other institutions, are still awaiting that the credits be formally transferred. In any case, it is up to the instructor's discretion to either allow the student to register by providing an override in the on-line registration process, or to deny the override. If an override is granted, it is up to the student to register for the course. Additionally, at the start of the semester, the student must complete the prerequisite compliance form. If the reason for the override has not yet been resolved, the reason will be recorded on the form. Based on a student not satisfying the prerequisite, the instructor may further discuss the issue with the student and arrive at a solution where either the student would prove their understanding of previous topics or the student would be dis-enrolled from the course. The new, piloted prerequisite compliance forms (possibly to be adopted in ME in the future) will provide a means and space to record that solution.

C. Transfer Students and Transfer Courses

Ideally, a student who plans to transfer into the Mechanical Engineering program at LSSU would contact the Coordinator of the program. The Coordinator assists the student in selecting courses that transfer directly into the program (specific courses from specific institutions with a previous evaluation history), evaluates other courses that potentially could transfer, and processes the paperwork necessary to admit the student into the degree program.

C.1 Admission of Transfer Students

LSSU classifies any applicant as a transfer student, if that student has enrolled in a postsecondary institution any time after the Summer following his/her high school graduation. The following policy applies to such.

Official university or college transcript(s) should be sent to the Registrar's Office. The results of any advanced placement or aptitude tests taken in high school or college should also be sent to the Admissions office.

The academic background of the applicant must demonstrate an ability to meet the requirements of an Engineering program at LSSU. A minimum GPA of 2.0 on all college level coursework and eligibility to return to the former college are required for admittance into the Mechanical Engineering program. Students with grade point averages of less than 2.0 will be admitted into the General Engineering program.

C.2 Transfer from General Engineering to Mechanical Engineering (If Necessary)

Students transferring into Mechanical Engineering follow the same process described previously in section A-2.

C.3 Transfer of Courses

For repeated courses, the grade for the most recent course will be used. Generally, a Chemistry course, English composition courses, a computer course with "C" as the preferred language, and some elective courses in social sciences and humanities transfer into the Engineering programs. Mathematics courses in differential and integral calculus, differential equations, probability and statistics, along with calculus-based general physics also transfer into the Engineering programs. Sophomore Engineering courses may transfer directly into Engineering programs if they have similar content and prerequisites as LSSU Engineering courses. The appropriate Coordinator, Chair, or Dean, determines if a course is transferable into an Engineering program. Engineering program Coordinators will be furnished a copy of the student's transcripts. The Chair or Academic Advisor may elect to waive the need for a student to take EGNR101, "Introduction to

Engineering", if he/she has transferred in any 200-level or higher engineering listed coursework, and who are at the sophomore-level or higher, by credits. This guidance is to be found in the ME Substitution & Waiver policy (attached as appendix F).

C.4 MACRAO/MTA Agreement between Michigan Colleges and Universities

An agreement regarding the transfer of General Education credit exists between participating Michigan colleges and universities; this is called the Michigan Transfer Agreement (MTA). Prior to the MTA's implementation in Summer 2015, there was a similar mechanism called the MACRAO transfer agreement. Since LSSU participated fully and without provision in the MACRAO transfer agreement, any transfer student who had completed the General Education requirements, at any participating institution, automatically met all General Education requirements at LSSU. This remains the case for the MTA. The details of this agreement are given below.

A minimum of 30 credits of coursework must be taken at one of Michigan's participating institutions. The courses needed to satisfy the MTA requirements are as follows:

- One course in English composition
- A second course in English composition or one course in communication
- One course in mathematics
- Two courses in social sciences (from two disciplines)
- Two courses in humanities and fine arts (from two disciplines excluding studio and performance classes)
- Two courses in natural sciences including at least one with laboratory experience (from two disciplines)

Additionally, the student must earn a minimum grade point of 2.0 in each of these courses for the MTA to be approved.

D. Advising and Career Guidance

The purpose of academic advising is to provide guidance for students to succeed in their academic pursuits. This includes:

a. Advising students on the sequence of courses that should be completed to finish their degree in a timely manner.

b. Providing information on academic support services available on campus such as counseling, preparing résumés and seeking job opportunities.

c. Interpreting LSSU's policies on issues such as dropping courses, taking an "I" grade, transferring courses from other institutions, waiving courses, and substituting courses.

d. Fostering a sense of joint responsibility towards lifelong learning.

e. Providing resources for students in various appeal processes such as an extension of probation or financial-aid programs.

f. Supplying recommendation letters for future student employment, scholarships, graduate school, etc.

The following sections describe the role of engineering faculty in advising and ensuring that students remain in good academic standing as they pursue their degree.

D.1 Assignment of Students to Faculty Advisors

All students admitted into the Mechanical Engineering program are assigned a faculty advisor who teaches courses in their major. The program Coordinator or the school Chair advises all incoming freshmen and all transfer students upon arrival (usu. at the Orientation). The students are then re-assigned to a new faculty advisor for the remainder of their time at LSSU. The Dean's office maintains updated advisee lists and posts them outside the School of Engineering and Technology office. Students may request a change of Academic Advisor, but the Coordinator of the program is responsible for the approval of all advisor changes.

New faculty members receive training as part of their orientation allowing them to effectively advise their assigned students. Within the School of Engineering and Technology (SET), new faculty members are mentored by other experienced SET faculty members in the areas of degree audits, substitution waiver form, and advising methodologies. Additionally, staff at LSSU provides occasional training of the University's web based Banner system, transfer evaluations, placement tests, financial-aid appeals, and other policies and procedures relevant to student advising. In ME, specifically, it has been the practice that a new faculty member joins the Coordinator for dual advising of freshmen EGNR101 students on the occasion of their annual Fall freshmen advising evening (a lab session in the EGNR101 course); additional discussion of the advising documents takes place in the bi-weekly ME meetings, to further familiarize new faculty with these.

The faculty receives a list of their advisees and written documents related to the students' academic backgrounds. Faculty members also have access to the University's web based Banner system (Anchor Access) to review the academic records of their advisees.

D.2 Faculty Advising

A student and his/her faculty advisor meet a minimum of once per semester. Furthermore:

a. The faculty advisor and student review the student's success toward meeting program requirements and review student progress toward the degree. A degree audit sheet is updated every semester. Midterm grades of courses in progress can also be reviewed.

b. The faculty advisor and student plan the student's courses for the next semester. The faculty advisor ascertains that the student has completed prerequisites and is in good scholastic standing before allowing the student to schedule any new courses for the next semester. Electronic removal of an advising hold, preventing registration prior to advising, serves as the formal mechanism to ensure that.

c. Both the faculty advisor and the SET Chair must approve any course waivers or substitutions.

E. Work in Lieu of Courses

Besides regular course work, four types of experiences, Dual Enrollment, Departmental Examination, Advanced Placement, and College Level Examination Program, may count toward a degree in any LSSU program, including the Mechanical Engineering program.

E.1 Dual Enrollment

High school juniors and seniors may take classes at Lake Superior State University through the High School Dual Enrollment Program. These courses may count toward the Mechanical Engineering program either as core classes (typically MATH151 Calculus I, MATH152 Calculus II, ENGR101 Introduction to Engineering, or CHEM115 General Chemistry I) or as General Education courses. Attendance as a High School Dual Enrollee does not constitute admission into any four-year degree program at the University.

Only students who have received endorsements in Mathematics, Science, Reading, and Writing are eligible to take courses in those areas. All students are eligible to take courses in other areas. Grade point average is not a determining factor in eligibility to enroll.

E.2 Departmental Examination

A policy exists for students to "test out" of a course by taking a Departmental Examination. The department is free to administer its own examination for any course that it offers. The student must have the written approval of the School of Engineering and Technology Chair to take the examination. The student must receive a grade of C or better on the examination in order to receive credit for the course, in which case the credit earned by exam is recorded as transfer credit on the student's transcript.
Although the policy for Departmental Exams exists, in the past six years, there is only one instance of a student taking such an exam in Mechanical Engineering (and this was unsuccessful; the exam was for EGEM320 Dynamics, specifically).

E.3 Advanced Placement (AP)

Course credit is awarded to students who receive a score of 3, 4, or 5 on any Advanced Placement exam listed in Table 1-2 below. The student will receive credit for the specified courses on the chart after being granted unconditional admission to Lake Superior State University. Note that Table 1-2 is not a complete list and only includes those courses which may count toward credit in the Mechanical Engineering program.

Table 1-2: AP Courses for Mechanical Engineering Program

Advanced Placement Exam	*LSSU Course Equivalent*	*Type of Course in ME Curriculum*
Art – History of Art	ARTS -250, ARTS-251	General Education – Humanities
Biology	BIOL131, BIOL132	General Education – Natural Sciences
Calculus AB	MATH-151	Mechanical Engineering Core
Calculus BC	MATH-151, MATH-152	Mechanical Engineering Core
Chemistry	CHEM-115	Mechanical Engineering Core
English – Language & Composition	ENGL-110, ENGL-111	General Education – Communications
English – Literature & Composition	ENGL-110, ENGL-111	General Education – Communications
European History	HIST-102	General Education – Social Science
French Literature	FREN-355, FREN-356	General Education – Humanities
French Language	FREN-351, FREN-352	General Education – Humanities
German Language	GRMN-241, GERM-242	General Education – Humanities
Human Geography	GEOG-201	General Education – Social Science
Macroeconomics	ECON-201	General Education – Social Science
Microeconomics	ECON-202	General Education – Social Science
Music – Listening & Literature	MUSC-220	General Education – Humanities
Physics C: Mechanics	PHYS-231	Mechanical Engineering Core
Physics C: Electricity and Magnetism	PHYS-232	Mechanical Engineering Core
Physics C	PHYS-231, PHYS-232	Mechanical Engineering Core
Psychology	PSYC-101	General Education – Social Science
Spanish Language	SPAN-261, SPAN-262	General Education – Humanities
Spanish Literature	SPAN-380, SPAN-381	General Education – Humanities
United States Government & Politics	POLI-110	General Education – Social Science

United States History	HIST-131, HIST-132	General Education – Social Science
World History	HIST-101, HIST-102	General Education – Social Science

E.4 College Level Examination Program (CLEP)

Course credit is also awarded to students who receive a passing score on any College Level Examination Program (CLEP) subject exam listed in Table 1-3 below. The student will receive credit for the specified courses on the chart after being granted unconditional admission to Lake Superior State University. These credits are not awarded grades, and do not apply towards the student's calculated GPA. Note that Table 1-3 is not a complete list and only includes those courses which may count toward credit in the Mechanical Engineering program.

Table 1-3: CLEP Courses for Mechanical Engineering Program

CLEP Exam – Passing Score	*LSSU Course Equivalent*	*Type of Course in ME Curriculum*
American Government – 50	POLI-110	General Education – Social Science
Biology – 50	BIOL131, BIOL132	General Education – Natural Sciences
Calculus – 50	MATH-151	Mechanical Engineering Core
Chemistry – 50	CHEM115	Mechanical Engineering Core
College Composition – 50	ENGL-110	General Education – Communications
French Language – 58	FREN-251	General Education – Humanities
French Language – 66	FREN-251, FREN-252	General Education – Humanities
History of the US I – 50	HIST-131	General Education – Social Science
History of the US II – 50	HIST-132	General Education – Social Science
Introductory Psychology – 50	PSYC-101	General Education – Social Science
Introductory Sociology – 50	SOCY-101	General Education – Social Science
Principals of Macroeconomics	ECON-201	General Education – Social Science
Principals of Microeconomics	ECON-202	General Education – Social Science
Spanish Language – 58	SPAN-261	General Education – Humanities

Spanish Language – 66	SPAN-261, SPAN-262	General Education – Humanities
Western Civilization I – 50	HIST-101	General Education – Social Science
Western Civilization II – 50	HIST-102	General Education – Social Science

F. Graduation Requirements

The name of the degree awarded through successful completion of the Mechanical Engineering program is Bachelor of Science in Mechanical Engineering.

Two semesters before the student plans to complete degree requirements and graduate, he/she submits a *Degree Audit* form and a *Declaration of Candidacy for Degree* form to the Registrar's office. The *Degree Audit* denotes all previous coursework and lists the courses to be taken during the final two semesters. The faculty advisor, program Coordinator, and school Chair must approve the *Degree Audit*. The Registrar determines the University requirements remaining for graduation, and the student is informed in writing of the remaining requirements. Any degree requirements not denoted on the *Degree Audit* are immediately brought to the attention of the school Chair, program Coordinator, and faculty advisor.

The *Degree Audit*, which is shown in the Curriculum section (Criterion 5), contains all the requirements for the B.S. Mechanical Engineering degree. However, those requirements are briefly summarized in Table 1-4 below.

Table 1-4: Summary of Requirements for the B.S. Mechanical Engineering Degree

Course Requirements	
General Education	24 credits
Mechanical Engineering Core (of which capstone is 6 cr.)	88 credits
Technical Electives	17 - 19 credits
	129 - 131 credits
Other Requirements	
General Education GPA	2.0
Mechanical Engineering GPA	2.0
Overall GPA	2.0
Minimum Credits at LSSU	30 credits
Minimum 300/400 Credits at LSSU	24 credits

Recently, an automated process using the web based Banner system has been upgraded to view the *Degree Audits*. This process began in 2013 with an overly cluttered form called the "Online Degree Audit". Beginning Fall 2017, an improved version (more condensed) titled "My Degree Plan" became available; both resources remain available to students and faculty, for the moment.

G. Transcripts of Recent Graduates

There have been 66 graduates of the Mechanical Engineering program over the past six years. A list of these students is shown in Table 1-5 below. At LSSU, "program options" are called "concentrations". Each student's "concentration" is listed on his/her transcript. The three possible concentrations available for a student in Mechanical Engineering are "Robotics and Automation", "Vehicle Systems", and "General". We are prepared to provide transcripts for any of these students.

Table 1-5: Recent Graduates from the Mechanical Engineering Program

Last Name	First Name	ID Number	Graduation Date
[redacted]	[redacted]	[redacted]	Fall 2012
[redacted]	[redacted]	[redacted]	Fall 2012
[redacted]	[redacted]	[redacted]	Fall 2012
[redacted]	[redacted]	[redacted]	Fall 2012
[redacted]	[redacted]	[redacted]	Fall 2012
[redacted]	[redacted]	[redacted]	Spring 2013
[redacted]	[redacted]	[redacted]	Spring 2013
[redacted]	[redacted]	[redacted]	Spring 2013
[redacted]	[redacted]	[redacted]	Spring 2013
[redacted]	[redacted]	[redacted]	Spring 2013
[redacted]	[redacted]	[redacted]	Summer 2013
[redacted]	[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	[redacted]	Spring 2014
[redacted]	[redacted]	[redacted]	Summer 2014
[redacted]	[redacted]	[redacted]	Fall 2014
[redacted]	[redacted]	[redacted]	Fall 2014
[redacted]	[redacted]	[redacted]	Spring 2015
[redacted]	[redacted]	[redacted]	Spring 2015
[redacted]	[redacted]	[redacted]	Spring 2015
[redacted]	[redacted]	[redacted]	Spring 2015
[redacted]	[redacted]	[redacted]	Fall 2015
[redacted]	[redacted]	[redacted]	Fall 2015
[redacted]	[redacted]	[redacted]	Spring 2016
[redacted]	[redacted]	[redacted]	Spring 2016
[redacted]	[redacted]	[redacted]	Spring 2016
[redacted]	[redacted]	[redacted]	Fall 2016
[redacted]	[redacted]	[redacted]	Fall 2016
[redacted]	[redacted]	[redacted]	Spring 2017
[redacted]	[redacted]	[redacted]	Spring 2017
[redacted]	[redacted]	[redacted]	Spring 2017

[redacted]		Spring 2017
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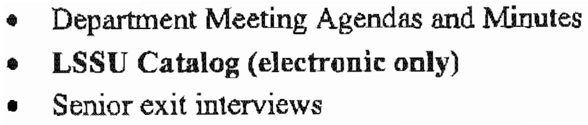
[redacted]		Spring 2018
[redacted]		Spring 2018
[redacted]		Spring 2018
[redacted]		Spring 2018
[redacted]		Spring 2018
[redacted]		Spring 2018
[redacted]		Spring 2018

A general list of material to be available for review by the EAC of ABET team is shown below, with **bold text** indicating items of particular relevance to policies regarding students:

- Course Binders Containing all Course Information
    - Detailed Course Syllabus
    - Course Assessment Summary
    - **Course Prerequisite Form (affidavit students sign testifying to satisfactory fulfillment of pre- and corequisite courses)**
    - Course Handouts (possibly lecture notes, supplemental handouts, etc.)
    - Examples of Student Work (homework, exams, quizzes, lab reports and/or worksheets, drawings, programs, etc.)
- Senior Projects Portfolios
- Student Outcome Reports (most recent)
- Industrial Advisory Board Information
- School Meeting Agendas and Minutes



- Department Meeting Agendas and Minutes
- **LSSU Catalog (electronic only)**
- Senior exit interviews

CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

A. Mission Statement

The University-level mission statement reads:

> "We equip our graduates with the knowledge, practical skills and inner strength to craft a life of meaningful employment, personal fulfillment, and generosity of self, all while enhancing the quality of life of the Upper Great Lakes region."

This mission statement is published in the LSSU Catalog and on the University's web-site at the URL https://www.lssu.edu/president/mission-vision/ , to which a link is also made via the LSSU catalog (www.lssu.edu/catalog , following the link A Look at LSSU).

The School of Engineering and Technology, as well, has maintained a Mission Statement since 1996 when the School was formed. The School has reviewed and modified the Mission Statement periodically, most recently in Spring 2014, so that it now reads:

> "To produce sought-after engineers and technologists by providing a rigorous undergraduate learning experience characterized by close student-faculty interaction."

This mission statement is published at the School's web page https://www.lssu.edu/school-of-engineering-and-technology/accreditation-outcome-reporting/.

It is apparent by comparing the two mission statements that the mission of the School is supportive of that of the University as a whole, and not conflicting in any fashion.

LSSU's statement dictates that we "equip our graduates… to craft a life of meaningful employment, personal fulfillment, …", and the School of Engineering & Technology responds by committing itself to a "produces sought after engineers"; evidently, the "meaningful employment" is attainable by those who are (by employers) "sought after", after which "personal fulfillment" is within reach of those well-enough prepared, by virtue of "a rigorous undergraduate learning experience".

The School's mission is, moreover, further clarified by a set of appended School goals (also periodically revised, most recently in Spring 2014 as well) as follows:

A. Deliver an undergraduate education that is current and provides knowledge and skills to be successful in professional careers or graduate school.
B. Provide programs that focus on the applications of fundamental principles of engineering, technology, mathematics, science, and computing to benefit society
C. Provide courses which incorporate and develop skills in communication, design, ethics, teamwork, technology, and capstone experiences relevant to the students' degrees.
D. Provide an education and opportunities for students with diverse abilities to enhance their professional growth and capacity for life-long learning.
E. Engage in continuous improvement activities through ongoing external and internal reviews
F. Enable faculty, staff, and students to apply engineering solutions that support regional economic growth and develop intellectual property
G. Maintain the School's viability, productivity, and effectiveness by supporting enrollment, retention, and placement initiatives.
H. Provide a supportive environment in which faculty, staff, and students are recognized as essential in the realization of the mission

Again, these clarifications to the School mission are aligned with the LSSU mission. Certainly, A through D can be seen as building the students future prospects for "meaningful employment, personal fulfillment, and generosity of self". Moreover, where LSSU endeavors to be "enhancing the quality of life of the Upper Great Lakes region", the School, correspondingly, through goal F, tries to "apply engineering solutions that support regional economic growth". Thus, the School's mission, and its goals, are highly complementary to that of LSSU as a whole.

These goals also serve as a link between the School's Mission Statement and the Program Educational Objectives (PEOs) to be discussed in the following.

B. Program Educational Objectives

The Department of Mechanical Engineering has the responsibility, in accordance with the School's mission and goals, to educate and prepare its students for meaningful and productive careers in engineering. To provide measures of how well this responsibility is met, the faculty have developed four Program Educational Objectives (PEOs).

Program Educational Objectives define the skills and qualities that practicing engineers should have after some period of employment. These are based on the needs of our graduates, and of employers of our graduates; input from our Industrial Advisory Board (IAB), graduates, and employers, as well as the judgment of the faculty applied to the review of such input, guide the gradual evolution of these objectives. They specify the expected knowledge, abilities, skills, and qualifications of experienced Mechanical Engineering graduates, i.e., graduates with approximately three years of professional experience. The Program Educational Objectives are applicable either to working graduates or to graduates pursuing advanced degrees.

The PEO:s for the Mechanical Engineering program are, moreover, common to the Electrical and Computer Engineering programs as well. They are published in at the URL https://www.lssu.edu/school-of-engineering-and-technology/accreditation-outcome-reporting/, and read as follows:

Computer Engineering, Electrical Engineering, and Mechanical Engineering Program Educational Objectives

Graduates of the Computer Engineering, Electrical Engineering, and Mechanical Engineering programs having three or more years of experience:

I. will have applied engineering knowledge and skills to solve problems in their professions.
II. will have demonstrated application of design and/or research principles subject to technical, practical, ethical, and other societal constraints.
III. will have set professional goals, experienced professional growth, engaged in ongoing professional development and learning activities.
IV. will be capable self-learners and make meaningful contributions to society.

C. Consistency of the Program Educational Objectives with the Mission of the Institution

The critical focus of the Mechanical Engineering program is to afford undergraduates of varying backgrounds and abilities every opportunity for achieving success as practicing Mechanical Engineers or in their graduate programs. Specific emphasis in the Mechanical Engineering program is given to professional and industrial related engineering practice. The relation between the Program Educational Objectives and the School Goals is shown in Figure 2-1 below.

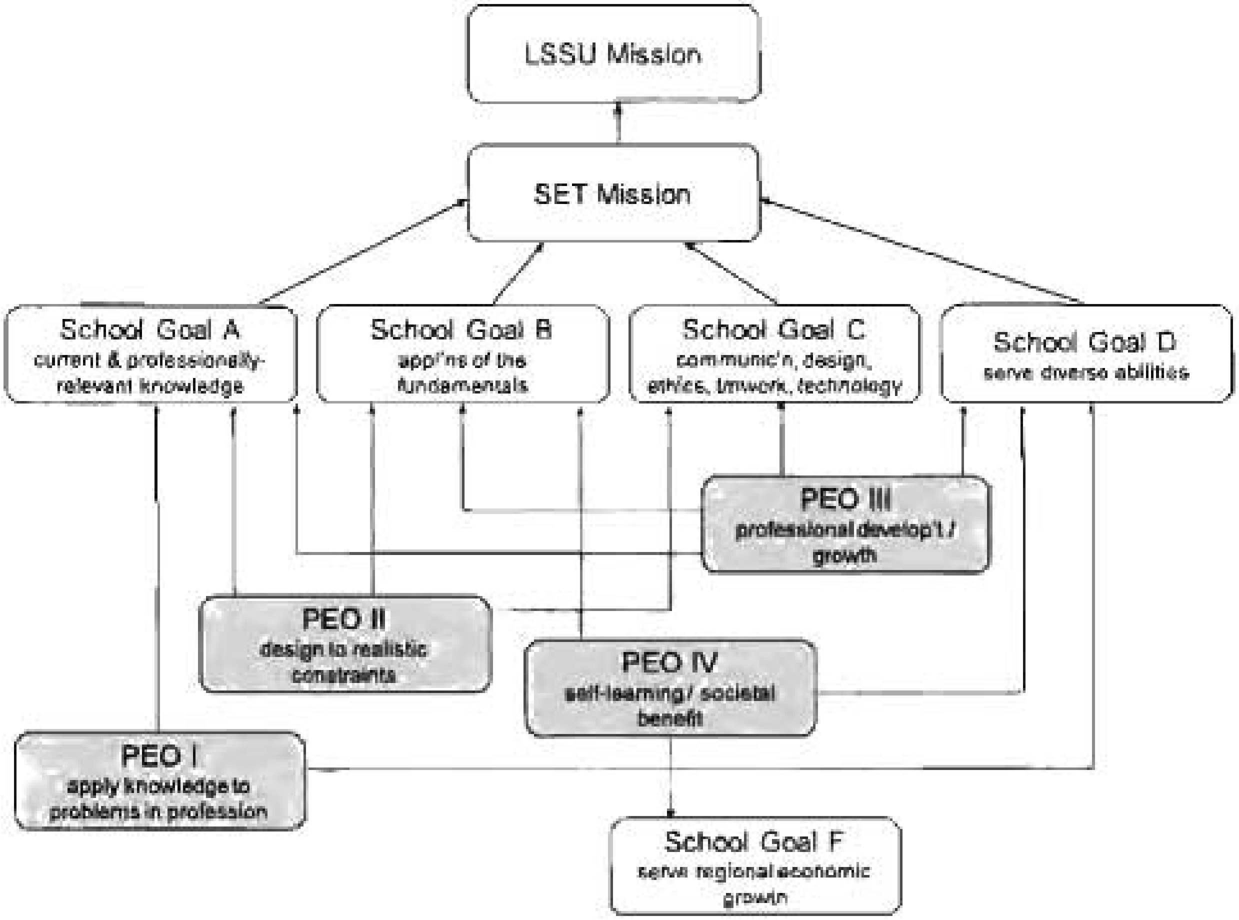


Figure 2-1. Relationship of Program Educational Objectives (in brief paraphrase) to the Mission, through the School Goals (paraphrased)

The Program Educational Objectives directly support the first four School Goals (A through D) which are focused upon student skills and abilities. The goals are the link to the mission statement for the School (and thence to that of LSSU). The last three School Goals (E through G) are only more indirectly relevant to the Program Educational Objectives, since they focus on faculty and institutional activities rather than the delivery of the ME or other programs. Indeed, Goal E relates to the assessment process whereby feedback is obtained that redirects some of the ways the program is delivered. Goals F and G relate to the School's economic development and other activities that make for a healthy environment in which the program is delivered. However, the mapping acknowledges that societal benefit could be towards the regional economy in the case of some alumni.

D. Program Constituencies

The School of Engineering & Technology recognizes as its principal constituents, all of the following:

- Current Students
- Alumni

- Faculty
- Employers of graduates
- Industrial Advisory Board (IAB)

This is not an exhaustive list that precludes other, perhaps more situational, interest groups; for instance, the economic development roles of the College, which the School supports, would suggest including entrepreneurial and industrial customers of the Product Development Center, and even the wider population of the Eastern Upper Peninsula – Northern Lower Peninsula region, which can be regarded as a beneficiary of the economic growth objectives of the School. Nevertheless, given the *primary* mission of the School to focus on offering quality academic programs, the list does identify the primary constituents.

The Industrial Advisory Board (IAB), in particular, was formed in 1985 and currently consists of approximately 30 members. IAB members possess a variety of professional experiences in the engineering and technology fields. The Board meets twice per year, once at a central Michigan location, and once on campus for program review and critique.

Notice that the PEO:s define the attributes expected of **alumni**, a few years into their careers. Accordingly, the *alumni*'s needs are met, and *students*' needs on track to be met, by the PEO:s by virtue of their being the recipients of the positive, self-beneficial attributes defined. It is evident, after all, that these are traits one widely considers desirable to attain; these stakeholders benefit by attaining them (in the present for alumni, and in the future for students).

The *employers*, as a stakeholder, have the need for engineers with adequate capabilities; the PEO:s defined here imply those kinds of capabilities. The *IAB* stakeholder group is largely a subset of the employers, so that its needs are met by the PEO:s in the same fashion.

E. Process for Review of the Program Educational Objectives

It is evident that PEOs represent a goal for the product of a slow process, i.e., an engineering professional developed first by a 4-year curriculum and then further by the first few years of a professional career. Hence, it is not desirable to make rapid or frequent changes to how the PEOs are defined. The PEOs are best seen as the foundation of a long-term plan for which stability is desirable, and are therefore reviewed for currency on a several-year cycle.

The constituents listed in section D, above, all have, by various mechanisms, a voice in the process of establishing and evaluating the continued relevance and attainment of Program Educational Objectives. Alumni and their employers have a voice through surveys collected from them, or by unsolicited feedback they may provide on other occasions. Students have a voice through individual course feedback questionnaires and, finally, through graduate exit interviews. The IAB is periodically solicited for feedback on the occasion of its biannual meetings; its feedback may either focus upon the relevance of the objectives themselves, or upon their degree of accomplishment.

Upon review by the faculty every several years, occasion is also provided to redefine the PEOs themselves, if necessary. Such redefinition could be motivated by comments obtained from any of the constituents mentioned above. It could also be motivated by trends the faculty observe in the needs of industry, to which the School is well-attuned thanks to its economic development activities, as well as its regular meetings with its Industrial Advisory Board and its involvement with senior project sponsoring industries. The faculty of the School, by majority vote, have complete discretion over the PEOs.

A general list of material to be available for review by the EAC of ABET team is shown below, with **bold text** indicating items of particular relevance to policies regarding PEOs:

- Course Binders Containing all Course Information
    - Detailed Course Syllabus
    - Course Assessment Summary
    - Course Prerequisite Form (affidavit students sign testifying to satisfactory fulfillment of pre- and corequisite courses)
    - Course Handouts (possibly lecture notes, supplemental handouts, etc.)
    - Examples of Student Work (homework, exams, quizzes, lab reports and/or worksheets, drawings, programs, etc.)
- Senior Projects Portfolios
- Student Outcome Reports (most recent)
- **Industrial Advisory Board Information**
- School Meeting Agendas and Minutes
- Department Meeting Agendas and Minutes
- LSSU Catalog (electronic only)
- Senior exit interviews

CRITERION 3. STUDENT OUTCOMES

A. Student Outcomes

The student outcomes for the LSSU Mechanical Engineering program are the same as those in ABET Criterion 3 (a) through (k); these are as listed below:

a. an ability to apply knowledge of mathematics, science, and engineering.
b. an ability to design and conduct experiments, as well as to analyze and interpret data.
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
d. an ability to function on multidisciplinary teams.
e. an ability to identify, formulate, and solve engineering problems.
f. an understanding of professional and ethical responsibility.
g. an ability to communicate effectively.
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
i. a recognition of the need for, and an ability to engage in life-long learning.
j. a knowledge of contemporary issues.
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The student outcomes are documented, along with School mission statement, School goals, and program educational objectives, on the LSSU web site at the following URL:

<https://www.lssu.edu/school-of-engineering-and-technology/accreditation-outcome-reporting/>

B. Relationship of Student Outcomes to Program Educational Objectives

The program education objectives for the program are listed below.

Graduates of the Computer Engineering, Electrical Engineering, and Mechanical Engineering programs having three or more years of experience:

I. will have applied engineering knowledge and skills to solve problems in their professions.
II. will have demonstrated application of design and/or research principles subject to technical, practical, ethical, and other societal constraints.
III. will have set professional goals, experienced professional growth, engaged in ongoing professional development and learning activities.
IV. will be capable self-learners and make meaningful contributions to society.

The eleven student outcomes (a-k) prepare students to attain, later as alumni, the four program educational objectives (I, II, III, and IV) through the course work as outlined in Criterion 5

Section A. A mapping of the student outcomes to each program educational objective is found in Table 3-1, below. The table lists each of the student outcomes and to what degree it supports each of the program educational objectives.

Table 3-1: Mapping of Student Outcomes to Program Educational Objectives

	PEO I	**PEO II**	**PEO III**	**PEO IV**
Student Outcome	**Apply Knowledge to Problems in Profession**	**Design to Realistic Constraints**	**Professional Development / Growth**	**Self Learning / Societal Benefit**
A. Appln of Math, Sci, Engrg	High	Moderate	N/A	Moderate
B. Experiment	Moderate	High	N/A	Moderate
C. Design	High	High	N/A	High
D. Teams	Low	Low	High	Moderate
E. Formulation	High	High	N/A	Moderate
F. Ethics	Low	High	High	High
G. Communications	Moderate	Low	Moderate	High
H. Broader Impacts	Low	High	Moderate	High
I. Life-Long Learning	N/A	N/A	High	High
J. Contemporary Issues	Moderate	Moderate	High	Moderate
K. Modern Tools	High	Moderate	Moderate	Moderate

B.1 Program Educational Objective I

Graduates of the Mechanical Engineering program having three or more years of experience will have applied engineering knowledge and skills to solve problems in their professions.

This objective is supported primarily by student outcomes a, c, e, and k. These outcomes are about applying knowledge and skills, designing systems, and solve problems all of which are directly needed for graduates to fulfill this objective. There are other outcomes that are not directly required but can help students to solve problems in their profession.

B.2 Program Educational Objective II

Graduates of the Mechanical Engineering program having three or more years of experience will have demonstrated application of design and/or research principles subject to technical, practical, ethical, and other societal constraints.

This objective is supported primarily by student outcomes b, c, e, f, and h. These outcomes are about understanding impacts of engineering and ethical responsibilities, interpreting data, solving problems, and designing systems within constraints all of which are directly needed for graduates to meet this objective. There are other outcomes that are not directly required but can help students to design systems given various constraints.

B.3 Program Educational Objective III

Graduates of the Mechanical Engineering program having three or more years of experience will have set professional goals, experienced professional growth, engaged in ongoing professional development and learning activities.

This objective is supported primarily by student outcomes d, f, i, and j. These outcomes are about working on teams, understanding ethical responsibilities, knowledge of contemporary issues, and recognizing the need for life-long learning, all of which are directly needed for graduates to meet this objective. There are other outcomes that are not directly required but can help students to experience professional growth.

B.4 Program Educational Objective IV

Graduates of the Mechanical Engineering program having three or more years of experience will be capable self-learners and make meaningful contributions to society.

This objective is supported primarily by student outcomes c, f, g, h, and i. These outcomes are about understanding ethical responsibilities and the impact of engineering solutions, recognizing the need for life-long learning, as well as the ability to design a system and communicate effectively all of which are directly needed for graduates to meet this objective. There are other outcomes that are not directly required but can help students to make meaningful contributions to society.

A general list of material to be available for review by the EAC of ABET team is shown below, with **bold text** indicating items of particular relevance to policies regarding student outcomes:

- Course Binders Containing all Course Information
    - Detailed Course Syllabus
    - Course Assessment Summary
    - Course Prerequisite Form (affidavit students sign testifying to satisfactory fulfillment of pre- and corequisite courses)
    - Course Handouts (possibly lecture notes, supplemental handouts, etc.)
    - Examples of Student Work (homework, exams, quizzes, lab reports and/or worksheets, drawings, programs, etc.)
- Senior Projects Portfolios
- **Student Outcome Reports (most recent)**
- Industrial Advisory Board Information
- School Meeting Agendas and Minutes
- Department Meeting Agendas and Minutes
- LSSU Catalog (electronic only)
- **Senior exit interviews**

CRITERION 4. CONTINUOUS IMPROVEMENT

A. Student Outcomes

The process for continuous improvement of the program is primarily a combination of student outcome and course assessment/evaluation. Assessment and evaluation of the student outcomes provides a means of improving the program while course assessment improves each individual course.

A.1 Overview of the Continuous Improvement Process

The block diagram shown in Figure 4-1 provides an overview of the continuous improvement process. The process starts with the ABET-EAC criteria as well as the mission and goals of the University, College, and School. From the criteria and missions, the program educational objectives (PEO:s) and the student outcomes are developed. The program educational objectives, in addition to input from the industrial advisory board and employers of our graduates, are used to inform in determining the program curriculum. From the program curriculum, courses and individual course objectives are designed. An essential component in this process is regularly measuring student performance in both the student outcomes and course objectives.

In addition to measuring student performance, constituent feedback is a vital part of our assessment process. Given our small student population, the sample size for student work is rarely statistically significant. The small size can also cause student performance to fluctuate as the academic ability of a particularly class varies. This can make it challenging to make definitive conclusions about changes made to a course and/or the program. As a result, more qualitative mechanisms are used in conjunction with student performance.

Student feedback is an essential component in our assessment. The small student population allows the faculty to get to know the students which makes them more comfortable with providing meaningful feedback. This includes formal feedback in the form of written comments from course assessment questionnaires, as well as graduate exit surveys and interviews. In addition, informal feedback, such as conversations with students, also plays an important role but is difficult to document. Faculty are also in contact with alumni and employers who provide valuable feedback to improve courses and the program.

Faculty regularly evaluate the student performance and constituent feedback. After thorough deliberation, recommendations for changes to courses or programs are developed. For minor changes, these recommendations are then implemented by course instructors. Larger changes may require approval from the University-wide curriculum committee and the Provost. These changes are usually initiated by the school chair or program coordinator.

The continuous improvement process, so described, takes place at the School level (SET) in the case of courses common to the Engineering programs (EE, CE, and ME). If the course is specific to the ME program, or at most shared with MfgET, then the process described takes place at the ME Department level instead.

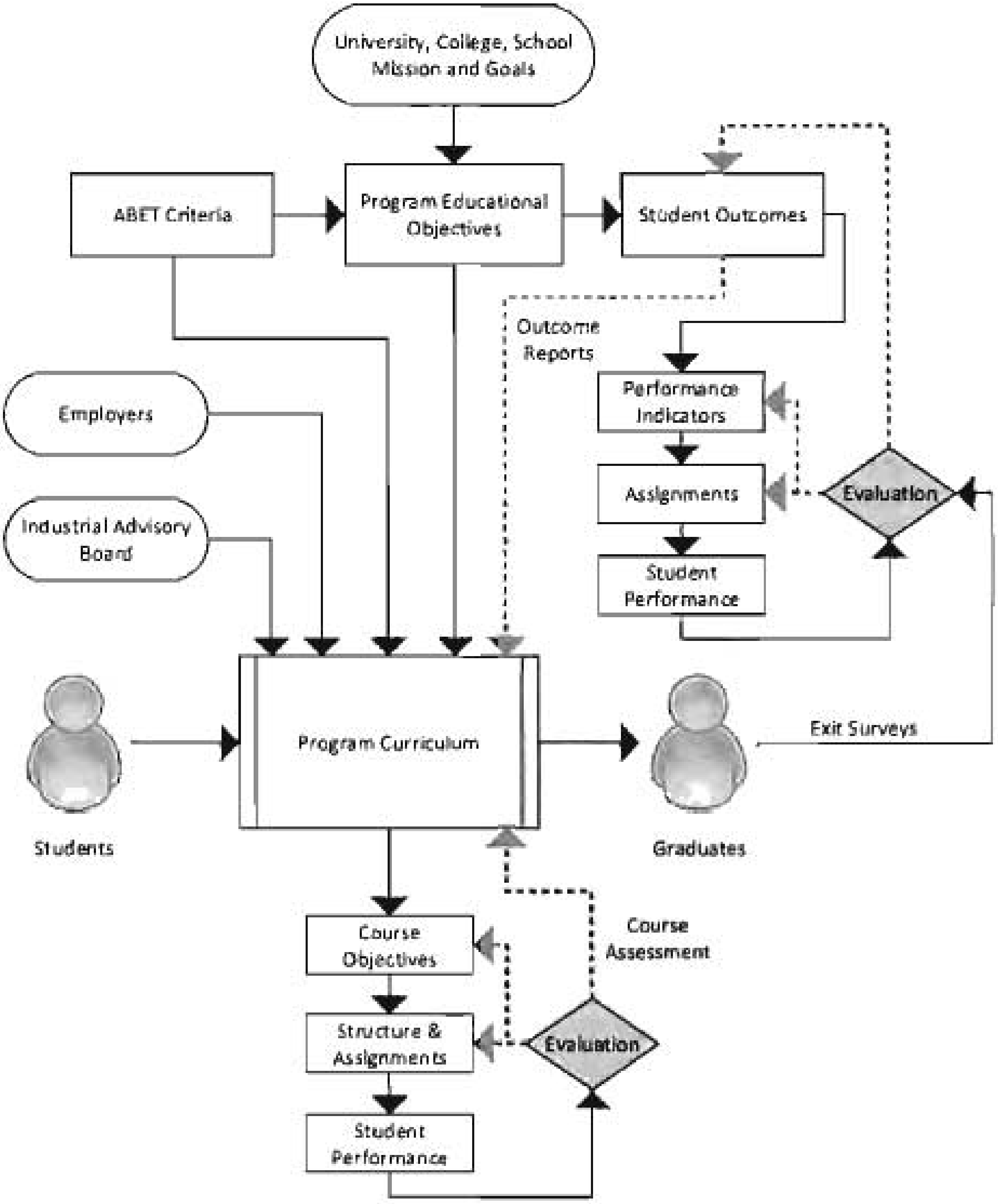


Figure 4-1: Overview of the Assessment Process

A.2 Student Outcome Evaluation

In order to evaluate student performance for each student outcome (A-K), one, two, or three performance indicators were established by the Department or School. Each performance

indicator is associated with a specific assignment/activity in one of the upper-level core courses in the curriculum. Student attainment of the performance indicator is evaluated by the instructor and, in some cases when practicable, another knowledgeable faculty member. Additionally, graduates are surveyed regarding their attainment of each student outcome at the end of their final semester. Upon completion of the survey, the program Coordinator conducts an interview with each graduate. To determine the attainment of the student outcomes, and hence the efficacy of the program in regard to accomplishing them, the performance indicators and the student survey results are evaluated on a three-year cycle.

To develop the performance indicators for each student outcome, an appropriate course from which to sample student work must be selected. Thus for each Engineering course in the curriculum, the faculty of the School of Engineering and Technology determined the extent of coverage and expected level of attainment for each student outcome to which it contributes. Then, upper-level courses with a relatively high-level of expected attainment were selected to ensure a summative assessment. Due to the relatively small number of students, some of the performance indicators include activities from courses that encompass students from the other Engineering programs. Next, for each of the selected courses, the performance indicators for the selected outcomes were developed. These performance indicators are designed to be a specific illustration of the outcome as it relates to the selected course. Finally, the specific assignment within the course is selected to assess student performance. These assignments are usually final exams or other summative items.

The performance indicators are evaluated every time a course containing the associated assignment is offered. Each student's (or for large classes a sample; for lab exercises and term projects, these may be from each group rather than each student) performance on the selected assignment is evaluated solely for the capability denoted by the performance indicator. Each sample of student work receives a score of 1, 2, 3, or 4, depending on how well the student meets the expected capability defined by the performance indicator. The meaning of the score is listed in Table 4-1, below, and ranges from unacceptable to exemplary. The evaluation is performed by the instructor(s) responsible for teaching the course and, when possible, an additional reviewer with expertise in the area. The results of the evaluation and any recommendations are reported in the *course assessment summary* report that is written at the conclusion of each course.

Table 4-1: Scoring of Student Work for Performance Indicators

Score	Meaning
1	Unacceptable
2	Below Standard
3	Meets Standard
4	Exemplary

Once every three years, the Department evaluates each student outcome by considering the results of each performance indicator and the results of the *senior exit surveys* over the previous years. Each objective is examined, and discussed in detail if there is cause for concern. The reviewers discuss their findings and recommendations. Faculty members share their experiences and brainstorm ideas to help improve the student performance. These results and any approved changes are then recorded in the *student outcome evaluation* report. Small changes are implemented by the instructor(s) of the appropriate course(s), while larger changes are implemented by the department or school (with input from the industrial advisory board and approval from the curriculum committee where appropriate). The efficacy of these changes is then discussed during the next evaluation of the outcome.

A.3 Summary Results of Student Outcome Evaluation

A summary of the student outcome evaluation results is provided below. The detailed results can be found in the *student outcome evaluation* report in Appendix G. For the sake of completeness and clarity, each student outcome is stated below followed by the associated performance indicators. Next, the selected course and assignment of student work to be evaluated is given. After that, the level of exposure and the expected level performance for the selected assignment are listed. Then, the average score of the student work for the most recent assignment is given. Finally, a brief summary of the analysis and recommendations (if any) of the outcome are included.

Student Outcome (A)

an ability to apply knowledge of mathematics, science, and engineering

Performance Indicator (A1)

the ability to solve a partial differential equation (PDE) numerically
EGNR-340 – final exam question on PDE's
(✓✓ = stress, Me = advanced-level math, basic-level engineering)
2.0 – 2.6 averages in last 3 semesters examined (F'16, S'17, F'17)

Performance Indicator (A2)

the ability to mathematically characterize a physical system's input-output relationship and use it to predict its response to an input
EGRS-460 – final exam question on step response of a physical system
(✓✓✓= focus, MsE = advanced-level math, basic-level science, advanced-level engineering)
2.4 and 3.8 averages, from student work the most recent two offerings (F'16, F'17)

Performance Indicator (A3)

the ability to use eigenvalue analysis to analyze critical values of physical systems to predict failure points (e.g. resonances, buckling loads, critical shaft speeds, critical vehicle speeds, etc.).
EGME-350 – buckling exam problem (typically exam 2)
(✓✓= stress, MSE = advanced-level math, advanced-level science, advanced-level engineering)
3.2 and 2.8 averages from student work the most recent two offerings (F'16, F'17)

Analysis and recommendations

There is a concern that student performance in this outcome is not at the expected level. Examples of issues students had meeting this outcome include:

- Many students have difficulties approaching a problem and only attempt to do so on a surface level.

- In particular, greater facility in working with differential equations would be desirable.

It was determined (ref. ME Assessment minutes, 4/20/2018) that the department should: 1) add a finite difference project for steady-state, 2D heat conduction, in EGME431 or 432; and, 2) implement a grade requirement of C or better for the following: MATH251 Calculus III, MATH310 Differential Equations, EGME225 Mechanics of Materials, and EGEM220 Statics *as a prerequisite to EGEM320 Dynamics* (note: EGEM220 *already* requires a C or better for graduation, and even as a prerequisite to enter EGME225, but presently, a student can enter EGEM320, even with a D- through C- grade in EGEM220).

Student Outcome (B)

an ability to design and conduct experiments, as well as to analyze and interpret data

Performance Indicator (B1)

the ability to develop a valid and reliable experimental procedure that will validate a product
EGNR-495 – design review on final product testing
(✓✓ = stress, ** = developed)
2.8 average of student work from Spring 2016

Performance Indicator (B2)

the ability to interpret experimental data with limitations associated with inherent and statistical uncertainties.
EGME-432 – experimental investigation of the drag coefficient of an aerodynamic object
(✓✓ = stress, ** = developed)
everages of 3, 2.63, and 2.15 for work from Fall 2014/2015, Fall 2016, and Fall 2017, respectively.

Analysis and recommendations

There is currently no concern regarding this outcome.

Student Outcome (C)

an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

Performance Indicator (C1)

the ability to reformulate implied customer needs as specifications and produce an acceptable design solution
EGNR-491 – product design review
(✓✓✓= focus, *** = high)
2.8 average of student work from Fall 2015

Performance Indicator (C2)

the ability to select values of design parameters to achieve the desired trade-off between competing priorities, such as between [strength and/or rigidity] and [product weight and/or bulk and/or cost]
EGME-350 – final design project report
(✓✓✓ = focus, *** = high)
3.0 average of student work from Fall 2016; 3.25 average from Fall 2017.

Analysis and recommendations

There is currently no concern regarding this outcome.

Student Outcome (D)

an ability to function on multidisciplinary teams

Performance Indicator (D1)

the ability to provide constructive criticism of team members
EGNR-495 – peer evaluations
(✓✓✓ = focus, *** = high)
3.1 average of student work from Spring 2016

Analysis and recommendations

There is currently no concern regarding this outcome.

Student Outcome (E)

an ability to identify, formulate, and solve engineering problems

Performance Indicator (E1)

the ability to restate verbal information in symbolic/quantitative form in the context of an engineering problem.
EGME-350 – performance analysis of machine elements in selected final exam problem(s)
(✓✓= stress, ** = developed)
3.54 average of student work from Fall 2016; 3.7 average from Fall 2017.

Analysis and recommendations

There is currently no concern regarding this outcome.

Student Outcome (F)

an understanding of professional and ethical responsibility

Performance Indicator (F1)

the ability to apply perspectives from established ethical philosophies in the analysis of a case study
EGNR-495 – ethics essay
(✓✓✓ = focus, ** = developed)
2.8 average of student work from Spring 2016

Analysis and recommendations

There is currently no concern regarding this outcome.

Student Outcome (G)

an ability to communicate effectively

Performance Indicator (G1)

the ability to make formal engineering presentations
EGNR-495 – final project presentations
(✓✓✓ = focus, *** = high)
3.0 average of student work from Spring 2016

Performance Indicator (G2)

the ability to write prose containing technical information
EGME-432 – one of the lab reports
(✓= exposure, ** = developed)
Averages of 2.5, 2.75, and 2.69 for Fall 2015, 2016, and 2017 respectively.

Analysis and recommendations

There is no great cause for concern, although the G2 results are marginal enough to warrant special attention going forward. It is however recommended that the grading form for G1 be modified to better separate the IAB's rating for the team's ability to communicate and that of the project outcome.

Student Outcome (H)

the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

Performance Indicator (H1)

the ability to reconcile environmental and cost priorities in design work
EGME-350 – design project: brief research essay on: 1) global viability (regulatory thresholds in world markets); 2) sustainability (recyclable materials, energy usage, etc.); and, 3) ethical sourcing.
(✓= exposure, ** = developed)
3.0 average of student work from Fall 2017 (this was a *new* indicator for that semester and onwards, so there is no comparable data from earlier semesters; the old indicator had been found unsuitable,)

Analysis and recommendations

There is currently no concern regarding *performance* in this outcome, but the amount of emphasis and exposure is very limited. The department will be exploring ways to augment.

Student Outcome (I)

a recognition of the need for, and an ability to engage in life-long learning

Performance Indicator (I1)

the ability to define and clarify customer needs through technical investigation
EGNR495 – faculty subjective evaluation for each individual on their respective team
(✓✓= stress, ** = developed)
2.7 average of student work from Spring 2016

Analysis and recommendations

There is a slight concern that student performance in this outcome is not at the expected level.

Student Outcome (J)

a knowledge of contemporary issues

Performance Indicator (J1)

the ability to use examples from a realistic case study in making arguments
EGNR-495 - ethics essay
(✓= exposure, * = foundational)
3.2 average of student work from Spring 2016

Analysis and recommendations

There is no concern for performance; however, the ME faculty called the relevance of the indicator into question. It will be referred to the full School (SET) faculty for discussion. The exit interviews suggest the students are unclear what "contemporary issues" might be trying to refer to.

Student Outcome (K)

an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Performance Indicator (K1)

the ability to solve a recursive problem by writing a program in a structured programming language, implementing the recursion in an iterative loop
EGNR-340 – exam question on Newton-Raphson root search or on Euler's method for solving an ordinary differential equation (ODE)
(✓✓✓= focus, ** = developed)
2.3, 3.0, and 3.1 averages of student work from last three examined offerings (F'16, S'17, F'17).

Performance Indicator (K2)

the ability to apply modern engineering software and techniques to produce and evaluate a solution
EGME-350 – FEA assignment on aircraft door latch mechanism
(✓✓= stress, ** = developed)
No recent evaluation. Unfortunately, Fall 2016 samples were discarded before evaluation, and Fall 2017 are awaiting review.

Analysis and recommendations

There is no concern.

A.4 Course Assessment

At the completion of every course offering, the instructor assesses the course objectives and produces a *course assessment summary* report (samples of which can be seen in Appendix J). The report includes an analysis of student attainment in the course objectives. For each course objective, the report includes the score from some graded activity (e.g., exam problem, report, etc.) specific to that objective, student's self-rated score, and in some cases the instructor's subjective score. The instructor may also provide a narrative commentary on the performance of students for each objective. Next, the report provides a brief analysis of the efficacy of the most recent course improvements. Finally, improvements planned for the next offering are discussed in an action plan.

Each Engineering course assessment is then reviewed at the Department or School at least once every two years. The Department evaluates the courses that appear solely in the ME program (or shared only with MfgET). All other "cross-disciplinary" courses (shared by ME with the other Engineering programs) are evaluated by the School (SET). The schedule for course evaluation is shown below in Table 4-2. This schedule includes all courses offered by the School of Engineering and Technology, and is intended to illustrate the pattern of course offerings and subsequent evaluation.

The review at the SET level (pertaining to those courses common to both ME and EE and/or CE) has exclusively been conducted in the SET meetings, in which the instructor leads a discussion about the student performance. Each objective is examined, and discussed in detail wherever there may be cause for concern. This provides an opportunity for faculty members to share their experiences and brainstorm ideas to help improve the student performance. If additional changes are recommended by the participating School faculty, these are recorded in the meeting minutes and the *course assessment summary* report. The instructor then implements the changes during the next offering of the course. The efficacy of these changes are then discussed during the next evaluation of the course.

For review at the ME department level (pertaining to those courses specific to the ME program, or at most shared with MfgET), the review may be conducted as described above, or has, some semesters, instead by conducted in writing, by circulating a packet containing the assessment reports. In the latter case, comments are written onto the reports, and a single meeting around the end of the semester discusses any comments which have been collected; this second approach intends to somewhat reduce the meeting time required for the process.

Table 4-2: Course Evaluation Schedule

Course Evaluation Schedule

Course	2013-2014			2014-2015			2015-2016			2016-2017			2017-2018			2018-2019			Group
	F13	S14	U14	F14	S15	U15	F15	S16	U16	F16	S17	U17	F17	S18	U18	F18	S19	U19	
[illegible]		X			X			X			X			X			X		ECE
[illegible]	X	X		X	X		X	X		X	X		X	X		X	X		ECE
EGEE-250	X			X			X			X			X			X			ECE
EGEE-280	X			X			X			X			X			X			ECE
[illegible]				X						X						X			ECE
[illegible]				X						X						X			ECE
EGEE-320	X						X						X						ECE
[illegible]					X						X						X		ECE
[illegible]		X						X						X					ECE
[illegible]	X			X			X			X			X			X			ECE
EGEE-431								X						X					ECE
[illegible]					X						X						X		ECE
[illegible]								X			X			X			X		ECE
[illegible]				X						X						X			ECE
[illegible]					X						X						X		ECE
[illegible]					X			X			X						X		ECE
EGEN-220	X	X		X	X		X	X		X	X		X	X		X	X		ME
EGEN-320	X			X			X			X			X			X			ME
[illegible]	X	X		X	X		X	X		X	X		X	X		X	X		ME
EGME-141	X	X		X	X		X	X		X	X		X	X		X	X		ME
[illegible]		X			X			X			X			X			X		ME
EGME-240		X			X			X			X			X			X		ME
EGME-275		X			X			X			X			X			X		ME
EGME-276		X			X			X			X			X			X		ME
EGME-310				X						X						X			ME
EGME-327		X			X			X			X			X			X		ME
EGME-331		X			X			X			X			X			X		ME
EGME-350	X			X			X			X			X			X			ME
EGME-411					X						X						X		ME
EGME-421		X						X						X					ME
EGME-431	X			X			X			X			X			X			ME
EGME-432	X			X			X			X			X			X			ME
EGMT-310		X			X			X			X			X			X		ME
EGMT-325		X		X			X			X			X			X			ME
[illegible]	X			X			X			X			X			X			School of E&T
[illegible]	X	X		X	X		X	X		X	X		X	X		X	X		School of E&T
[illegible]		X			X			X						X			X		School of E&T
[illegible]								X											SPFB
[illegible]				X			X						X			X			School of E&T
[illegible]	X	X		X	X		X	X		X	X		X	X		X	X		School of E&T
[illegible]	X						X						X			X			School of E&T
[illegible]	X	X			X		X	X		X	X		X	X		X	X		School of E&T
[illegible]				X			X			X			X			X			ECE
[illegible]							X						X			X			ECE
[illegible]					X						X						X		ECE
[illegible]																			SPFB
[illegible]																			SPFB
[illegible]	X			X			X			X			X			X			SPFB
[illegible]		X			X			X			X			X			X		SPFB
[illegible]					X			X			X			X			X		School of E&T
[illegible]	X				X			X		X	X		X	X		X	X		School of E&T
[illegible]	X			X			X			X			X			X			School of E&T
[illegible]	X			X			X			X			X			X			School of E&T
[illegible]																			School of E&T
[illegible]		X			X			X			X			X			X		School of E&T
[illegible]	X			X			X			X			X			X			School of E&T
[illegible]		X						X			X			X			X		School of E&T
[illegible]	X			X			X			X			X			X			School of E&T
[illegible]	X			X	X		X			X			X			X			School of E&T
[illegible]	X			X			X			X			X			X			School of E&T
[illegible]																			School of E&T

☐ Not Offered

☐ X Offered

☐ X Scheduled to be Evaluated

☐ X Evaluated by School of E&T

☐ X Evaluated by Department of ECE

▨ Evaluated by Department of ME

☐ X Evaluated by Senior Projects Faculty Board

A.5 Program and Course Improvements

In summary curricular improvements (at both the course and program level) are made by the School of Engineering and Technology faculty using a combination of student outcome and course evaluations. While student performance provides the most important indicator of achievement, given our small size, constituent (student, IAB, and employer) feedback is also a vital part of continuous improvement.

All curricular improvements are made by the School of Engineering and Technology faculty based on the results of the evaluations, and with advice from the Industrial Advisory Board (IAB) and the other stakeholders on larger issues. Ultimately, the program is improved by small changes to courses (course layout, syllabi, grading structure, extent of coverage, *etc.*), changes to content in courses (alteration of objectives, topical content, *etc.*), and large curricular changes (course deletion, course addition, shifting material from one course to another, adding new material to the curriculum, *etc.*). The smaller changes tend to be made at the time of course evaluation while the more significant changes tend to be made at the time of program evaluation.

B. Continuous Improvement

Continuous improvement is an important part of maintaining a quality program. As such assessment is an important part of the School of Engineering and Technology. Below are a few examples of changes made within the Electrical Engineering program.

B.1 Improvement Example for Student Outcome A

The most recent evaluation of student outcome A suggests some shortfalls in students' abilities to apply mathematics, science and engineering knowledge; most particularly, but not exclusively, this applies to mathematics, notably differential equations. This conclusion was taken based on examining several semesters of work, in three different courses.

One could describe the issue as, often but not always, a tendency to approach problem-solving very superficially, with a goal of trying to reduce almost all problems to the simplistic model of applying whichever equation happens to be readily available, with too little concern for its relevance or validity in the circumstances, and always expecting to apply it in the fashion of determining an output based on known inputs; understanding of the underlying principles, cognizance of approximating assumptions made, and actual meaning of the physical quantities involved, is given little value in this way of thinking.

It was determined that the situation could possibly be helped by the institution of several C or better requirements. These would be for MATH251 Calculus III, MATH310 Differential Equations, EGME225 Mechanics of Materials, and EGEM220 Statics as a prerequisite to EGEM320 Dynamics (note: EGEM220 already requires a C or better for graduation, and even as a prerequisite to enter EGME225, but presently, a student can enter EGEM320, even with a D- through C- grade in EGEM220).

These changes have not yet been enacted, having just been adopted in April 2018, and will have to be pursued through the formal University curriculum process, which we will undertake in the Fall 2018.

B.2 Improvement Example for Student Outcome F

In the last ABET report (2012) it was mentioned that students indicated that they thought ethics (student outcome F) should be removed from senior projects (EGNR-495). The recommended action was to create a new General Education course that would cover ethics, economics, and sustainability as it applies to the design and use of technology. This course would then allow for the removal of that material from senior projects giving student more time to focus on their project.

For a number of reasons, the creation of this class was not possible. However, based on faculty discussions and student feedback, it was instead decided to bring in an expert in ethics. Thus Dr. Jason Swedene, a Professor in Department of Humanities & Philosophy who specializes in ethics, began teaching the ethics portion of senior projects in the spring of 2017.

From the latest student outcome evaluation, there is no concern for outcome F. Student feedback regarding the ethics portion has overall very positive, with students enjoying Dr. Swedene's lectures. Some students indicated that they would prefer that ethics be moved to the Fall semester of senior projects (EGNR-491). The possibility of moving this topic is currently being explored and may occur in the future. Overall, it seems that bringing in Dr. Swedene was beneficial to the program.

B.3 Improvement Example using Course Assessment: EGME338 Fluid Mechanics

Many years of course assessment review showed that our old format for offering Fluid Mechanics was flawed, and harmful to student performance and achievement of the course objectives. Course and program assessment, in combination, addressed this problem beginning the 2014 – 2015 academic year, leading to far more satisfactory results.

The old model divided the semester-long subject of Fluid Mechanics into two courses, formally: 9 weeks of EGME338 (2 cr), followed by 5 weeks of EGME339 (1 cr). The EGME338 course had very low-level Mathematics prerequisites (Calculus I, allowing even the Business & Life Sciences Calculus not based on trigonometry), whereas the last-five-week course EGME339 had the higher prerequisites of Calculus III and Differential Equations. The first course was intended to serve not only ME students, but also an elective for Technology and especially Fire Science students. However, the ME students suffered poor results in the more mathematically-intensive parts of Fluid Mechanics (integral and differential formulations of flow regimes), these being concentrated in a mere 5-weeks at the end of the semester, even as the non-Engineering students had trouble handling even the first course; nobody seemed to benefit from this arrangement. Certainly, the EGME339 course assessment, several years running, adequately demonstrated this both via performance-by-objective and through student comments; the graduate exit interviews contributed further clarification of this problem to the ME Coordinator.

Accordingly, effective 2014 – 2015, the two courses were unified into a single course, also called EGME338, but now at 3 credits, spanning the whole semester, and with the upper level prerequisites. The subject was abandoned as an elective in the non-Engineering degrees, necessarily, as part of this change, but in exchange, the ME students benefitted from a more rational distribution of the course content over the duration of the semester. Subsequent performance was notably improved.

B.4 EGME240 GD&T Course Expansion in ME Program

As a result of discussions with the Industrial Advisory Board (IAB), 2013, it was determined that the program curriculum would benefit from more student competence in Geometric Dimensioning and Tolerancing. Accordingly, this course was made required in the ME-General concentration (where, previously, it had been merely an elective), and allowed as an elective in the Robotics & Automation concentration; it had already been, and was retained as, a requirement in the Vehicle Systems concentration. This did not, indeed, go quite as far as the IAB wished, as it left it merely an elective (one of a choice of 4 courses) in Robotics & Automation, but the judgment of the faculty was that it had somewhat less relevance in that field than the others. Accordingly, this serves as an example that the departmental faculty are, on the one hand, responsive to stakeholder (notably the IAB) feedback, but on the other hand, treat it with discretion and judgment, balancing that industry perspective against our perspective, also informed by trends in academics.

B.5 Update of Vehicle Systems Concentration

Very recently, and only going into effect formally in the 2018-2019 academic year, the EGNR362 Vehicle Energy Systems course was replaced in the Vehicle Systems concentration by a choice of either of two courses: EGME442 Finite Element Analysis, or EGRS461 Design of Control Systems. It's not yet clear on what schedule these will be offered going forward, but for Spring 2019 at least, EGME442 will be offered for the first time in many years. Thereafter, at least one of these will be offered every other year at the longest; perhaps it will be possible to offer both, in alternation.

This decision was undertaken considering a variety of circumstances.

Firstly, it was clear from Departmental curriculum discussions that the vehicle energy theme was rather outside the theme of the rest of the concentration, which is focused on dynamics/vibrations/controls; propulsion people are usually a completely different set, within the vehicle industries, from vehicle dynamics people. On the other hand, exactly the vehicle dynamics people (more or less the type generated by this concentration) are typically charged with applying control systems (e.g., antilock brakes or electronic stability control in automobiles, suspension lean control in high speed rail, vessel roll stabilization control systems in maritime, etc.) and often the same people are active in finite element analysis in various vehicle industries. Aspects of the formalized program assessment processes that contributed to this perspective include discussions with industry contacts (with IAB and senior projects customers, specifically, these are part of the systematic process, although some such discussions were also outside of that realm), and feedback obtained in graduate exit interviews.

Secondly, the long-time instructor of EGNR362, from Electrical Engineering, retired, and the instructional demands upon the ECE Department, particularly with the Schools initiative to add a Robotics degree, made it far from certain the replacement would have the necessary expertise to offer EGNR362 anymore.

Thirdly, from the ME program Coordinator's perspective, the chance to offer a new course (as EGME442 was tasked to our two newest faculty) may hopefully serve as somewhat of a faculty retention initiative as well.

B.6 Future Improvements to the Process

As discussed, there is a continuous improvement process in place and being used to improve both the courses (course assessment) and the program (student outcome evaluation). However, the adherence to this process needs to be improved moving forward. There is a very strong history of using course assessment as the primary means for improvement of the program (up until the last ABET accreditation). As a result, programmatic changes are often discussed during these course assessment meetings. This itself is not an issue; however the recommendations and rationale were not always properly documented and included in the student outcome evaluation reports. Thus, these reports have not necessarily contained the complete summary. Moving forward, the department and school must be more diligent in documenting the assessment and evaluation of the student outcomes. This should be easier with the experience gained from going through the student outcome evaluation process.

C. Additional Information

Additional information regarding assessment and the student outcomes can be found in:

- *Course Assessment Summary* reports (Appendix J)
- *Student Outcome Evaluation* report (Appendix G)

A general list of material to be available for review by the EAC of ABET team is shown below, with **bold text** indicating items of particular relevance to policies regarding continuous improvement:

- Course Binders Containing all Course Information
    - Detailed Course Syllabus
    - **Course Assessment Summary**
    - Course Prerequisite Form (affidavit students sign testifying to satisfactory fulfillment of pre- and corequisite courses)
    - Course Handouts (possibly lecture notes, supplemental handouts, etc.)
    - **Examples of Student Work (homework, exams, quizzes, lab reports and/or worksheets, drawings, programs, etc.)**
- Senior Projects Portfolios
- **Student Outcome Reports (most recent)**
- **Industrial Advisory Board Information**
- **School Meeting Agendas and Minutes**
- **Department Meeting Agendas and Minutes**
- LSSU Catalog (electronic only)
- **Senior exit interviews**

CRITERION 5. CURRICULUM

A. Program Curriculum

A.1 Plan-of-Study

For the purpose of planning and evaluating the curriculum, as well as academic advising, the ME department has summarized the full set of course requirements in two complementary formats. These are to be found in the Mechanical Engineering *Plan-of-Study* document, wherein the courses comprising the curriculum are arranged in a suggested temporal sequence (semester-by-semester) in which students could feasibly take them, and in the Mechanical Engineering *Degree Audit Sheet* document, wherein the arrangement is instead alphabetical by discipline; the latter serves at the University level, moreover, as a kind of check-off sheet for meeting program requirements. The most up-do-date versions of these documents (applicable to students starting in Fall 2018) are found in appendices L and M; versions for earlier years will be available as part of the display materials at the visit.

Table 5-1, below, collects this information in terms of a list of courses (sequential, i.e., as in the first mentioned document, the "plan-of-study"), but also indicating to which curricular components they contribute, and providing recent enrollment information.

Courses are all semester-length (15 weeks; i.e., 14 weeks of instruction and 1 week for final examinations or other summative activities).

Table 5-1 (*a*): Curriculum, ME w/Robotics & Automation Conc.

Mechanical Engineering: Robotics & Automation Concentration
129 - 130 credit hours

Course (Department, Number, Title) List all courses in the program by term starting with first term of first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective	*Subject Area (Credit Hours)*				Last Two Terms the Course was Offered	Maximum Section Enrollment for the Last Two Terms the Course was Offered
		Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other		
1st YEAR: FALL							
EGME141 Solid Modeling	R		3			F17/S18	14
EGNR101 Introduction to Engineering	R		2✓			F16/F17	54
ENGL110 First-Year Composition I	R			3		F17/S18	24
MATH151 Calculus I	R	4				F17/S18	29
Cultural Diversity Elective e.g. GEOG306 Cultural Geography*	SE			3		F17/S18	48
1st YEAR: SPRING							
CHEM115 General Chemistry	R	5				F17/S18	75
EGME110 Manufacturing Processes I	R		3			F17/S18	26
EGNR140 Linear Algebra & Numerical Appl'ns for Engineers	R		2			F17/S18	28
ENGL111 First-Year Composition II	R			3		F17/S18	24
MATH152 Calculus II	R	4				F17/S18	20
2nd YEAR: FALL							
EGEM220 Statics	R		3			F17/S18	14
EGNR265 "C" Programming	R		3			F17/S18	22
MATH251 Calculus III	R	4				F17/S18	27
PHYS231 Applied Physics for Engineers & Scientists I	R	4				F16/F17	49
Social Science Elective e.g. PSYC101 Intro. to Psychology*	SE			3		F17/S18	98
2nd YEAR: SPRING							

EGME225 Mechanics of Materials	R		3			S17/S18	25
EGME275 Engineering Materials	R		3			S17/S18	26
EGME276 Strength of Materials Lab	R		1			S17/S18	10
EGRS365 Programmable Logic Controllers	SE		3✓			F17/S18	13
MATH310 Differential Equations	R	3				F17/S18	24
PHYS232 Applied Physics for Engineers & Scientists II	R	4				S17/S18	40
3rd YEAR: FALL							
EGEE210 Circuit Analysis	R		4			F17/S18	22
EGEM320 Dynamics	R		3			F16/F17	19
EGME350 Machine Design	R		4✓			F16/F17	22
EGNR340 Numerical Methods for Engineers	R	1				F17/S18	14
MATH308 Probability & Mathematical Statistics	R	3				F16/F17	28
3rd YEAR: SPRING							
COMM101 Fundamentals of Speech Communication	R			3		F17/S18	24
EGME337 Thermodynamics	R		4			S17/S18	17
EGME338 Fluid Mechanics	R		3			S17/S18	20
EGRS385 Robotics Engineering	SE		4			S17/S18	23
Other Tech Elective from List of Four Alternatives e.g., EGME240 Assembly Modeling and GD&T	SE		3			S17/S18	22
4th YEAR: FALL							
EGME431 Heat Transfer	R		3			F16/F17	18
EGME432 Thermal Fluids Lab	R		2✓			F16/F17	19
EGNR491 Engineering Design Project I	R		3✓			F16/F17	39
EGRS460 Control Systems	R		4			F16/F17	22
EGRS430 System Integration & Machine Vision	SE		4			F16/F17	27
4th YEAR: SPRING							
EGNR495 Engineering Design Project II	R		3✓			S17/S18	39
EGRS435 Automated Manufacturing Systems	SE		3			S17/S18	16
Social Science Elective e.g., SOCY101 Intro. to Sociology*	SE			3		F17/S18	55
Humanities Elective e.g., HUMN251 Humanities I*	SE			4		F17/S18	61
Hum. Elec. e.g., PHIL305 Modern Contemporary Philosophy*	SE			3		S17/S18	28
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		32	73	25			

OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM							
PERCENT OF TOTAL		24.62%	56.15%	19.23%			
Total must satisfy either credit hours or percentage	Minimum Semester Credit Hours	**32 Hours**	**48 Hours**				
	Minimum Percentage	25%	37.5 %				

*Example courses used for illustration.

Table 5-1 (*b*): Curriculum, ME w/Vehicle Systems Conc.

Mechanical Engineering: Vehicle Systems Concentration
130 - 131 credit hours

Course (Department, Number, Title) List all courses in the program by term starting with first term of first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective	*Subject Area (Credit Hours)*				Last Two Terms the Course was Offered	Maximum Section Enrollment for the Last Two Terms the Course was Offered
		Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other		
1st YEAR: FALL							
EGME141 Solid Modeling	R		3			F17/S18	14
EGNR101 Introduction to Engineering	R		2✓			F16/F17	54
ENGL110 First-Year Composition I	R			3		F17/S18	24
MATH151 Calculus I	R	4				F17/S18	29
Cultural Diversity Elective e.g. GEOG306 Cultural Geography*	SE			3		F17/S18	48
1st YEAR: SPRING							
CHEM115 General Chemistry	R	5				F17/S18	75
EGME110 Manufacturing Processes I	R		3			F17/S18	26
EGNR140 Linear Algebra & Numerical Appl'ns for Engineers	R		2			F17/S18	28
ENGL111 First-Year Composition II	R			3		F17/S18	24
MATH152 Calculus II	R	4				F17/S18	20
2nd YEAR: FALL							
EGEM220 Statics	R		3			F17/S18	14
EGNR265 "C" Programming	R		3			F17/S18	22
MATH251 Calculus III	R	4				F17/S18	27
PHYS231 Applied Physics for Engineers & Scientists I	R	4				F16/F17	49
Social Science Elective e.g. PSYC101 Intro. to Psychology*	SE			3		F17/S18	98
2nd YEAR: SPRING							

EGME225 Mechanics of Materials	R		3			S17/S18	25
EGME275 Engineering Materials	R		3			S17/S18	26
EGME276 Strength of Materials Lab	R		1			S17/S18	10
EGME240 Assembly Modeling and GD&T	SE		3✓			S17/S18	22
MATH310 Differential Equations	R	3				F17/S18	24
PHYS232 Applied Physics for Engineers & Scientists II	R	4				S17/S18	40
3rd YEAR: FALL							
EGEE210 Circuit Analysis	R		4			F17/S18	22
EGEM320 Dynamics	R		3			F16/F17	19
EGME350 Machine Design	R		4✓			F16/F17	22
EGNR340 Numerical Methods for Engineers	R	1				F17/S18	14
MATH308 Probability & Mathematical Statistics	R	3				F16/F17	28
EGME310 Vehicle Development and Testing	SE		2			F14 (as EGME300)/F16	18
3rd YEAR: SPRING							
COMM101 Fundamentals of Speech Communication	R			3		F17/S18	24
EGME337 Thermodynamics	R		4			S17/S18	17
EGME338 Fluid Mechanics	R		3			S17/S18	20
EGME415 Vehicle Dynamics	SE		2			S15/S17	14
EGME442 Finite Element Analysis	SE		3			(New: to begin S19)	N/A
4th YEAR: FALL							
EGEE280 Introduction to Signal Processing	SE		4			F16/F17	23
EGME431 Heat Transfer	R		3			F16/F17	18
EGME432 Thermal Fluids Lab	R		2✓			F16/F17	19
EGNR491 Engineering Design Project I	R		3✓			F16/F17	39
EGRS460 Control Systems	R		4			F16/F17	22
4th YEAR: SPRING							
EGME425 Vibrations and Noise Control	SE		4✓			S16/S18	14
EGNR495 Engineering Design Project II	R		3✓			S17/S18	39
Social Science Elective e.g., SOCY101 Intro. to Sociology*	SE			3		F17/S18	55
Humanities Elective e.g., HUMN251 Humanities I*	SE			4		F17/S18	61
Hum. Elec. e.g., PHIL305 Modern Contemporary Philosophy*	SE			3		S17/S18	28

TOTALS-ABET BASIC-LEVEL REQUIREMENTS		32	74	25			
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM							
PERCENT OF TOTAL		24.43%	56.49%	19.08%			
Total must satisfy either credit hours or percentage	Minimum Semester Credit Hours	32 Hours	48 Hours				
	Minimum Percentage	25%	37.5 %				

*Example courses used for illustration.

Table 5-1 (c): Curriculum, ME General

Mechanical Engineering: General (i.e., no named concentration)
(showing, here, example technical elective choices that just minimally satisfy the required totals: EGME240, plus 14 total other credits, of which 5 cr. at the 400 level)
129 credit hours (minimum possible, but 130 in this example due to particular Gen Ed elective selection)

Course (Department, Number, Title) List all courses in the program by term starting with first term of first year and ending with the last term of the final year.	Indicate Whether Course is Required, Elective or a Selected Elective	*Subject Area (Credit Hours)*				Last Two Terms the Course was Offered	Maximum Section Enrollment for the Last Two Terms the Course was Offered
		Math & Basic Sciences	Engineering Topics Check if Contains Significant Design (√)	General Education	Other		
1st YEAR: FALL							
EGME141 Solid Modeling	R		3			F17/S18	14
EGNR101 Introduction to Engineering	R		2✓			F16/F17	54
ENGL110 First-Year Composition I	R			3		F17/S18	24
MATH151 Calculus I	R	4				F17/S18	29
Cultural Diversity Elective e.g. GEOG306 Cultural Geography*	SE			3		F17/S18	48
1st YEAR: SPRING							
CHEM115 General Chemistry	R	5				F17/S18	75
EGME110 Manufacturing Processes I	R		3			F17/S18	26
EGNR140 Linear Algebra & Numerical Appl'ns for Engineers	R		3			F17/S18	28
ENGL111 First-Year Composition II	R			3		F17/S18	24
MATH152 Calculus II	R	4				F17/S18	20
2nd YEAR: FALL							
EGEM220 Statics	R		3			F17/S18	14
EGNR265 "C" Programming	R		3			F17/S18	22
MATH251 Calculus III	R	4				F17/S18	27
PHYS231 Applied Physics for Engineers & Scientists I	R	4				F16/F17	49

Social Science Elective e.g. PSYC101 Intro. to Psychology*	SE			3		F17/S18	98
2nd YEAR: SPRING							
EGME225 Mechanics of Materials	R		3			S17/S18	25
EGME275 Engineering Materials	R		3			S17/S18	26
EGME276 Strength of Materials Lab	R		1			S17/S18	10
EGME240 Assembly Modeling and GD&T	SE		3✓			S17/S18	22
MATH310 Differential Equations	R	3				F17/S18	24
PHYS232 Applied Physics for Engineers & Scientists II	R	4				S17/S18	40
3rd YEAR: FALL							
EGEE210 Circuit Analysis	R		4			F17/S18	22
EGEM320 Dynamics	R		3			F16/F17	19
EGME350 Machine Design	R		4✓			F16/F17	22
EGNR340 Numerical Methods for Engineers	R	1				F17/S18	14
MATH308 Probability & Mathematical Statistics	R	3				F16/F17	28
EGME310 Vehicle Development and Testing	R		2			F14(as EGME300)/F16	18
3rd YEAR: SPRING							
COMM101 Fundamentals of Speech Communication	R			3		F17/S18	24
EGME337 Thermodynamics	R		4			S17/S18	17
EGME338 Fluid Mechanics	R		3			S17/S18	20
EGRS385 Robotics Engineering	SE		4			S17/S18	23
EGME415 Vehicle Dynamics	SE		2			S15/S17	14
4th YEAR: FALL							
EGME431 Heat Transfer	R		3			F16/F17	18
EGME432 Thermal Fluids Lab	R		2✓			F16/F17	19
EGNR491 Engineering Design Project I	R		3✓			F16/F17	39
EGRS460 Control Systems	R		4			F16/F17	22
EGMT216 CAM with CNC Applications	R				3	S17/S18	8
4th YEAR: SPRING							
EGNR495 Engineering Design Project II	R		3✓			S17/S18	39
EGRS435 Automated Manufacturing Systems	SE		3			S17/S18	16
Social Science Elective e.g., SOCY101 Intro. to Sociology*	SE			3		F17/S18	55
Humanities Elective e.g., HUMN251 Humanities I*	SE			4		F17/S18	61

Hum. Elec. e.g., PHIL305 Modern Contemporary Philosophy*	SE			3		S17/S18	28
TOTALS-ABET BASIC-LEVEL REQUIREMENTS		32	70	25	3		
OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM							
PERCENT OF TOTAL		24.62%	53.85%	19.23%	2.30%		
Total must satisfy either credit hours or percentage	Minimum Semester Credit Hours	32 Hours	48 Hours				
	Minimum Percentage	25%	37.5 %				

***Example courses used for illustration.**

A.2 Curriculum Alignment to PEOs

There are, for the Mechanical Engineering program, four stated educational objectives; these are described in chapter 2, above. The curriculum aligns with and supports these, as explained in the following.

PEO I. The first PEO calls for alumni to *apply knowledge* from the discipline in solving *problems within the profession*. Most importantly, the curriculum is there to supply the knowledge base which is to be applied; secondarily, the curriculum practices problem-solving skills which are generalizable to the application of other knowledge that may be later obtained, as well as skills in design and software that are tools in professional problem solving.

The curriculum fulfills the primary function described, furnishing the knowledge base, by its development of breadth across the discipline and the engineering sciences (see figure 5-3 regarding major curricular components, i.e., broad subject areas, addressed in the discipline by sets of courses), with significant depth in the key areas of thermal-fluids and solid mechanics (see figure 5-4, where prerequisite structure suggests depth in these areas).

The development of problem solving skills, in parallel with subject knowledge, will be evidenced in the course-specific display materials at the time of the visit.

PEO II. The second PEO requires the practice of design or research within realistic (economic, societal, etc.) constraints. The curriculum has a number of courses which impart design experience, constrained by realistic specifications; these are expected to develop an early-stage experience in the student which should facilitate the transition to design work in the profession. The courses checked in Table 5-1 have particularly significant design projects.

PEO III. The third PEO says that alumni set goals, experience professional growth, and engage in on-going learning / professional-development. Accordingly, the curriculum is so constructed as to provide both the *tools* and the *attitude* necessary to engage in continued learning.

The primary *tool* is the coherence of knowledge, in the sense that advanced and/or applied knowledge (upper-level engineering sciences, and capstone/design experiences) be rooted in fundamentals and derived from first principles; the development of first principles (e.g., Newton's law or energy balance laws, for example) into advanced principles (e.g., Navier-Stokes equations, wave equations and speeds of sound, conductive heat transfer laws, etc.) within the curriculum instills the ability to see the larger picture and interconnectedness within the discipline, and the ability to extrapolate and develop competencies that go beyond the knowledge obtained directly from the curriculum. The deep prerequisite structure of the curriculum, and also the structure and philosophy of individual courses, i.e., emphasizing the linkages of "first principles" to advanced results, develops this tool.

The *attitude* promoting life-long learning is instilled, especially, by exposure to experiences that are interdisciplinary, e.g., the senior (capstone) project and the Introduction to Engineering project. The interdisciplinairity is suggestive to the student of how the need can arise, in authentic engineering design and development scenarios, to synthesize knowledge beyond that obtained directly in the student's own coursework.

Concerning professional growth, the EGNR101 Introduction to Engineering course introduces students to the LSSU student chapters of professional societies, notably including ASME and SAE for ME students especially. Sustained extracurricular involvement in these societies is expected to be a factor promoting professional growth, particularly to the extent the association with the corresponding national organizations continues after graduation.

PEO IV. The fourth PEO says that alumni will be, furthermore, societally-beneficial as individuals.

The curriculum contributes to this objective by providing competencies that are of use to society, most directly manifested by the various concentration courses which show industry-specific applications, to the transport and automation industries in particular (for the Vehicle Systems and Robotics & Automation concentrations, respectively). But of course, the broader core of Mechanical Engineering is versatile in its applications to a great many industries, as well as to government, academia, and the non-profit sector.

A.3 Curriculum Support of Student Outcomes

There are, for the ME Program, eleven Student Outcomes established; these are described in Chapter 3 above, and coincide exactly with the ABET (a) – (k) criteria. The courses comprising the core part of the curriculum support these, as illustrated by the mapping of Table 5-2.

Table 5-2: Mapping of Courses to Student Outcomes Supported. Color-highlighted cells indicate courses (rows where highlighted) serving as sources of evidence for attainment of specific student outcomes (columns where highlighted).

Course	A	B	C	D	E	F	G	H	I	J	K
EGEE-210	✓✓ m, S, E	✓ *	✓ *	✓ *	✓ *		✓ *				✓ *
EGEM-220	✓✓✓ m, E						✓ *				✓ *
EGEM-320	✓✓ M, S, E						✓ *				✓✓ *
EGME-110	✓ e										✓ *
EGME-141	✓ m		✓ *				✓ *		✓ *		✓✓ *
EGME-225	✓✓ m, s, e				✓ *						✓ *
EGME-275	✓✓ m, s, e				✓ *						
EGME-276	✓✓ m, e	✓✓ *					✓✓ *				✓ *
EGME-337	✓✓ M, S, E							✓ *	✓ **	✓ *	
EGME-338	✓✓ M, S, E										
EGME-339	✓✓ M, S, E										✓*
EGME-350	[illegible]		[illegible]	✓✓ *	[illegible]		✓✓ **	[illegible]	✓✓ **		[illegible]
EGME-431	✓✓ M, S, E				✓ *						✓ *
EGME-432	✓✓ M, S, E	[illegible]					[illegible]		✓ **		✓ *
EGNR-101	✓ E		✓✓ *	✓✓ *	✓ *	✓✓ *	✓✓ *	✓ *	✓ *	✓ *	✓✓✓ *
EGNR-140	✓✓ m, e				✓✓ *		✓ *				✓✓✓ *
EGNR-265	✓ m, s		✓ **		✓✓ **		✓ *		✓ *		✓✓✓ **
EGNR-340	✓✓ M, e	✓ *			✓ **						✓✓✓ **
EGNR-491	✓ E		✓✓✓ ***	✓✓✓ **	✓✓✓ **	✓✓ *	✓✓✓ ***	✓ *	✓✓ **		✓✓ ***
EGNR-495	✓ E	✓✓ **	✓✓✓ ***	✓✓✓ ***	✓✓✓ **	✓✓✓ **	✓✓✓ ***	✓✓ **	✓✓ **	✓ *	✓✓ ***
EGRE-460	✓✓✓ M, s, E	✓ *	✓ *		✓✓✓ ***		✓ **				✓ *

▇	evaluated for ME alone
▒	evaluated in common with EE

▒	evaluated in common with CpE and EE

✓	exposure (for instance, one graded assignment)
✓✓	stress (for instance, one course objective)
✓✓✓	focus (for instance, multiple objectives or course title)

*	foundational – ready for further development
**	developed – prepared for practical application
***	high – approaching that of a practicing engineer

m (M)	basic-level (advanced-level) mathematics
s (S)	basic-level (advanced-level) science

e (E)	basic-level (advanced-level) engineering

(A) an ability to apply knowledge of mathematics, science, and engineering

(B) an ability to design and conduct experiments, as well as to analyze and interpret data

(C) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(D) an ability to function on multidisciplinary teams

(E) an ability to identify, formulate, and solve engineering problems

(F) an understanding of professional and ethical responsibility

(G) an ability to communicate effectively

(H) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(I) a recognition of the need for, and an ability to engage in life-long learning

(J) a knowledge of contemporary issues

(K) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The table, firstly, serves as a mapping, indicating which courses are intended to contribute in some way to attainment of which Student Outcomes, by virtue of cells being filled when that is the case at the intersection of the course-row with the objective-column. For instance, in the EGME432 row, the cell in column G is occupied and that in column H is not; accordingly, EGME432 can be expected to contribute something to outcome G (communications), but not by design (although perhaps incidentally, and inconsistently if so) to outcome H (broader impacts).

But the table also provides, secondly, an indication of the *degree* to which each course contributes. The number of check marks, from one to three, increases with an increasing such contribution. As the legend below the table shows, a single check mark would suggest a fairly secondary contribution, mere "exposure" without any especial stress in the course; this might be the case if, for example, a single or few assignments, adding up to a small portion of the course grade and effort expended, were to exercise the student outcome concerned. Two checks indicate that the student outcome is, instead, *stressed* in the course, such as would be the case if it corresponded to a course objective. Three checks would suggest that the class is largely focused on contributing to that objective, as if multiple course objectives contribute to it.

The table, thirdly, indicates the expected level of development, with regard to that outcome, to be displayed by students performing satisfactorily. The number of asterisks, for all outcomes except A, correlates to the level of development; for A in particular, the letters m, s, and e are instead used to distinguish the math, science, and engineering aspects, respectively, of the outcome, with the lower case – upper case distinction to indicate level of development (lower case implying lower development and upper case higher). Thus, a single asterisk in B – K means a *foundational* level, i.e., an outcome at the very initial stages of development; two asterisks implies some readiness for practice, and three a level comparable to a practicing professional. Lower case m indicates the application of basic mathematics (through univariate calculus), and upper case M a more advanced mathematics (e.g., multivariate calculus, differential equations); the s vs. S and e vs. E distinctions are analogous for application of natural sciences and engineering sciences.

Fourthly, and finally, the table indicates from which courses evidence is purposefully collected in order to assess the attainment of Student Outcomes via the curriculum, i.e., "program assessment" evidence. This is understood to be evidence that sheds light on the workings of the whole curriculum, not merely the course from which the evidence is extracted, towards the outcome concerned. Cells with color highlighting are those indicating an evidentiary source; the course corresponding to the cell's row provides evidence of attainment of the objective corresponding to the cell's column. The color chosen for highlighting furnishes the additional information as to whether any distinction is made, or not, between ME students and other Engineering students. Thus, red means ME students exclusively, whereas purple implies grouping with Electrical Engineering students and yellow with *all* Engineering students (ME, EE, CE).

To return to the EGME432 example, we had noted that the circumstance that column G was occupied implied some contribution of that course (Thermal-Fluids lab) to outcome G (communications). In fact, the table also tells us, by a single check, that the emphasis on communications is only minor, and the two asterisks that the expectation for students is an intermediate level of development in their oral presentations and technical reports in that course. Finally, the red highlighting means that the department collects and evaluates evidence from that course (one would have to consult the course or program assessment reports for specifics) for purposes of evaluating the program's attainment of outcome G, and that such evidence is (unlike that from, say, EGNR495 for the same objective) not confounded with that of students from other Engineering disciplines.

Note that the technical electives of the concentrations (or ME-general) also support the Student Outcomes, but to varying degrees and varying distribution; accordingly, these are *not* included in the table, but the respective course assessment reports may be consulted for the same kind of information for those technical electives as supplied here for the core courses.

A.4 Prerequisite Structure

Figure 5-1, below, shows direct prerequisite and co-requisite relationships between the core courses of the curriculum (omitted are the technical electives in the concentrations, as well as those elective general education courses typically requiring no prerequisites).

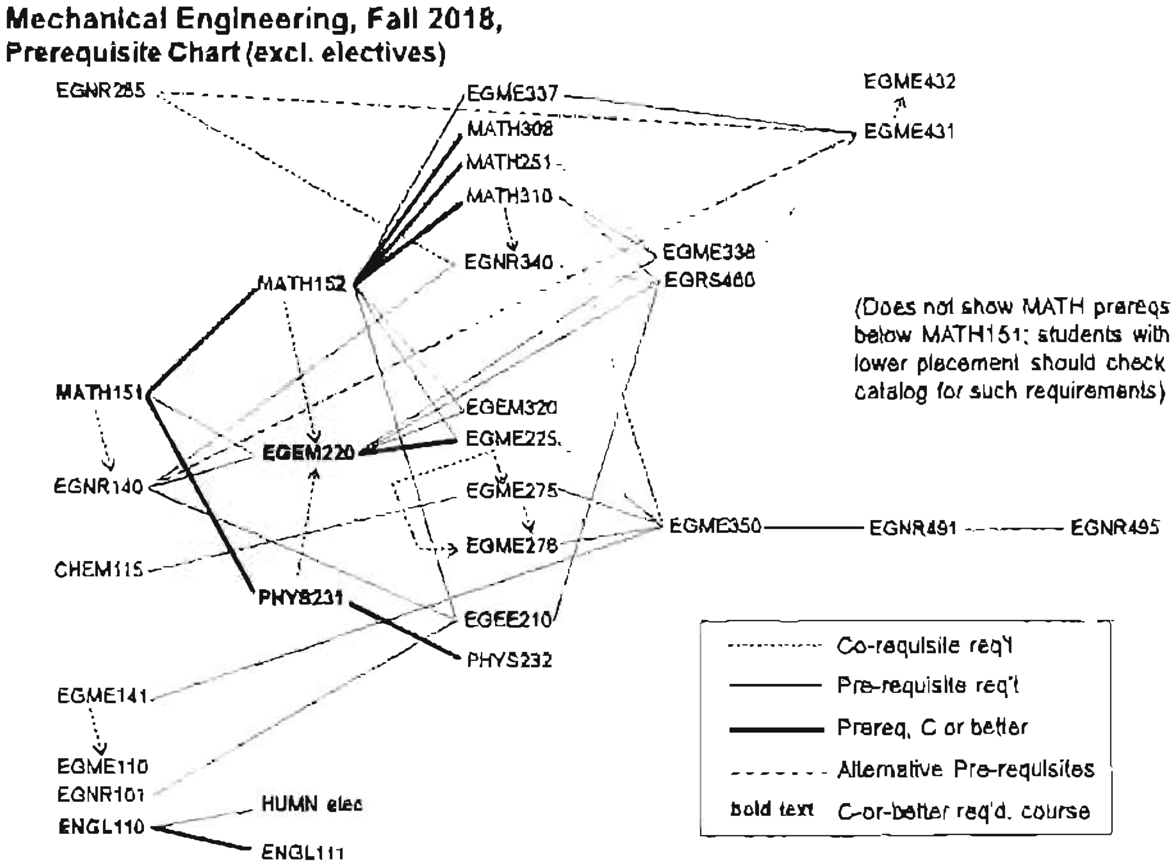


Figure 5.1 Prerequisite Structure for Required Courses. The highlighted vertical columns represent layers of depth within the prerequisite structure (courses with equal numbers of preceding courses in prerequisite sequence); note that these do *not* precisely align with specific semesters or even academic years within the program. Technical elective courses, and general education courses without prerequisite relationships, are omitted.

The prerequisite chart of fig.5-1, arranged so that courses with the same length of prerequisite chain are vertically aligned in gray-highlighted columns, is useful to illustrate a few key features of the ME program:

- that there is a significant *depth* developed throughout the curriculum; the final capstone course, EGNR495, is so much as *sixth* in a chain of prerequisites, and there are many courses that are 3 or 4 layers deep;
- certain courses, such as MATH152 Calculus II or EGEM220 Statics, are the *knowledge base* of a large part of the subsequent core curriculum, as can be seen by the *divergence* of many lines from those courses to the right;
- certain other courses, such as EGME350 Machine Design, EGME338 Fluid Mechanics, EGME431 Heat Transfer, and EGRS460 Control Systems, *synthesize* knowledge obtained widely from across the discipline, as is evident by the *convergence* of many lines towards them from the left.

The depth of a course within the prerequisite structure (i.e., number of preceding courses in prerequisite sequence) does not necessarily coincide with the academic year, but correlates to it, as illustrated by fig.5-2, in which the vertical columns are retained, but color highlighting instead groups same-academic-year courses (corresponding to the recommended sequencing of the plan-of-study document).

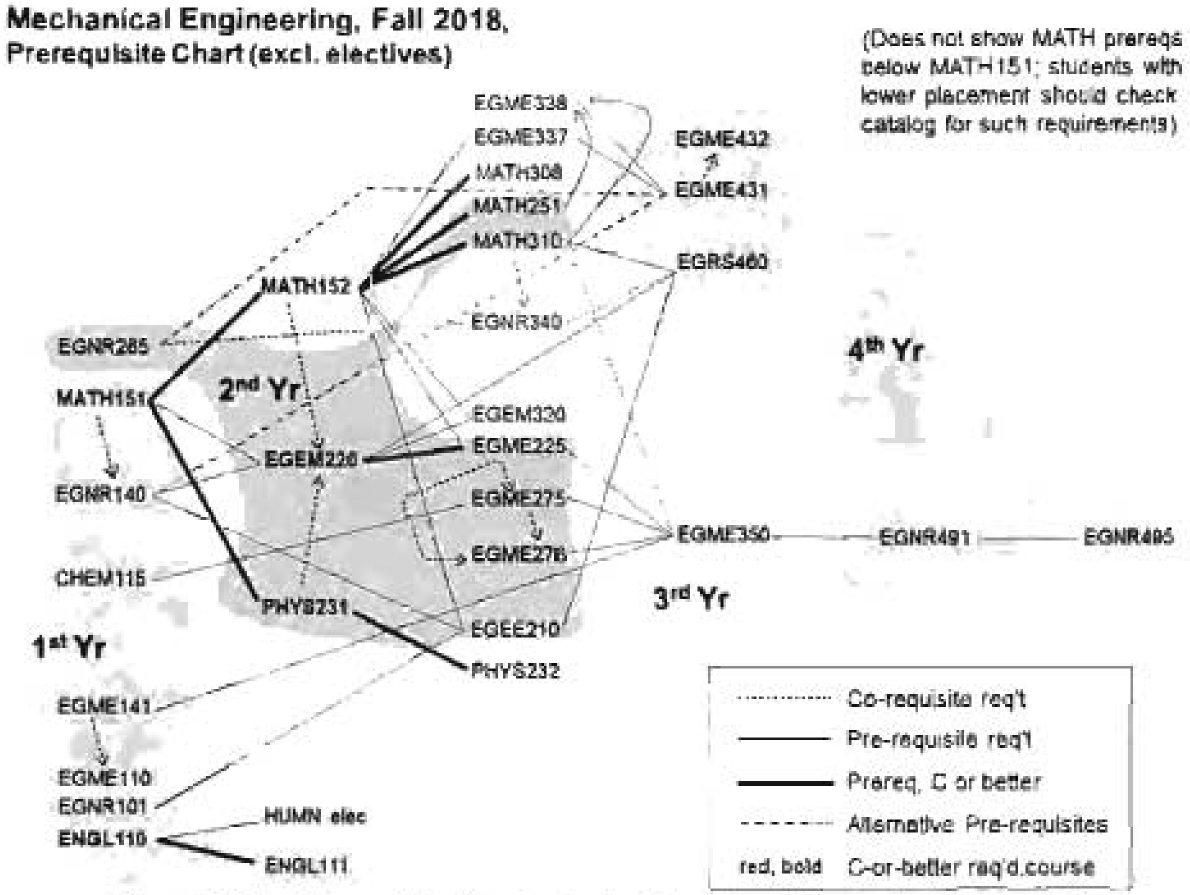


Figure 5.2 Core Prerequisite Structure by Academic Year. The structure is repeated from fig.5.1, but with highlighting to show suggested semester in the Plan-of-Study. Technical elective courses, and general education courses without prerequisite relationships, are again omitted.

Aside from these few observations, however, the prerequisite chart broken down at the detailed courses level, as in figs. 5-1 and 5-2, is less than ideal for observing the overall structure of the curriculum as the series and parallel development of blocks of courses with common themes, most notably the solid mechanics and thermal-fluids blocks of courses. Figure 5-3, below, breaks down the discipline, below, by these course blocks; on the basis of this breakdown, the more manageable and perspicuous prerequisite course structures of the individual blocks are thereafter presented in figures 5-4 through 5-6.

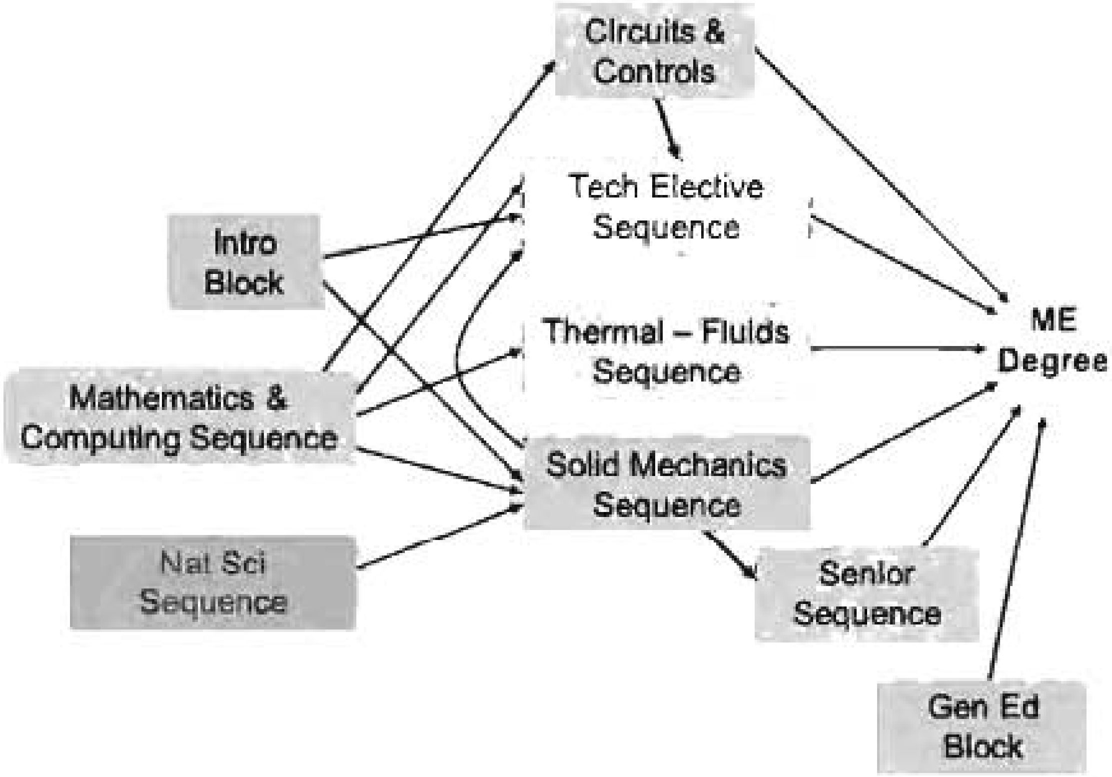


Figure 5.3. ME Program Structure as the Culmination of Coherently-Themed Course Blocks (representing branches of ME, and groupings of support subjects). Arrows represent the existence (and direction) of prerequisite requirements between course blocks.

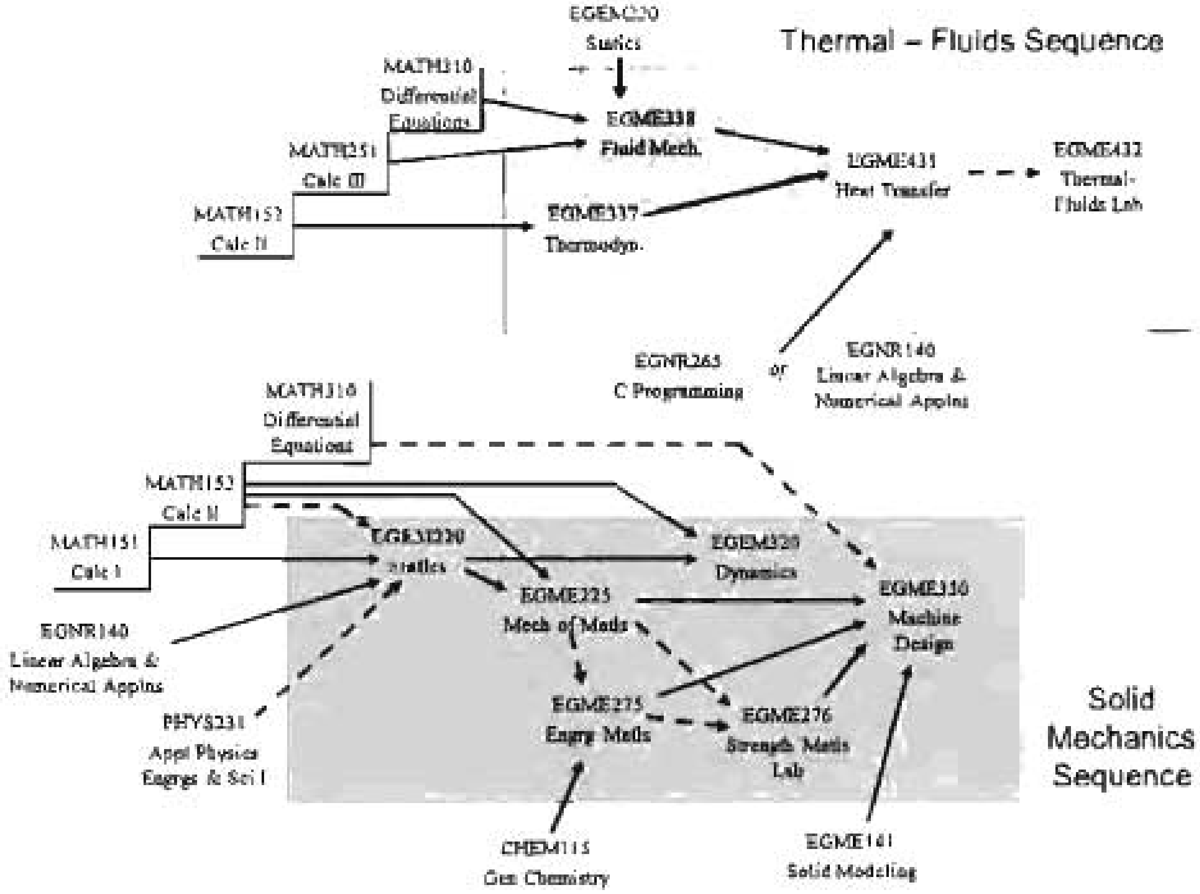
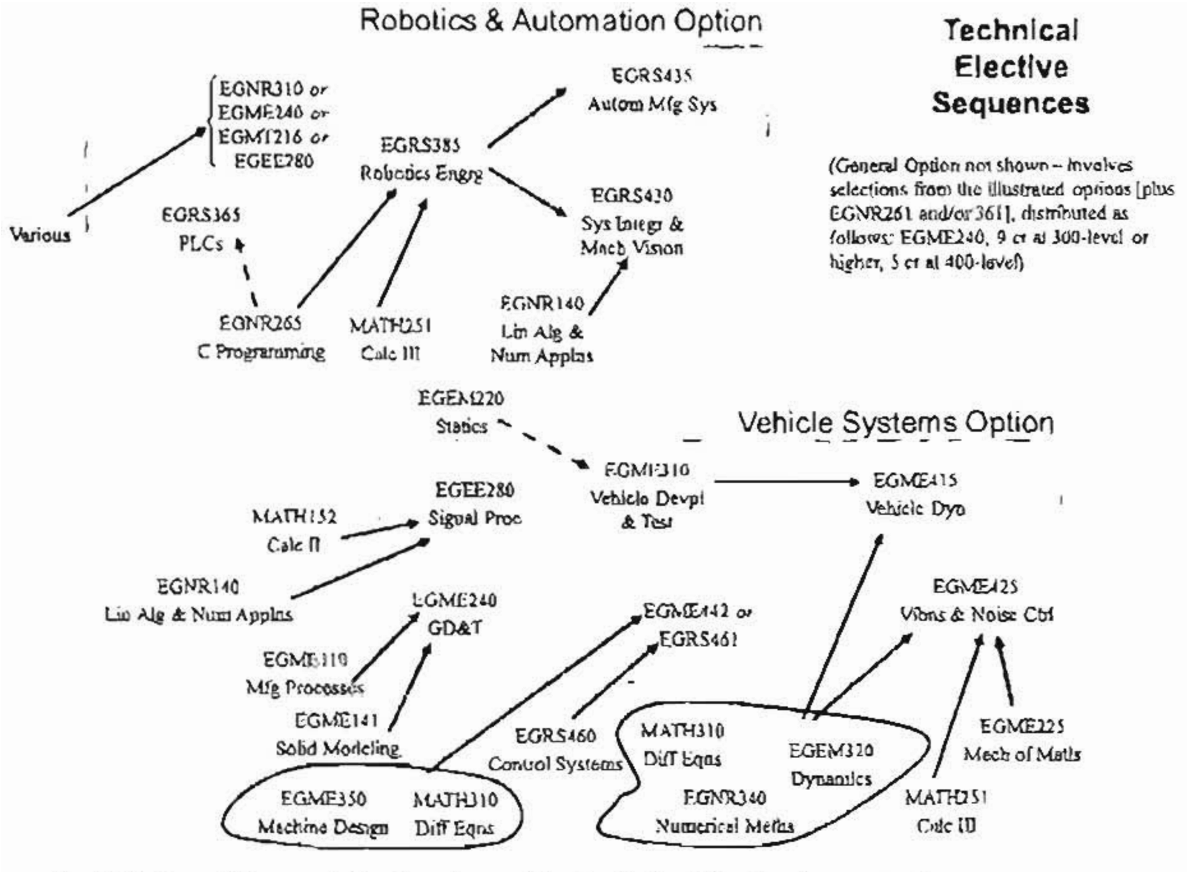


Figure 5.4. Internal Prerequisite Structure: Solid Mechanics & Thermal-Fluids Course Blocks.



Technical Elective Sequences

(General Option not shown – involves selections from the illustrated options [plus EGNR261 and/or 361], distributed as follows: EGME240, 9 cr at 300-level or higher, 5 cr at 400-level)

Fig.5.5 Internal Prerequisite Structure of the Technical Elective Concentrations.

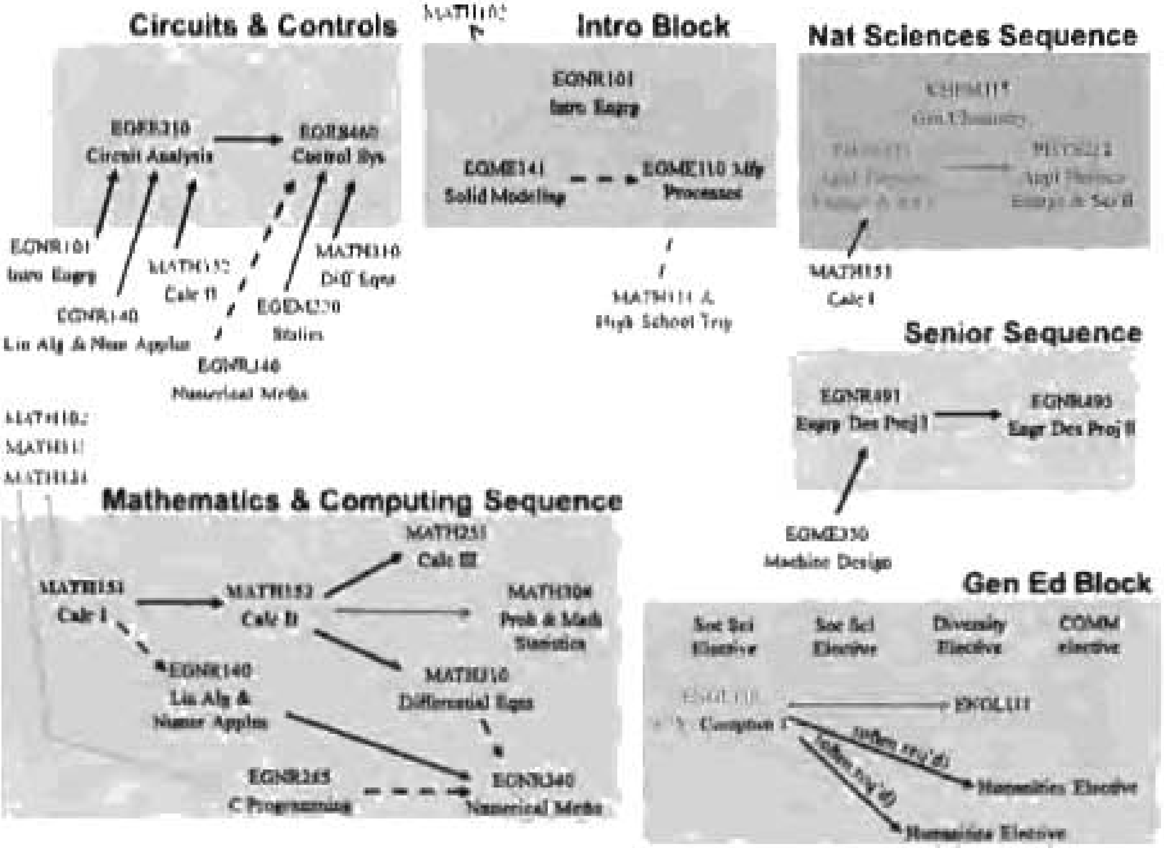


Fig.5.6 Internal Prerequisite Structure of Supporting Subject Course Blocks.

To enforce compliance with the prerequisite structure outlined above, the University's registration system is designed to disallow enrollment in courses for which students lack the prerequisites or have not already enrolled in co-requisites. In recent years, furthermore, the Registrar has also adopted the practice of flagging and dis-enrolling students who could preliminarily enroll in a course while in the process of completing a prerequisite course, but who then subsequently do not successfully complete that prerequisite requirement (by withdrawing, failing, or not attaining a C in cases that require such). To provide some redundancy in ensuring compliance, furthermore, students, at the beginning of any course, are also asked by the Engineering instructor to complete and sign a statement that testifies to their having satisfactorily completed any prerequisite courses, and having enrolled in (or already completed) any co-requisite courses. Waivers for prerequisites must be approved by the ME Coordinator, and a departmental policy statement (appendix F) exists to provide guidance for frequently-occurring cases, while not restricting the discretion of the advisor and Coordinator. Appendix K also contains example prerequisite forms.

A.5 Depth in Subject Areas

As indicated in Table 5-1, the program consists of at least 129 credits; insofar as these are semester credits, this is in accordance with the standard for total semester credits of at least 124. The distribution of these credits by subject area is as follows:

• Mathematics	19 credits
Instructed by Math Dep't	18 credits
Instructed by School of Engrg & Techn	1 credit
• Basic Sciences (Chemistry, Physics)	13 credits
• General Education (communications, English, humanities, social sciences, diversity)	24 hours (min.)
• Engineering Sciences (core courses)	50 credits
• Senior Sequence (capstone)	6 - 13 credits
• Technical Electives (largely Engrg Sci and applied Engrg courses, but possibly including an Engrg Techn course)	17 - 19 credits
	129 (min.) credits

These various components, and their relation to criterion 5, will be discussed in detail in the following.

Mathematics and Basic Sciences. Criterion 5 requires that the curriculum include a minimum of 32 credits of mathematics and basic sciences (or a quarter of the total credits if that were less, but as a quarter of 129 is 32-and-a-fraction, it is evidently *not* less in this case). The ME program at LSSU meets that requirement by virtue of the courses listed in Table 5-3 below.

Table 5-3: Mathematics & Basic Sciences Component of Curriculum.

Course	Credits
Offered by Mathematics Dept.	
MATH151 Calculus I	4
MATH152 Calculus II	4
MATH251 Calculus III	4
MATH310 Differential Equations	3
MATH308 Probability & Mathematical Statistics	3
Offered by School of Engineering & Technology	
EGNR340 Numerical Methods	1
Offered by the College of Science & the Environment	
CHEM115 General Chemistry I	5
PHYS231 Appl. Physics for Eng. and Sci. I	4
PHYS232 Appl. Physics for Eng. and Sci. II	4
Total	32

Some students entering Mechanical Engineering program do not possess a sufficient mathematical background to be placed in MATH151 at the outset. These students are instead placed in lower level Mathematics courses, as appropriate to their initial preparation. Academic credit at the University *is* certainly awarded for such courses (except for any below the 100-level), and the grade point average *does* account for them, but they do not apply towards any degree requirements of the ME program, and stand outside of the program's minimum 129 required credits.

The EAC program criterion for degrees named Mechanical Engineering specifies, furthermore, that the mathematics component must include "multivariate calculus and differential equations". This is fulfilled by MATH251 Calculus III (which addresses multivariate calculus), MATH310 Differential Equations (which covers ordinary differential equations), and EGNR340 Advanced Numerical Methods (which addresses ordinary and partial differential equations). These syllabi are provided in appendix A (and a more complete syllabus for EGNR340, specifically, in appendix D).

The Engineering-instructed course EGNR340 Advanced Numerical Methods is regarded, for present purposes, as essentially a mathematics rather than an engineering science course. It not only introduces numerical methods related to mathematics concepts from other courses (e.g., numerical integration, eigenvalue analysis, etc.), but also original mathematics content (e.g., partial differential equations) not introduced in the MATH-listed courses of the curriculum.

It is also noteworthy that the program criterion calls not merely for *inclusion* of the Mathematics in the curriculum, but also for its *application* ("…to apply… mathematics"). Accordingly, many of the Engineering courses do make application of the Mathematics content, all the way from lower mathematics through topics from multivariate calculus and differential equations as the criterion specifies. As examples from the core, EGME338 Fluid Mechanics makes use of multivariate calculus (e.g., Stoke's theorem for open channel flow analysis), and EGME350 Machine Design makes use of differential equations (for beam bending and eigenvalue analysis for buckling load and critical rotor speed analyses). Technical elective courses such as EGRS385 Robotics Engineering (using multivariate calculus for kinematic analyses) or

EGME425 Vibrations & Noise Control (using partial differential equations for resolving Euler-Bernoulli beam resonances), to mention one course from each named concentration, also contribute substantially to the application of mathematics.

The Mathematics portion of the curriculum, and its support of subsequent Engineering Sciences courses, is illustrated in figure 5-7; this clarifies the Mathematics-level underlying key Engineering courses.

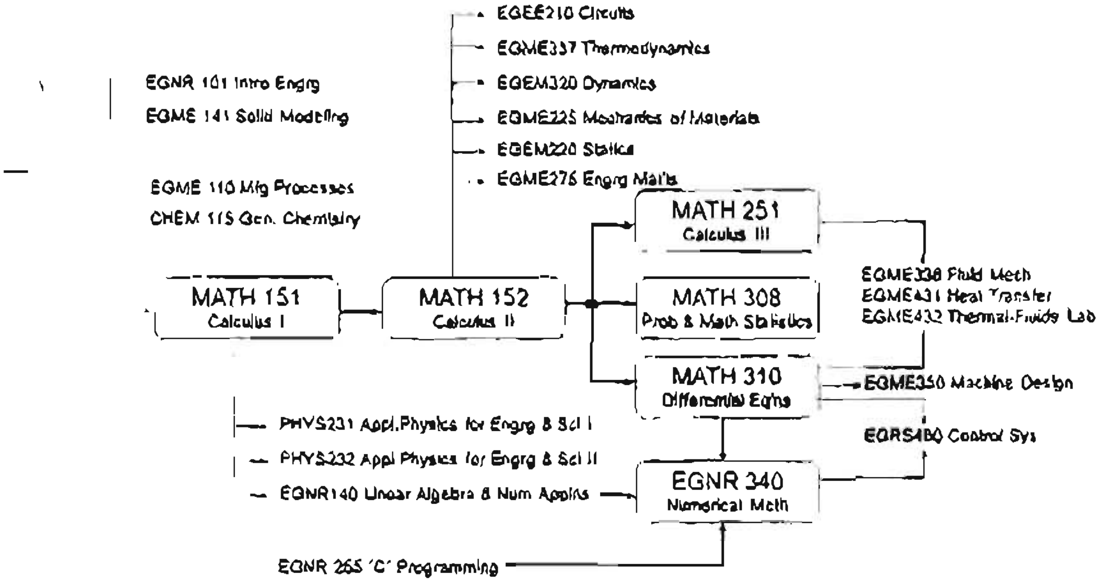


Figure 5-7. Internal Structure of Mathematics Component, and Relation to Subsequent Science and Engineering Courses. Grayed-out courses are not formally part of the ME program, but may be needed by some students before beginning Calculus I, if underprepared in Mathematics. Some prerequisite relations shown are indirect, but presented to indicate the Math levels of the Science/Engineering courses concerned. No distinction is made between pre-requisite and co-requisite arrows in *this* diagram (but that level of detail can be found in section 5.A.4 above).

Consistent with the criterion 5 requirement that some basic science courses include experimental experiences, all three of the courses in natural sciences (CHEM115, PHYS231, and PHYS232) have a laboratory component; these are 3 hours/week for CHEM115, and 2 hours/week for each of the two Physics courses.

Figure 5-8 illustrates the structure of the natural sciences portion of the curriculum, its mathematics prerequisites, and the Engineering Science courses which it serves.

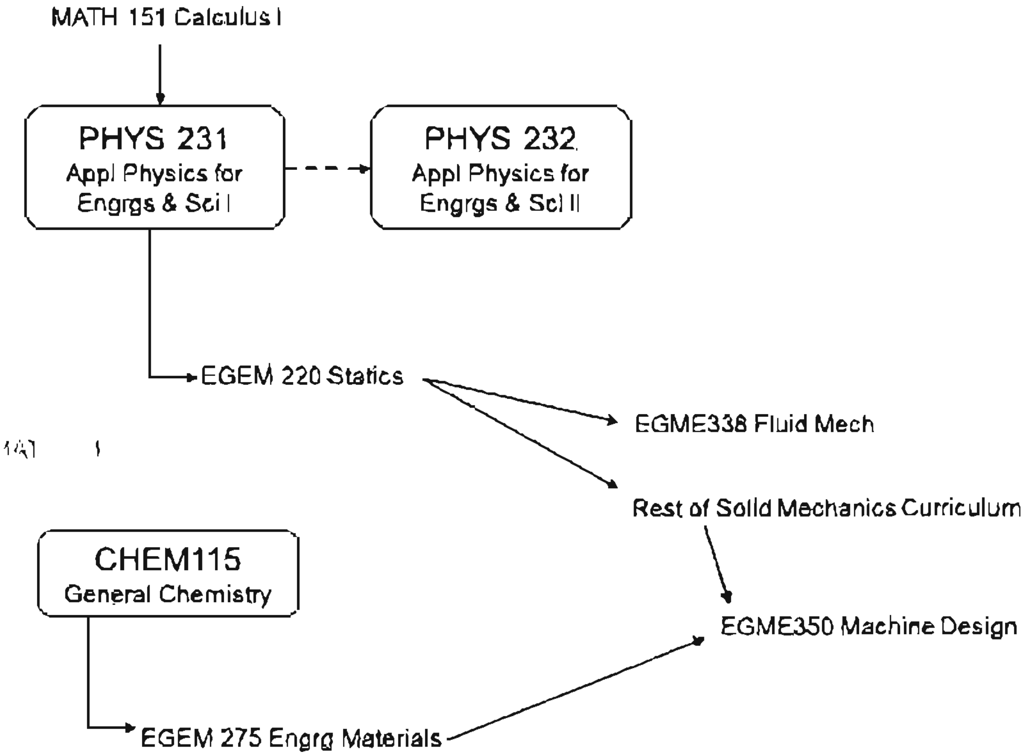


Figure 5-8. Internal Structure of Natural Sciences Component, and Relation to Subsequent Engineering Courses.

Engineering Courses. Criterion 5 requires one-and-a-half years (48 credits) of engineering topics (engineering science and engineering design). Indeed, the core of the ME program at LSSU provides 50 such credits, as broken down in Table 5-4, below; these are complemented by at least 17 additional credits of technical electives (not shown in the table), of which most are also Engineering courses (i.e., all 18 in the Vehicle Systems concentration, and at least 14 in the Robotics & Automation concentration; Robotics & Automation and the ME-General each permit 3 of the credits from a certain Engineering Technology course, EGMT216; furthermore, 400-level Math substitutions may also be used in the ME-General, limited to one).

Table 5-4: Core Engineering Component of Curriculum.

Course	Credits
General Engineering	
EGNR101 Introduction to Engineering	2
EGNR140 Linear Algebra & Numerical Appl'ns for Engrs	2
EGNR265 "C" Programming	3
Electrical Engineering	
EGEE210 Circuit Analysis	4
Engineering Mechanics	
EGEM220 Statics	3
EGEM320 Dynamics	3
Mechanical Engineering	
EGME110 Manufacturing Processes	3
EGME141 Solid Modeling	3
EGME225 Mechanics of Materials	3
EGME275 Engineering Materials	3
EGME276 Strength of Materials Laboratory	1
EGME337 Thermodynamics	4
EGME338 Fluid Mechanics	2
EGME339 Fund. of Fluid Mechanics	1
EGME350 Machine Design	4
EGME431 Heat Transfer	3
EGME432 Thermal and Fluids Lab	2
Control Systems Engineering	
EGRS460 Control Systems	4
Total	50

The EAC criterion 5 notes that "The engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering practice on the other." It will be evident from a consideration of figures 5-4 through 5-6, showing prerequisite structure, as well as figure 5-7 highlighting Math levels and 5-8 highlighting usage of the Sciences, that the Engineering Science courses are indeed based upon foundations in Mathematics and the basic Sciences. Finally, the Engineering sciences lead into practice, as is highlighted especially by the use of EGME350 Machine Design, which itself is the culmination of many earlier courses, as a prerequisite to EGNR491, the first of the senior sequence courses (conventional route).

The EAC program criterion for degrees named Mechanical Engineering specifies, furthermore, that the program "...prepare students to work professionally in either thermal or mechanical systems, while requiring topics in each area". Accordingly, the program contains substantial amounts of credit in each of those areas, as tabulated in Table 5-5; prerequisite structure within these areas is well-developed, giving the depth needed for professional work, as illustrated in fig.5-4, above.

Table 5-5: Breakdown into Thermal-Fluids and Solid Mechanics Sub-components.

Area	Credits
Thermal-Fluids Area	
EGME337 Thermodynamics	4
EGME338 Fluid Mechanics	3
EGME431 Heat Transfer	3
EGME432 Thermal and Fluids Lab	2
Sub-total	**12**
Solid Mechanics Area	
EGEM220 Statics	3
EGEM320 Dynamics	3
EGME225 Mechanics of Materials	3
EGME275 Engineering Materials	3
EGME276 Strength of Materials Laboratory	1
EGEM320 Dynamics	3
EGME350 Machine Design	4
Sub-total	**20**

Modeling, Analysis, Design, Realization. The EAC program criterion for degrees named Mechanical Engineering specifies, finally, that the program require students "to model, analyze, design, and realize physical systems, components or processes". It is the Engineering portion of the program, naturally, which accomplishes this task.

Firstly, as regards *design*, Table 5-1, above, indicates (by a check mark) those courses which contain a substantial design project.

Secondly, as regards *modeling* and *analysis*, these activities are often inseparable from corresponding design activities. Indeed, much design can be regarded as iterative, wherein modeling and analysis stages are interspersed to prove out the adequacy of design decisions made thusfar. Accordingly, many of the detailed design activities to which reference will be made in the course-specific materials will also lead the reader to modeling and analysis activities. However, it is worth noting that, in particular, intensive numerical *modeling* activities, involving algorithm writing in the context of physical systems, can be found in EGNR340 Advanced Numerical Methods, EGME431 Heat Transfer, EGEM320 Dynamics, EGME415 Vehicle Dynamics (a technical elective), EGME425 Vibrations & Noise Control (a technical elective), and EGRS460 Control Systems; less intensive such activities take place in EGEM220 Statics, EGME225 Mechanics of Materials, and EGME275 Engineering Materials, as well. Various other courses involve modeling using commercial software (e.g., FEA in EGME350 Machine Design, multi-body dynamics in EGME310 Vehicle Development and Testing, an elective). Manufacturing processes are modelled in EGRS435 Automated Manufacturing Systems (a technical elective) using commercial software, as well. Practically all Engineering Science courses at the 200-level and above involve *analysis* using hand calculation.

Finally, as regards *realization*, some ME courses require fabrication and testing of a proof-of-concept prototype product as the culmination of a design experience, such as EGME432 Thermal-Fluids Lab presently (examples of past projects: design & build of a test bench for measuring forces of water jets on flat and hemispherical plates; design & build of a test bench to measure thermal conductivities of materials; design & build of a test bench for measuring efficiencies of convective cooling fins; etc.). Most notably, however, the senior (capstone) sequence courses provide such realization, as described below in section A.6.

General Education. There is a general education component comprising 24 credits (minimum) that are not otherwise called out by the degree program. The General Education mission statement reads as follows:

> "In a diverse and changing world, college graduates must be prepared for a lifetime of learning in a variety of fields. In order to meet this challenge, general education requirements foster the development of general skills and knowledge that are further developed throughout the curriculum."

Note that the LSSU University-level perspective is that the General Education component is actually 36 credits minimum, but that definition of "General Education" also includes Mathematics and Natural Sciences courses, which, for present purposes, are not included in what is referred to as "General Education" in this report (since they are fulfilled by specific program requirements). These are broken into 4 blocks:

- a *Communications* block, consisting of two English composition courses (ENGL110, ENGL111) and a speech course (almost always COMM101, although alternatives are listed which tend to be impractical for Engineering students). The courses have the objective that students *analyze, develop, and produce rhetorically complex texts, and communicate competently in a variety of contexts*.

- a *Humanities* block, consisting of two elective courses from the humanities, including humanities, fine arts, or languages. These courses have the objective that students *analyze, evaluate, and explain human aesthetics and its historical development*.

- a *Social Sciences* block, consisting of two elective courses from areas such as history, sociology, psychology, geography, etc. These courses have the objective that students *think critically and analytically about the causes and consequences of human behavior*.

- a *Diversity* block, consisting of a single elective course. These courses have the objective that students *view the world from cultural perspectives other than their own*.

A.6 Major Design Experience

As noted above, the EAC program criterion for degrees named Mechanical Engineering specifies that the program require students to "to model, analyze, design, and realize physical systems, components or processes". Although, as noted above in section A.5, there are many courses that provide design and modeling experiences, the senior (capstone) sequence is a particularly significant contributor of these, and, above all, the course which goes furthest in providing realization. Projects, as a rule, require proof-of-concept and not mere design, usually implying that a prototype be fabricated and tested.

There are three possible paths for students to follow for their senior year capstone experience: *Industrial-path, Coop-path*, and *Research-path*; all of these paths provide a realistic design experience in an academic environment. In recent years, most students have chosen the Industrial-path, with just a few opting for the Coop path. The research path, while remaining available in principle, had been entirely inactive; however, for the first time in many years, three students are now pursuing it, having just completed the initial course in the Spring 2018 semester.

The industrial-path consists of the senior design course sequence EGNR491 – EGNR495. The initial course, EGNR491, has a strong emphasis on team and communication skills during the definition and proposal phase, and initial design phase, of a multi-disciplinary project. Then, in EGNR495, students continue to work on multidisciplinary teams to implement and engineer, i.e., realize, a final design for an industrial customer.

Alternatively, the Cooperative Education path students may substitute an equivalent design experience during their Co-op internship for the EGNR495 course (realization phase). They still take the EGNR491 course for the benefit of its academic content, and also assist one of the fully-year (industrial-based) project teams during that semester, in order to gain further project experience. While the Co-op internship is in progress, they take the courses EGNR450 and 451, with similar technical writing and oral presentation assignments to those of the industrial path courses.

Finally, the research-path students take, instead, a three-course sequence: EGNR260 – 460 – 461, of which the first (EGNR260) is largely a literature study and introduction to basic research methodologies, taken in the 2nd-semester junior year; the 460 and 461 courses are largely coincident with the 491 – 495 courses of the industrial sequence, with the same lectures, and participation in the same team / communication skills activities, but the nature of the project differs, being rather an academically-oriented research project under the direction of a faculty member. Rather than a prototype necessarily, a scientific paper (perhaps complemented by a conference presentation or poster display) is the expected tangible outcome.

The Senior Year Experience for all of these paths requires the application of student knowledge and skills acquired in earlier course work to enhance their ability to accomplish required objectives. As described above, for most students (industrial path), the senior design experience at LSSU involves participating in an intensive design project that spans *two* semesters. Students work on multidisciplinary teams (i.e., typically a mix of students from the disciplines MfgET, ME, EE, EET, and CE (Computer Engrg), often 3-7 students depending on the scope. They ordinarily design and build a product or process prototype or proof-of-concept for an industrial customer; some projects, however, are supported directly by LSSU. Typical project budgets are $5000 - $30,000, but have occasionally fallen out of that range on both ends. Example project descriptions for some projects, from the past few years, which have involved ME students, are:

- Design and build of two window-based solar systems, utilizing 3M Brand Prestige Series Window Film to reflect near infrared light onto photovoltaic cells. This not only allows for increased power output, but also provides room temperature and shading control while allowing visible light through the window. The first system is an improvement on a previous senior project, and replaces an entire window. The second system is a new design, which replaces window-mounted blinds.

- Design and implementation of a robotics training work cell in LSSU's Robotics Lab to be used for educating future engineering students, Summer camps, and demonstrations to visitors. Team CAS installed 2 KUKA industrial robots, a linear conveyor used to transport workpieces between robots, and several types of end-of-arm tooling for the robots. Team CAS also designed the layout, pallets, fixtures, and other components for the work cell. In conjunction with Team ACE, user manuals, engineering documentation, and lab exercises were created. Teams CAS and ACE will present a demonstration project that will showcase the full capabilities of this work cell and the new technologies available in the robotics industry.
- Conduct of a consulting study, sponsored by a major Canadian fully-integrated steel mill (Essar), to recommend noise abatement measures for the benefit of the facility outdoors and surrounding residential areas. The project involved diagnosis of the noise issues on the basis of extensive outdoor sound measurements, and source vibration measurements. It then made projections, using a ray acoustics outdoor sound model, of the sound reductions attainable by various proposed noise control steps (barriers, stack silencers, etc.).
- Feasibility study and conceptual design of an LNG (liquefied natural gas) bunkering barge, sponsored by a ship-building company (Moran Iron Works), which would refuel an anticipated fleet of Great Lakes vessels operating on LNG fuel. Design efforts focused on economic scaling of the barge, layout of refueling tanks and equipment, and capsize stability in Great Lakes waves, allowing for LNG sloshing in tanks, the latter phenomenon studied by simulation and wave tank experiments.
- Design of a multipurpose robot hand and tutorial guides for the application of advanced program features in an industry-standard robotics simulation software called ROBOGUIDE. The robot hand is capable of picking up two types of automotive components from a bin. The features and applications explored in ROBOGUIDE for the tutorials include machine vision capabilities, calibration, robotic path generation, and 3D bin picking. Simulation studies allows for the verification of robotics applications in the virtual world. Team ASE will demonstrate some of the advanced features in ROBOGUIDE using a FANUC LR Mate robot in the robotics lab at LSSU.
- Design and build of a laser measuring system for Mactech, Inc., that has a vision of incorporating precision measurement tools alongside its on-site services. It will be used to replace traditional dial indicators during the alignment process. The system will overcome several obstacles frequently encountered with traditional mechanical indicators, such as visibility, physical manipulation, and size constraints. The device will also be modular and wireless so that it can be attached to any machine desired by the operator, its linear adjustability will make it compatible with cylindrical objects of a given diametrical range, and will allow Mactech to observe surface quality before and after machining.
- Design and build of an automated brake pedal applier for Continental Automotive's hardware-in-loop systems. Currently, Continental uses these hardware-in-loop systems to test brake systems, but the system must have a human operator to apply the brake pedal. Team ABI's unit will be used to automate the brake testing process by controlling the position of the pedal and how much force is applied.

- Design and implementation of a robotics workcell to simulate the dispensing of Spikefast, a wood filler product, into railroad ties. A Motoman robot, using custom end of arm tooling and a machine vision system, locates the positions of spike holes on railroad ties as they move by on a continuous conveyor. This project serves as a proof of concept for future development of a wood product dispensing system in the railroad industry.

The research-path group which has just completed EGNR260 is working on a project using surface-wave seismic techniques for either obstacle detection, or for detecting oil spills under lake ice layers (of application to the regional problem of monitoring Great Lakes pipelines for winter leaks); the exact direction is still developing.

More information regarding senior design projects, including more extensive descriptions of specific projects, can be found on the School's web site at the URL https://www.lssu.edu/school-of-engineering-and-technology/senior-projects/. The senior design courses are managed by a multidisciplinary team of faculty called the senior projects faculty board (SPFB). Figure 5-9 below depicts the major activities associated with the senior design courses. The display materials available at the time of the visit will also contain portfolios of the design projects.

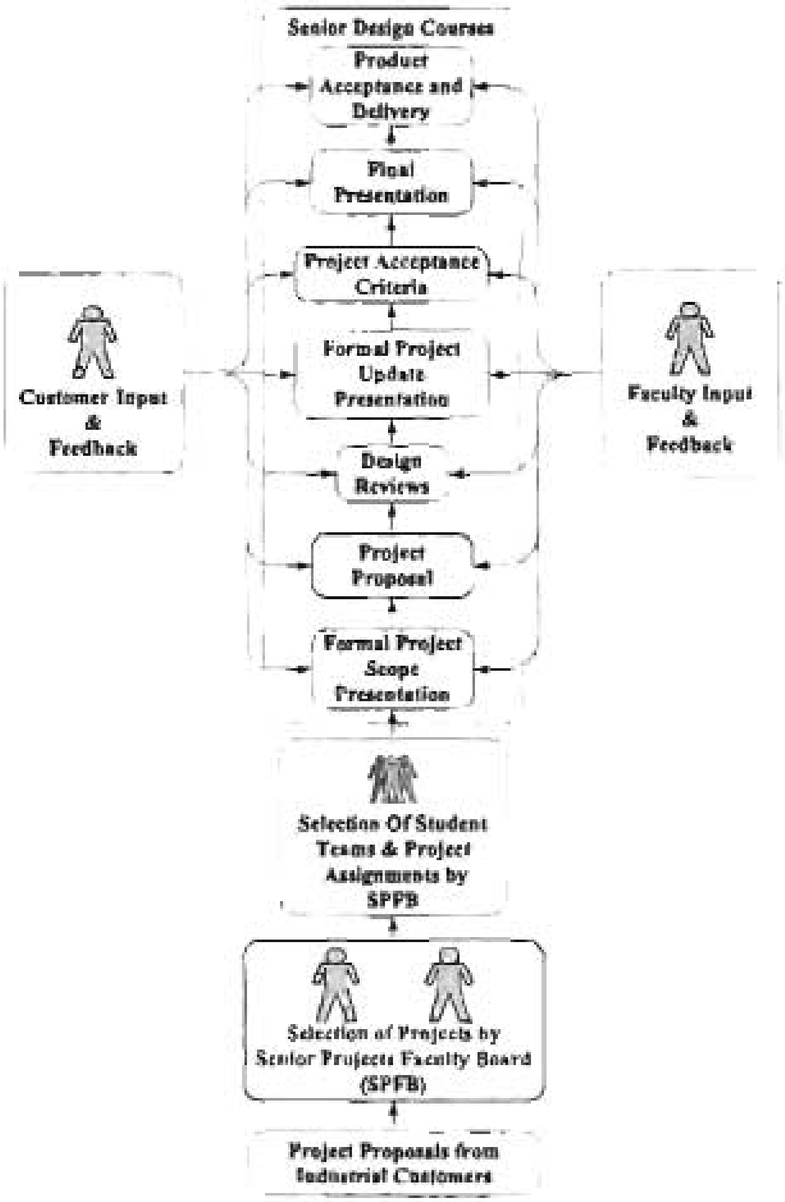


Figure 5-9. Overview of Senior Design Projects

As is evident from the process illustrated, there are several identifiable phases that put a premium on non-technical skills: multiple presentations (scope, update, final) enhance oral communications skills; written documents such as the project proposal ("project definition & plan") develop technical writing skills; customer meetings, team meetings, design reviews, etc. develop skills in running effective meetings and recording useful minutes; timeline software tools, action items and responsibility charts develop skills in time and resource management; all of these things as well as the project's design and implementation aspects, and various team assignments, all encourage the development of teamwork skills.

Evidently, as the projects are technical in nature, they require the application of the engineering skills of the student throughout; the required design and implementation tasks are the primary avenues for making use of engineering skills.

Appendix I contains the detailed syllabi for the senior design experience courses EGNR491 and EGNR495, and attachments to these.

A.7 Cooperative Education

Cooperative education opportunities exist for the engineering and technology students at LSSU. Co-op is not a large part of the curriculum, but the students may use some co-op to replace the second course in the senior (capstone) sequence, as described above. The most basic co-op course (EGNR250), which is 2 credit hours, requires that a student write a business report describing their work in the engineering field. They must also complete an evaluation of their work experience and submit an evaluation of their work performance from the supervisor. Students may also elect to use two upper level co-op classes (EGNR450 and 451, as discussed above with respect to the alternative capstone experience paths) to replace EGNR495, the second semester of senior projects (as described above). In this co-op experience, the students must complete a project at the co-op site that requires at least 60% of their time over the course of two semesters. The content of the project is approved by the co-op Coordinator and the Senior Projects Faculty Board (SPFB). The academic requirements for the projects are very similar to those of the projects completed by the students in the senior design experience on campus, including graded presentations and written reports. The SPFB reviews the major documents submitted by the student to fulfill the course requirement.

B. Course Syllabi & Review Materials

For more detailed information on specific courses listed in Table 5-1, note that all courses have detailed syllabi. Examples of the detailed syllabi of *some* courses are collected, as examples, in appendix I; such syllabi are updated with each course offering, and electronic copies are kept on the Engineering network (y:/-drive), so that such detailed syllabi, comprehensively for all Engineering courses going at least a dozen years back, remain available for review.

More concise syllabi for *all* courses in the program are provided in Appendix A. Each of these syllabi contain the following elements:

1. Course number and name
2. Credits and contact hours
3. Instructor's / course coordinator's name
4. Text book, title, author, and year, and any other supplemental materials
5. Specific course information
    a. brief description of the content of the course (catalog description)
    b. prerequisites and/or co-requisites
    c. whether a required, elective, or selected elective course in the program
6. Specific goals for the course
    a. specific outcomes of instruction (course objectives)
    b. which of the student outcomes are addressed by the course.
7. Brief schedule of course topics/activities

A general list of material to be available for review by the EAC of ABET team is shown below, with **bold text** for items of particular relevance for demonstrating that the curriculum has the elements specified by criterion 5, and that procedures enforce prerequisite sequences:

- Course Binders Containing all Course Information
    - **Detailed Course Syllabus**
    - **Course Assessment Summary**
    - **Course Prerequisite Form (affidavit students sign testifying to satisfactory fulfillment of pre- and corequisite courses)**
    - Course Handouts (possibly lecture notes, supplemental handouts, etc.)
    - **Examples of Student Work (homework, exams, quizzes, lab reports and/or worksheets, drawings, programs, etc.)**
- **Senior Projects Portfolios**
- Student Outcome Reports (most recent)
- Industrial Advisory Board Information
- School Meeting Agendas and Minutes
- Department Meeting Agendas and Minutes
- **LSSU Catalog** (electronic only)
- Senior exit interviews

CRITERION 6. FACULTY

The School of Engineering and Technology (SET) contains positions for ten full-time faculty, two laboratory engineers, and a consulting engineer (with one of the lab engineers serving part-time as a second consulting engineer). School and program leadership rests with key faculty members who perform these functions on a release time basis. The School faculty work very well together as a combined team on school-related items. For purposes of program direction and planning, the School faculty members also meet as two separate departments: 1) Department of Electrical and Computer Engineering (ECE), and 2) Department of Mechanical Engineering (ME). The Mechanical Engineering program is housed within the Department of Mechanical Engineering, which is comprised of four full-time faculty members, and one laboratory engineer, and functionally (although not reflected formally in the organizational chart) a fifth faculty member, who is actually allotted to a separate Engineering Technology department, but ordinarily participates in ME meetings, bringing especially the MfgET and Robotics/Automation perspectives. It should be noted that due to the retirement of one of the ECE faculty members, the ECE department has been operating for the 2017-2018 academic year with only 4 full-time faculty members, and the School therefore has been operating with only 9 full-time faculty members. A search is presently in progress to fill the open ECE faculty position.

Because of its small size, the School of Engineering and Technology offers engineering curricula that are significantly impacted by the other engineering disciplines in the School and also receive a significant amount of instruction from the faculty in the Department of Math and Computer Science. By the time they leave LSSU, Mechanical Engineering graduates, for example, will have taken classes taught (or team-taught) by most of the ten-person School of Engineering and Technology faculty. Furthermore, much of the continuous improvement process occurs at the School level, in which the entire School of Engineering and Technology faculty participate. Hence, the discussion provided on the faculty in this section will include all members of the School faculty; however, special attention will be paid to the Department of Mechanical Engineering faculty which directly administers the Mechanical Engineering program.

LSSU is dedicated to its primary mission as a teaching institution by offering challenging undergraduate programs and services to students. In recognition of this mission, all members of the LSSU faculty are required by the University contract to devote 50-75% of their efforts during the academic year toward student learning activities and an additional 10-20% towards advising/student support activities. The remaining effort is directed towards scholarly and creative activities (5-20%) and service to the institution, profession, and/or general community (10-20%). The emphasis on teaching will come out in the subsequent sections, especially in Faculty Qualifications, Faculty Workload, and Authority and Responsibility of Faculty.

A. Faculty Qualifications

The Mechanical Engineering program at LSSU, like the Electrical Engineering and Computer Engineering programs, can be characterized as one that emphasizes the fundamentals of engineering, traceability of theoretical results to first principles, applications of theory, and a heavy laboratory component that coordinates with the theoretical content. The faculty members instructing the program, consequently, generally share these philosophical precepts as regards engineering education.

Faculty Hiring. Consistent with the institution's primary mission of teaching, and the School's philosophy of maintaining an applied emphasis in its engineering and technology programs, the evaluation process employed in the hiring of new faculty accordingly places somewhat more emphasis on a candidate's philosophy of engineering education, promise as an instructor, and industrial experience, than it does on academic research credentials.

A candidate for the School of Engineering and Technology faculty is generally expected to have some teaching experience (either as faculty member or a teaching assistant) and to possess excellent communication skills. Each candidate is asked to give a sample lecture (on a topic specified by the hiring committee chair and generally kept the same for all visiting candidates) during the on-campus interview. This lecture is ordinarily given to both students and faculty. Feedback is thereafter solicited from those in attendance, and is given much weight in the subsequent hiring decision.

A.1 Faculty Composition.

As was noted before, the Mechanical Engineering graduates are affected by nearly all the faculty in the SET due to the small size of the School and the interwoven nature of the engineering disciplines. Some faculty primarily teach courses that are required in the Mechanical Engineering program, while other faculty interact with Mechanical Engineering students through their participation in project-based courses such as EGNR-101 *Introduction to Engineering* or the EGNR-491-495 *Senior Design Projects I and II* capstone sequence. Background information is therefore presented for all faculty members in the SET below in Table 6-1 with a special note to those that routinely participate in the ME departmental meetings.

An overview of the nine full-time and four adjunct faculty members of the School of Engineering and Technology in Table 6-1 indicates the following:

- All faculty members have appropriate BS degrees in engineering or engineering technology
- All full-time faculty members have appropriate advanced degrees in CE, EE, or ME to teach courses in the respective programs
- An average of 5.6 years of government and industrial experience
- An average of 14.9 years of teaching experience
- 11% of full-time faculty members are licensed Professional Engineers

- A medium level of professional society involvement
- A medium-high level of professional development
- A medium-low level of consulting and other industrial involvement

Table 6-1: Faculty Qualifications

School of Engineering & Technology

Faculty Name	Highest Degree Earned- Field and Year	Rank [1]	Type of Academic Appointment[2] T, TT, NTT	FT or PT[3]	Years of Experience			Professional Registration/ Certification	Level of Activity[4] (H, M, or L)		
					Govt./Ind. Practice	Teaching	This Institution		Professional Organizations	Professional Development	Consulting/ summer work in industry
Baumann, David (ECE)	PhD, EE, 1992	P	T	FT	4	25	19	Michigan	L	L	L
Jones, Andrew (ECE)	PhD, ECE, 2002	ASC	T	FT	0	19	13		M	M	H
Moening, Joseph (ECE)	PhD, EE, 2010	ASC	T	FT	0	13	8		M	H	L
Weber, Paul (ECE)	PhD, EE (CE), 2006	ASC	T	FT	1	12	9		M	M	M
King, Jeff (ECE)	BS, EET, 1996	A	NTT	PT	4	20	20		L	M	L
Becks, Eric (ECE)	MS, EE, 1981	A	NTT	PT	37	8	10		M	M	H
Devaprasad, Jim	MS, ME, 1986	P	T	FT	1	32	32		H	H	M
Hildebrand, Robert	PhD, Acoustics, 2001	ASC	T	FT	4	19	13		M	M	L
Leach, David	MS, ME, 2018	I	TT	FT	18	7	7		L	M	H
Mahmud, Zakaria	PhD, ME, 2003	ASC	TT	FT	1	15	4		M	M	L
Zarepoor, Masoud	PhD, ME, 2016	AST	TT	FT	0	2	2		H	H	M
Huff, Jordan	BS, ME, 2017	A	NTT	PT	1	0.5	1		M	M	H
Finley, David (Dean, 2017-2018)	PhD, ChemE, 1996	P	NTT	FT	7	12	6	Indiana	H	H	L
Muller, Kimberly (Dean, Starting Fall 2018)	PhD, Mathematics, 2004	P	T	FT	0	24	14		M	H	L

1. Code: P = Professor ASC = Associate Professor AST = Assistant Professor I = Instructor A = Adjunct O = Other
2. Code: TT = Tenure Track T = Tenured NTT = Non Tenure Track
3. FT = Full Time Faculty or PT = Part Time Faculty, at the institution.
4. The level of activity, high, medium or low, should reflect an average over the three years prior to the visit.

A.1.1 Departments of Mechanical Engineering & Manufacturing Engineering Technology Faculty

As will be demonstrated in this section, the ME faculty is, furthermore, mutually complementary in their mix of competencies, and, these span the Mechanical Engineering discipline as traditionally understood. They bring a blend of educational and professional experience. Given below is a brief description of each member of the ME faculty, including strengths and the faculty member's relationship to curricular areas.

Dr. Robert Hildebrand (ME Professor)

Dr. Hildebrand has research and publication background in the areas of noise and vibrations, vehicle dynamics, and soil dynamics. He has a good mix of industrial, consulting, research and teaching experience, often with a particular emphasis on editing and translating work. Accordingly, he strongly supports the program's emphasis on applications of fundamentals, on laboratory instruction, and on communications. He regularly teaches EGME-275 Engineering Materials, EGME-276 Strength of Materials Lab (co-taught), EGME-310 Vehicle Development & Testing, EGNR-310 Quality Engineering, EGEM-320 Dynamics, EGME-350 Machine Design, EGNR-340 Numerical Methods, EGME-415 Vehicle Dynamics, and EGME-425 Vibrations & Noise Control, regularly serves as a senior project faculty advisor, and has often team-taught MATH-310 Differential Equations. Dr. Hildebrand is the coordinator of the Department of Mechanical Engineering.

Prof. James Devaprasad (ME/MfgET Professor)

Prof. Devaprasad has been a professor in the School of Engineering and Technology at LSSU for 32 years. His areas of teaching emphasis include robotics and automation. He was the Coordinator or Chair of Manufacturing Engineering Technology for much of that time, and has also served as Chair of the School of Engineering and Technology for a time while the Dean position was vacant. He is currently the coordinator of General Engineering and Technology as well as the director of LSSU's Robotics Center.

Prof. Devaprasad has been the leader in developing the robotics laboratory through industrial donations and grants, and has been in key leadership roles nationally in the Society of Manufacturing Engineers (SME) and the Robotics Industries Association. He normally teaches several robotics courses in both the engineering and engineering technology curricula and often serves as the advisor or customer for robotics senior projects. He also supports the Robotics Technology minor available for the Engineering Technology students and Computer Science students. He is a recipient of the Outstanding Young Manufacturing Engineer award from SME and the distinguished faculty award from the Michigan Association of Governing Boards of universities. He serves as the director of the Women in Technology summer camps and the Robotics summer camps that he and his colleague founded over 27 years ago. He also led the successful initiative to create a B.S. in Robotics Engineering during the Spring 2018 semester.

Mr. David Leach (ME Instructor)

Mr. Leach started working for the LSSU Product Development Center in 2008, and became a full time faculty member in 2014. He has MS and BS Mechanical Engineering degrees from Michigan Technological University, and is currently enrolled in MTU's doctoral mechanical engineering program, with an expected start date of Spring 2019. Mr. Leach's areas of interest include CNC machining, manufacturing processes, product development, plastics design, lean manufacturing, quality systems, and manufacturing sustainability. David primarily teaches EGME-141 Solid Modeling, EGME-240 Assembly Modeling and GD&T, EGME-110 Manufacturing Processes, EGMT-216 CAM with CNC Applications, EGMT-225 Statics and Strength of Materials, and EGNR-491/495 Senior Projects. He has automotive industry experience in product and quality engineering for Class A exterior plastic trim. Mr. Leach is our cooperative education coordinator and is responsible for our co-op sequence of courses: EGNR-250, EGNR-450, and EGNR-451. David is also the faculty advisor for Tau Kappa Epsilon (TKE), a service fraternity at LSSU.

Dr. Zakaria Mahmud (ME Professor)

Dr. Mahmud has a BS in Mechanical Engineering from Bangladesh University of Engineering and Technology (Dhaka, Bangladesh), MS in Sustainable Energy Engineering from The Royal Institute of Technology (Stockholm, Sweden), and PhD in Engineering Science and Mechanics from the University of Alabama (Tuscaloosa, Alabama). After graduation, he taught for one year in Aerospace Engineering Department at Texas A & M University (College Station, TX). He then led NASA SBIR phase II project as Principal Research Engineer at Techsburg Incorporated (Blacksburg, VA). Dr. Mahmud then taught in Mechanical Engineering Technology program at Georgia Southern University (Statesboro, GA). Before joining in LSSU since Fall 2014, he taught for seven years in Mechanical Engineering at North Dakota State University (Fargo, ND). His primary research interests are in the areas of experimental aerodynamics and micro-fluidics. He regularly teaches the following courses at LSSU: EGNR 101 Introduction to Engineering, EGNR-140 Linear Algebra and Numerical Applications, EGME-337 Thermodynamics, EGME-338 Fluid Mechanics, EGME-431 Heat Transfer, and EGME-432 Thermal Fluids Laboratory. Dr. Mahmud is serving as a co-advisor for Engineering house and advisor for the Society of Automotive Engineers (SAE).

Dr. Masoud Zarepoor (ME Professor)

Dr. Zarepoor received his BS in Mechanical Engineering from Shiraz University. He pursued his graduate studies by receiving MS and PhD degrees in Mechanical Engineering from Wright State University and Old Dominion University, respectively. His PhD research was focused in the areas of vibrations, nonlinear dynamics, bistable structures, and piezoelectric materials. He joined LSSU in 2016 as an Assistant Professor in Mechanical Engineering, where he teaches Statics, Mechanics of Materials, Vibrations, and Finite Element Analysis courses. He also continues his research works in the area of vibrations and piezoelectric actuation of bistable structures at LSSU and serves as the Faculty Advisor for the ASME student chapter at LSSU.

Mr. Jordan Huff (ME Lab Engineer)

Mr. Huff is a full-time mechanical laboratory engineer for the School of Engineering and Technology. He has a BS ME degree from LSSU and has experience in manufacturing as well as vehicle development and testing. Prior to earning his bachelor's degree, he was self-employed and restored vehicles. He supports both mechanical and manufacturing aspects of the program and is active in professional groups such as SAE (Society of Automotive Engineers). Mr. Huff also provides mechanical engineering support for LSSU's Product Development Center and has also served as an adjunct lab instructor for the manufacturing and processes course.

ME Faculty Composition in Light of ME Program Criteria. It will be evident from the descriptions above, that the ME faculty composition contributes to satisfaction of the curriculum aspects of the ME program criteria. These call for required content in both thermal and mechanical systems; indeed, Dr. Mahmud, especially, provides the required competence in thermal systems, and Drs. Hildebrand and Zarepoor, especially, in solid mechanics / mechanical systems, each with the ability to provide some level of back-up in the opposite sub-field. The criterion also calls for application of modeling, analysis, design, and realization; there is a breadth of professional experience in each of these kinds of activities when the full set of ME faculty is considered, and that is further complemented by experience from the ECE faculty (see below).

Finally, the faculty aspect of the ME program criteria calls for maintenance of currency in specialty areas by those faculty "responsible for the upper-level professional program". The reader can find more comprehensive, and detailed, listings of full professional development activities in the CV's in appendix B. However, a few examples are provided here to demonstrate PD activities directly connected to the faculty's respective specialty areas:

- Dr. Zarepoor (participating in the upper level courses EGME350, EGME442, EGME425, EGNR491, and EGNR495) has maintained an aggressive publication program since joining LSSU in Fall 2016, with 2 conference papers and a journal article in that time span, and one more of each going back an additional year. All of these are in his specialty area of vibrations, broadly, smart materials more specifically.
- Dr. Mahmud (participating in the upper level courses EGME337, EGME338, EGME431, EGME432, and EGME442) has also published a journal article in fluid mechanics within the last 6-year cycle, and has reviewed a journal article in 2017.
- Dr. Hildebrand (participating in the upper level courses EGNR340, EGME350, EGME415, EGME425, EGNR491, and EGNR495) has consulted with the Finnish railways on seismic survey technique, leading to publication, and has often in recent years served in editorial roles in such specialty areas as railway noise, ground vibrations, wave barriers, etc.
- Prof. Devaprasad (participating in the upper level courses EGNR491 and EGNR495) has been involved in a wide range of robotics workshops, conferences, tours, and industry interaction, fully detailed in his CV, but including for instance: Mechatronics workshop at

NYU (2016), Robotics industry forum in Orlando (2017), AUTOMATE 2015 conference in Chicago, etc.

- David Leach (participating in the upper level courses EGRS385, EGRS435, EGNR491, and EGNR495) has obtained an advanced degree, i.e., an MS degree in Mechanical Engineering, 2018, from Michigan Technological University, Houghton; he has since enrolled in their doctoral program. He has also attended workshops, including the NIMS Machining Level I certification.
- Jordan Huff (participating in the upper level courses EGNR491, and EGNR495) has, like David Leach above, also attended a workshop to obtain NIMS Machining Level I certification.

A.1.2 Department of Electrical and Computer Engineering Faculty

The following faculty members from the ECE Department provide teaching and key ancillary support for the ME program:

Dr. David Baumann, P.E. (ECE Professor)

Dr. Baumann has BS, MS, and PhD degrees in Electrical Engineering and an MS degree in Statistics from the University Wisconsin. As a graduate student he worked under the direction of Dr. R. A. Greiner in the Electro-Acoustics Laboratory. His research involved acoustic monitoring of machinery condition and active attenuation of noise in air ducts. He has four summers of research experience at the Naval Surface Warfare Center involving active vibration control of submerged propellers. He taught for 6 years at Oral Roberts University and has now taught for 19 years at LSSU. He has expertise and teaches courses in the areas of Electromagnetics, Control Systems, Circuits and Signals, Probability and Statistics, and Power Distribution. He served several years as the coordinator of the Senior Projects Faculty Board and the coordinator of the Department of Electrical and Computer Engineering and served the past six years as the Chair of the School of Engineering and Technology.

Dr. Andrew Jones (ECE Professor)

Dr. Andrew Jones joined LSSU during the 2005-2006 academic year. He has degrees in Electrical Engineering (BS/MS) and in Computer Engineering (PhD). He previously taught at Purdue University for three years. Dr. Jones has research experience in digital and micro-controller systems as applicable to mobile robotics systems. He primarily teaches courses in robotics, software development, digital electronic and micro-controller areas and was awarded with the LSSU Distinguished Teacher Award in 2010. Dr. Jones has also engaged in applied research activities with entrepreneurs interested in developing electronic products as well as consultations for industrial companies. He is also involved with FIRST with coordinating local FLL (FIRST Lego League) tournaments and mentoring the local FRC (FIRST Robotics Competition) team. He is the advisor for the LSSU chapter of IEEE. Dr. Jones is the coordinator of the Department of Electrical and Computer Engineering.

Dr. Joseph Moening (ECE Professor)

Dr. Moening has been at LSSU since the start of the 2010-2011 academic year. He has BS, MS, and PhD degrees in Electrical Engineering from the University of Toledo. His areas of interest include power electronics, renewable energies, semiconductor devices, analog electronics and micro/nano-device fabrication. He primarily teaches courses related to these areas. He has research experience in laser-based micro-structuring of thin films as well as power processing systems. His is the co-advisor for the Engineering House.

Dr. Paul Weber (ECE Professor)

Dr. Weber has a BS in Computer Engineering, and MS and PhD degrees in Electrical Engineering from Michigan Technological University. While at Michigan Tech, his primary research was in the area of fault-tolerant distributed control algorithms for safety-critical systems (e.g. fly-by-wire aircraft control). After finishing graduate school, he taught for three years as a Visiting Assistant Professor at University of Minnesota Duluth. During his time there, he also developed research in the areas of energy and engineering education, which he has continued while at LSSU since joining the faculty in the fall of 2009. Dr. Weber's primary teaching expertise is in digital design and embedded systems. He is currently the coordinator for Senior Projects and began serving as the Chair for the School of Engineering & Technology during the Spring 2018 semester.

Mr. Eric Becks (ECE Consulting Engineer)

Mr. Becks earned his BS and MS in Electrical Engineering/System Science from Michigan State University. Prior to joining the LSSU Product Development Center (PDC), Eric Becks was involved in industrial and entrepreneurial activities. His work experience ranges from Engineering Manager in a multi-national company to President of a diagnostic equipment manufacturing firm. Mr. Becks was involved in the formation of real estate, retail, internet marketing and manufacturing businesses as well as negotiating a leveraged buy-out. He has designed numerous products including several that have received industry awards. Besides his duties at the PDC, Mr. Becks also serves as Director of Intellectual Property & Economic Development for LSSU and President & CEO of SSMart^{SM}, Inc., the Sault Ste. Marie/LSSU SmartZone. He has also served as a school board member for 14 years; 12 as president.

Mr. Jeff King (ECE Lab Engineer)

Mr. King is a full-time laboratory engineer for the School of Engineering and Technology. He has a BS degree in Electrical Engineering Technology from LSSU, and is pursuing a BS degree in Mathematics from LSSU on a part-time basis. He has valuable professional engineering experience in industrial electrical controls and PLCs, and is responsible for the School's electronic and computer systems. He occasionally teaches as an adjunct in the areas of electrical circuits, electronics, and PLC's for the engineering technology programs in the School and has instructed sections of the digital fundamentals laboratory. He also assists significantly in the senior design projects on the PLC and electrical design and implementation aspects.

B. Faculty Workload

The faculty member is understood to have duties in instruction (encompassing teaching, office hours, advising, and student support/mentoring), "professional development" (encompassing research and scholarly work), and service (to the University—including the School and the Department, to the Profession, and/or to the Community as outreach).

The instructional portion, specifically, is fulfilled by instructing coursework amounting to 24 contract hours per year (or an average of 12 per semester), where "contract hours" are defined below. Although faculty members are considered full time if teaching at least 24 contract hours per year (average of 12 or more contract hours per semester), professional development and scholarly work are duties that fall outside the 24+ measured contract hours.

B.1 Definition of Contract Hours

Faculty time commitment is measured contractually in contract hours (also "load hours"), which are *not* identical to credit hours earned by a student. A student earns a *credit* hour for each hour of lecture per week, and an additional credit hour for a 1-3 hour lab. On the other hand, one *contract* or *load* hour is one hour of lecture or 1.5 hours of lab (i.e., the actual lab time is multiplied by 2/3 to generate contract hours).

The time distribution of the faculty member's workload (implied based on proportionality to the contractually allowable weights given in the supervisory evaluation of the faculty member) is 50-75% for the student learning activities (corresponding primarily to the 24 load hours per year), 10-20% "advising/student support activities," 5-20% scholarly and creative activities (including research), and 10-20% University/School/Departmental/Community service. In a few cases, such as very heavy advising loads and special lab/research director appointments, contract load may be given for activities besides courses.

B.2 Instructional Workload

The amount of time and energy that faculty are expected to provide to an engineering program greatly influences the general strength of the program. Typical indicators of workload include contract hours, and student-to-faculty ratios (reflective of typical class and lab enrollments). A detailed list of instructional duties of the individual ME faculty members (the four current full-time ME faculty members, one full time Engrg Technology faculty member, and one ME laboratory engineer/consulting engineer) is shown in Table 6-2. A broad overview of the instructional workload broken down by group (regular faculty, lab engineers, etc.) meanwhile is shown in Table 6-3.

Table 6-2 (*a*): *Faculty Workload Summary, Fall Semester*

School of Engineering & Technology

Faculty Member	PT or FT[1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to Program[5]
			Teaching	Research or Scholarship	Other[4]	
Baumann, David (ECE)	FT	F2017: EGEE280 (4), EGNR346 (1), EGRS460 (4)	75%		25% SET Chair	75%
Jones, Andrew (ECE)	FT	F2017: EGEE250 (4), EGNR101 (2) Team, EGNR265 (3), EGRS380 (2)	92%		8% ECE Coordinator	100%
Moening, Joseph (ECE)	FT	F2017: EGEE210 (4) Lec, EGEE330 (4), EGEE370 (4) Lab, EGRS365 (3)	100%			100%
Weber, Paul (ECE)	FT	F2017: EGNR261 (3), EGNR361 (1), EGNR491 (3) Lec & Crd, EGRS430 (4)	100%			100%
Becks, Eric (ECE)	PT	F2017: EGNR491 (3) Adv&Lec, EGEE370 (4) Lec	15%		50% PDC Engineer 35% Assoc Dean	85%
King, Jeff (ECE)	PT	F2017: EGNR491 (3) Adv, EGEE210 (4) Lab	10%		90% Lab Engineer	100%
Devaprasad, Jim	FT	F2017: EGRS381 (1), EGRS480 (3), EGRS481 (1), EGRS496 (3), EGNR491 (3) Adv	62%		30% Robotics Center Coordinator 8% Eng. Tech. Coordinator	100%
Hildebrand, Robert	FT	F2017: EGNR340 (1), EGNR491 (3) Adv, EGEM320 (3), EGME350 (4) Team	80%	12% Scholarship	8% ME Coordinator	100%
Leach, David	FT	F2017: EGME110 (3), EGME141 (3), EGNR490 (4) Adv, EGNR491 (3) Adv	100%			100%
Mahmud, Zakaria	FT	F2017: EGNR101 (2) Team, EGNR140 (2), EGME431 (3), EGME432 (2)	100%			100%
Zarepoor, Masoud	FT	F2017: EGEM220 (3), EGME350 (4) Tm, EGMT225 (4), EGNR495 (3) Adv	75%	25%		100%
Huff, Jordan	PT	F2017: None	10%		70% Lab Engineer 20% PDC Engineer	100%
Finley, David (Dean, 2017-2018)	N/A	F2017: None	0%		100% Dean and Interim Provost	25%
Muller, Kimberly (Dean, Start: Fall 2018)	FT	F2017: MATH111 (3), MATH151 (4)	75%	5%	20% Math & CS Chair	0%

Key: Lec = Lecture Only; Lab = Lab Only; Crd = Coordinator; Tm = Team Taught, Adv = Project Advisor

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the Self-Study Report is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution

Table 6-2 (*b*): Faculty Workload Summary, Spring Semester

School of Engineering & Technology

Faculty Member	PT or FT[1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to Program[5]
			Teaching	Research or Scholarship	Other[4]	
Baumann, David (ECE)	FT	S2018: EGEE210 (4), EGEE411 (3), EGNR340 (1), EGNR490 (1)	87.5%		12.5% Faculty Senate	87.5%
Jones, Andrew (ECE)	FT	S2018: EGEE355 (4), EGNR265 (3), EGRS215 (2), EGRS385 (4) Lec	92%		8% ECE Coordinator	100%
Moening, Joseph (ECE)	FT	S2018: EGEE475 (4), EGRS365 (3)	100%			100%
Weber, Paul (ECE)	FT	S2018: EGEE125 (4), EGNR495 (3) Crd, EGRS385 (4)Lab	75%		25% SET Chair	75%
Becks, Eric (ECE)	PT	S2018: EGNR245 (3), EGNR495 (3) Adv	15%		50% PDC Engineer 35% Assoc Dean	85%
King, Jeff (ECE)	PT	S2018: EGNR495 (3) Adv	10%		90% Lab Engineer	100%
Devaprasad, Jim	FT	S2018: EGRS385 (3) Lab, EGRS435 (3), EGNR495 (3) Adv	62%		30% Robotics Center Coord. 8% Eng. Tech. Coordinator	100%
Hildebrand, Robert	FT	S2018: EGNR260 (2), EGNR490 (1), EGNR495 (3) Adv, EGME275 (3), EGME276 (1), EGME425 (4)—Team	80%	12% Scholarship	8% ME Coordinator	100%
Leach, David	FT	S2018: EGME110 (3), EGME240 (3), EGNR495 (3), EGMT216 (3)	100%			100%
Mahmud, Zakaria	FT	S2018: EGNR140 (2), EGME337 (4), EGME338 (3)	100%			100%
Zargoor, Masoud	FT	S2018: EGEM220 (3), EGME225 (3), EGME425 (4) Tm, EGME276 (1), EGNR495 (3) Adv, EGME141 (3)	75%	25%		100%
Huff, Jordan	PT	S2018: EGME110 (3) Lab	10%		70% Lab Engineer 20% PDC Engineer	100%
Finley, David (Dean, 2017-2018)	N/A	S2018: None	0%		100% Dean and Interim Provost	25%
Muller, Kimberly (Dean, Start: Fall 2018)	FT	S2018: MATH152 (4), MATH207 (3)	75%	5%	20% Math & CS Chair	0%

Key: Lec = Lecture Only; Lab = Lab Only; Crd = Coordinator; Tm = Team Taught, Adv = Project Advisor

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the Self-Study Report is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.

Table 6-2. Faculty Workload Summary

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the Self-Study Report is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.

Table 6-3: SET Faculty Workload Overview for 2017-2018

	Instruction Only		Instruction + Release	
Instructional Subgroup	Load Hours	Percentage	Load Hours	Percentage
Full-Time Faculty (active)	242.79	89.8%	271.64	90.5%
Full-Time Faculty (on sabbatical)	0	0%	0	0%
Lab Engineers	13.39	5.0%	14.14	4.7%
PDC Engineers	14.03	5.2%	14.43	4.8%
External Adjuncts	0	0%	0	0%
Total	270.21	100%	300.21	100%

For the regular faculty, a full-time teaching load is 12 contract hours (or sometimes "load hours") per semester, with the option to take on up to 6 additional load hours per semester with "overload" compensation at a reduced rate. A faculty member may fall under 12 for a given semester, if compensated in the same academic year by an overload in the other semester, such that 24 contract hours are performed per year. Single semester loads are limited to 18, and annual (excluding summer) loads to 32.

The average School-wide load for the full-time faculty during the 2017-2018 academic year was 15.1 load hours per semester (i.e., an average of 3.1 hours of overload), and about 90% of the instruction was provided by them. Note that the situation was unusual that year, however, because a faculty member was retired and was not filled immediately (as of the time of this report, the search for a new faculty member is still on-going). In the 2015-2016 academic year, for comparison, the average load had been 13.4 load hours per semester. Furthermore, if the present year's load were divided by 10 full-time faculty members, instead of 9, the average load per semester would be 13.6 load hours per semester. Furthermore, the student-faculty ratio for courses in the School of Engineering and Technology in the Spring 2018 semester was approximately 16:1. With faculty research commitments less than is traditional in academia, no supervision of graduate students, and reasonable limits on other non-instructional activities as outlined below, adequate faculty coverage for quality teaching and student interaction is thereby assured.

The teaching load limits, and the general goals of keeping faculty near to the nominal load of 12 hours per semester and of maintaining a healthy student-to-faculty ratio, are intended to allow faculty members time to participate in non-classroom, professional activities as well as provide for quality student interaction and class preparation. Thus, beyond the expectations for teaching, faculty are also expected to hold regular office hours, and to participate in academic advising, student group advising, service activities, and professional development.

B.3 Office Hours and Advising

All regular, full-time faculty keep 5 office hours per week, at which they are available to meet students; those teaching less than full-time (e.g., the lab and PDC engineers) have numbers of office hours that are pro-rated by their respective fractions of a full-time teaching load. These office hours permit students to interact with the faculty member to supplement in-class instruction. In the last few years, moreover, the University has reinstated recitation sections in some problem-solving courses, for which faculty provide a one-hour recitation and are accordingly relieved of an hour of office hour burden. Thus, the standard is that the total of recitation hours and office hours add up to 5 per week (note that no faculty currently have so far had more than 1 recitation hour per semester, and exceeding 2 recitation hours per faculty member per semester will be discouraged should that situation ever arise, in order that the number of general office hours will remain adequate).

Academic advising, in its aspect as a service to students, is described above. Concerning, on the other hand, its aspect as a faculty activity and time burden, note that the approximately 180 students enrolled in the School are divided amongst the 9 fulltime faculty members as advisees, so that the average is about 20 advisees per faculty member. The advising duties of the faculty member are to meet with each advisee prior to registration, recommend courses for which to register, and discuss course selection alternatives from the perspectives of progress to degree completion, student interests, and career relevance. As a benchmark, 15-minute advising sessions are used for freshmen students in EGNR-101 *Introduction to Engineering* (for students in that course only, these are scheduled during a specific lab session). Thus, an estimate of 4-5 hours of ordinary advising burden per faculty member per semester is reasonable; there is also some additional burden on the program coordinators and the school chair, specifically, in handling supplemental advising related to course overrides, transfer credit evaluation, and waivers, but this phenomenon is compensated through the release time adjustments to the 12-hour full-time load.

Faculty members also advise senior project teams, which provide a substantial amount of additional interaction with students and their respective industrial sponsor contacts in a realistic professional setting. Certainly, advising of senior projects teams is another time-consuming activity for faculty that resembles some of the out-of-classroom student interaction activities described above, but in principle, since this activity is compensated by teaching load from the EGNR-491 and EGNR-495 courses, it is more properly seen as part of team-teaching those courses.

The office hour and academic advising burdens are implied extensions of the instructional component of the faculty members' duties; they do not generate additional contract hours with the exception of extreme cases where 50 or more advisees are assigned to a single adviser, but are rather understood to be a part of the duties inherent in fulfilling the 24 load hours.

B.4 Release Time Assignments

Certain leadership roles within the School or the Departments (school chair, program coordinators) or within team-taught courses (lab section coordinators, senior projects board chair) *do* provide "release time" contract hours which may be counted towards the 24 contract hour per year requirement. These assignments are described in detail in section 8-A, Authority and Responsibility of Faculty.

B.5 Non-Instructional Workload

The 24-load hour requirement, described above, may be understood to comprise (with the exception of release time appointments) the *instructional* part of the faculty member's duties, only. Outside of the 24 load hours fall the additional duties of service and scholarship. As noted previously, this may be up to 40% of the faculty member's workload (scholarship up to 20%, and service up to 20%). This is an adjustment from 6 years ago when 100% of a faculty member's time could be devoted to teaching for a given year, although there was always an expectation of accomplishment in both the service and the scholarship categories by the time of tenure and promotion decisions.

Professional development activities, by their nature, vary considerably in kind and scope from faculty member to faculty member; the reader is referred to the faculty CVs in appendix B below, for specifics.

Service activities, also vary in kind and scope among faculty members, especially with regards to service to the general Community. However, many of the other service activities are School-coordinated to such an extent that a rough overview can be given. Faculty members within the School regularly serve on University-wide committees (e.g., curriculum, general-education, student retention, etc.), serve on School committees (e.g., Engineering scholarship awards committee), support the faculty association, and participate in assessment. Each faculty member has a unique, measurable, responsible role in the School's assessment program (e.g., assessing a performance indicator for a specific student outcome). There are also initiatives within the School, and LSSU, to increase new student enrollment, by means such as high school visit and lab tours, each of which represent common service activities of the faculty. Faculty members serve as advisors to student chapters of national professional organizations, including SAE, ASME, IEEE, and SWE; serving as such an advisor generally involves overseeing that the clubs operate within their bylaws, recruit, fundraise, manage their budgets, and participate in regional and national events. Faculty members occasionally participate, finally, in summer orientations, although the Chair has usually undertaken the majority of this particular burden.

C. Faculty Size

As noted above, in Table 6-3, the 10 faculty (even in the absence of one due to retirement) were able to cover almost 90% of the instructional burden, and with only a moderate amount of overload per semester (3.1 contract hours average) and reasonable class sizes (average around 16). All of these figures are the same or better when the full set of faculty members are present for the full academic year, which is the ordinary situation.

All faculty maintain at least 5 hours of some combination of office hours and recitations (in practice, the latter has never exceeded 1 of the 5 hours for any faculty member). Senior student exit surveys consistently support the notion that these interactions are not only sufficient in quantity, but also in quality; a consistent theme is that students have excellent and fruitful access to faculty members.

Each student has a faculty member assigned as an academic advisor, and meets with the faculty member at least once per semester. As noted above (section 6-B), there is an average of around 20 student advisees per faculty member, suggesting a situation in which sufficient attention can be given to each.

University service and professional development activities are discussed in section 6-B, *Non-Instructional Workload* and 6-D, respectively.

The faculty have, finally, opportunities to interact with industrial and professional practitioners in a variety of contexts, including senior projects and cooperative education projects (see criterion 5-A, above), PDC-sponsored projects (see section 6-D below), IAB meetings (see section 2-D above), sabbaticals (although, in practice, this has not been done in this 6 year cycle, and would require significant planning given the size of the faculty and teaching loads) and summer internships (e.g., see CV for Andrew Jones for the latter).

D. Professional Development

All of the School faculty members have pursued professional development activities over the past five years. These include grant writing, consulting, research, publication of scholarly articles and texts, conference presentations, and attending teaching development training seminars, but the level of these activities is, consistent with the focus of the LSSU mission on teaching, less than is traditional elsewhere in academia. The major activities for School of Engineering & Technology faculty are listed below in Table 6-4. A detailed list of each faculty member's activities can be found in the CVs in appendix B.

Table 6-4: Summary of Faculty Development Activities

Activity	Number of Active Faculty	Comments
Industrial Consulting	11	Industrial training, consulting through PDC, external consulting, Senior Project support for external industrial customers, developing new academic program at different university
Journal/Conference Papers	6	Approximately 25 papers over a six year period
Grants and Fundraising	8	Approximately $1.86M over a six year period.
Research	7	Internal projects, external projects, and government projects.
Attendance of Conferences and/or Professional Workshops	11	Over 55 conferences and/or workshops attended over a six year period.
Peer Review for Journals/Conferences	5	Peer review of sets of papers for over 40 journals and/or conferences.

Faculty have also had the opportunity to become involved in consulting projects through the Product Development Center (PDC), established in 2008 (see organizational structure in Background, section D). "Center" is to be understood here, not so much a facility (although there is capital equipment associated, and a building in progress), but as a team of one full-time engineer and one part-time engineer that accept a range of consulting projects from industry and entrepreneurs to design or improve engineered products. The concept is that the engineers can pass on some work to promising student employees, and also more specialized work to faculty as experts. While some members of the faculty have indeed carried out work in such projects, most of that was at the end of the previous 6-year cycle with only one faculty member working for an external company with the support of the PDC several years ago within this present 6-year cycle.

Many members of the faculty also regularly serve on the Senior Projects Faculty Board (SPFB). The SPFB oversees all senior year experiences within the School of Engineering & Technology. As many projects are sponsored by industry, *senior projects provide good opportunities for faculty to work closely with industry.* This interaction has resulted in faculty providing training for industrial-based engineers, occasional summer employment opportunities for faculty, and general faculty professional development due to the close industrial ties.

E. Authority and Responsibility of Faculty

E.1 Leadership Structure

The leadership structure within the School of Engineering & Technology consists of a School Chair as well as program Coordinators for {CE and EE}, ME, and the Engineering Technology programs. All of these fall under the administration of the Dean who is, in turn, under the Provost. The latter two have approval/veto authority. Further information about this can be found later in the "Leadership Responsibilities" portion of this subsection.

E.2 Establishing policy

This subsection addresses the faculty's role, and those of administrators, in defining the program's curriculum, continuous improvement process, educational objectives, and student outcomes ("program outcomes" in the LSSU parlance). For all of these areas, it is the faculty that are the primary authority over all of these areas and who *plan and originate curricular change proposals*, but administrators have approval/veto authority relative to curriculum, specifically.

Curricular matters for the Mechanical Engineering program, including prerequisite structure and the detailed course requirements comprising the program, are planned at the Departmental level. The ME departmental faculty regularly meet (bi-weekly during the academic year), with the ME coordinator setting the agenda, and it is in this forum that the curriculum (among other business) is addressed in detail, and in which any action to change it originates; i.e., administration does *not* generate its own curricular change proposals. The department ordinarily operates by consensus, although a formal majority vote is, in principle, required to adopt any change; such a vote could be undertaken in the unlikely event there were no clear consensus and a decision could not be forestalled. A change so approved by the ME faculty is then proposed to the entire School faculty, and a formal vote taken at that level, usually after discussion in a School faculty meeting (discussion may be foregone in the case of minor changes, e.g., prerequisite issues related to ME courses not common to the other disciplines). Upon School faculty approval, the Dean must approve, after which the proposal proceeds to a University-wide Curriculum Committee, a committee consisting primarily of faculty, but also of administration and student representatives, and in which the School is represented by a single voting faculty member. If approved at that level, it must, finally, receive approval by the Provost, usually after advisory discussion in the Provost Council (a body comprised of the Deans and Associate Provost).

The student outcomes and PEOs for the Mechanical Engineering and other Engineering programs, which are provided in chapters 2 and 3 above, and the continuous improvement process outlined in chapter 4, are defined and revised by the entire faculty of the School of Engineering and Technology (i.e., both ECE faculty and ME faculty collectively). Regular occasion is provided for this by the meetings which review the student outcome and PEO assessment reports. Of course, external advice, such as that from the IAB, Dean, and others may at times be sought as well, but this is always at the initiative of the School faculty. The Dean and higher administrative instances (Provost, etc.) have no formal approval, veto or other role in the process concerning student outcomes and PEOs, although the atmosphere is collaborative and their input is welcomed and respected.

Thus, all the regular faculty of the entire School, each of which, as noted in section 6-A, has some kind of a role in the Mechanical Engineering program, also has a voice in establishing its student outcomes and PEOs, and continuous improvement process, and thereby the general direction of the program. By virtue of the wide involvement of faculty in the assessment process for all of the School's programs, and the similarity in the assessment process for all of the Engineering programs, the entire School faculty is in a well-informed position concerning interpreting assessment results for the Mechanical Engineering program. Minutes of assessment meetings or routed, commented packets of assessment reports, concerning the Mechanical Engineering program student outcomes (available for review) and individual course objectives demonstrate that the entire faculty, regardless of academic rank or other factor, regularly attends and participates in the deliberations, and that ample time is taken in these deliberations such that all perspectives are thoroughly heard and considered, and consensus obtained; accordingly, formal votes are unusual.

In summary, the faculty has autonomy with regard to defining and revising student outcomes, PEOs, and continuous improvement, but does not despise the input of other constituents; regarding curriculum, that autonomy is not complete, insofar as administrative approvals are part of the process. The former (student outcomes, PEOs, continuous improvement) is addressed by the School faculty collectively, while the latter (curriculum) is primarily planned by the Departmental faculty (with later School faculty discussion and approval).

E.3 Implementation of Policy

Implementation of curricular decisions, PEOs, student outcomes, and the continuous improvement process is now addressed.

Curriculum. Curricular decisions, once all approvals are obtained, are ultimately effected by the Registrar (in ensuring that a student completes all curricular requirements before awarding a degree) and the faculty (by virtue of their offering the courses with the intended, as-approved content, and in an effective way; that latter point is elaborated upon below, as part of "point 2" in the discussion of student outcome implementation in this section).

PEOs and Student Outcomes. PEOs are "implemented" by virtue of their dictating a consistent set of student outcomes that support them, and the student outcomes, in turn, are implemented by each of the following mechanisms:

- alignment of the curriculum (i.e., program course requirements) to the student outcomes

- content in specific courses (e.g., to include a design project in a course)
- sponsorship of student organizations

Regarding the curriculum piece, there must be a process to ensure consistency and quality of the courses, and their inclusion of the elements dictated by the student outcomes. That process is aided by the mutual consent of the faculty in defining the student outcomes, as discussed above; since all faculty members have had a voice in the student outcomes (which the faculty agreed to align directly with the ABET student outcomes A-K), there is a common commitment to including the elements of the student outcomes in the courses. The process itself has two aspects:

1) ensuring that each of the qualities specified by the student outcomes is incorporated throughout the curriculum, by identifying sets of courses, each of which supports some element of a student outcome in some way;
2) ensuring that each course, individually, is both well-taught by the faculty member and that it adequately addresses its course objectives (which ultimately address some elements of the student outcomes, even if indirectly as noted in the last point).

To satisfy point 1) of the process, i.e., to be sure that the student outcomes are reflected throughout the curriculum, deliberate planning of the curriculum is necessary; for the Mechanical Engineering program, this is largely the province of the ME department, and deliberations on the curriculum are indeed well-represented in the minutes of that body (available for review).

As an example of PEO and student outcome implementation, notice that PEO-I calls for, among other things, an experienced graduate to "...solve problems in their professions." Evidently, solving problems as a professional implies engaging in a process, inevitable parts of which will involve formal written and oral communications with others involved. Thus, student outcome (g) calls more specifically for the "ability to communicate effectively". Thus, PEO-I is, indirectly, supported in the curriculum by more directly supporting student outcome (g). And student outcome (g) can be supported by incorporating graded activities involving technical writing or oral presentation into a planned subset of the courses in the Mechanical Engineering curriculum, which the ME Department makes part of its curriculum planning. As each course is also separately assessed, there is an opportunity to ensure that such assignments are incorporated into the course syllabus and that grade performance respective to these communications assignments is tracked. In summary, a process of curriculum planning, reflected most notably in the minutes of the ME department, as well as a process of course-level assessment, is practiced to satisfy point 1).

To satisfy point 2), further, a distinction is necessary between, on the one hand, quality of instruction, and, on the other, faithfulness of the course to its objectives (which will somehow, however indirectly, support the student outcomes and ultimately the PEOs).

The process of ensuring quality of instruction (typically referred to as "evaluation" at LSSU) is the province of the Dean rather than that of Chairs or other faculty. The Dean, however, does utilize faculty members' expertise as peer evaluators during the process of evaluation. The Dean evaluates the instructional performance of faculty, taking account of confidential questionnaires filled-in by students at the end of a course, by visitations to faculty lectures, and by review of samples of course materials. This evaluation is evidently prejudicial for the prospects of the faculty concerned in the annual renewal, tenure and promotion processes.

The process of ensuring faithfulness of the course to its objectives (typically referred to as "course assessment" at LSSU, as opposed to "evaluation") is, on the other hand, the province of the faculty themselves, but collectively. Thus, the practice amongst the ME faculty is that each faculty member, during the last week of classes or perhaps after the final exam, collects from the students a survey questionnaire on their confidence levels in the various course objectives, adequacy of prerequisites, adequacy of course materials, and other factors relating to the course, save the quality of instruction. The questionnaires, together with grade data broken down by course objective, are then tracked for each course, and serve as a basis to ensure faithfulness of the course to its objectives.

Finally, it is worthy of note that yet another factor contributes to quality in the courses (part of point 2) – namely, the many team teaching scenarios. These often pair more experienced faculty with less experienced ones in the same course, which provides for a kind of informal mentoring in teaching that ultimately also contributes to the overall quality of the courses in the program.

Continuous Improvement. The continuous improvement process is implemented, primarily, through curricular change informed by the assessment process and consistent with the student outcomes and PEOs. This process, to function, requires some amount of leadership within the School and the Departments. This leadership is provided by the Coordinator (at the Department level) and the Chair (at the School level), and is described in the section 8A.

Leadership Responsibilities. Faculty members with release time assignments having some administrative responsibilities relative to the Mechanical Engineering program are the ME coordinator, and the SET chair. This leadership encompasses assessment, curriculum, scheduling, advising, hiring, and other, matters, but *not* formal supervision of other faculty members. These duties are detailed in section 8A.

A general list of material to be available for review by the EAC of ABET team is shown below, with **bold text** indicating items of particular relevance to policies regarding faculty:

- Course Binders Containing all Course Information
    - Detailed Course Syllabus
    - Course Assessment Summary
    - Course Prerequisite Form (affidavit students sign testifying to satisfactory fulfillment of pre- and corequisite courses)
    - Course Handouts (possibly lecture notes, supplemental handouts, etc.)
    - Examples of Student Work (homework, exams, quizzes, lab reports and/or worksheets, drawings, programs, etc.)
- Senior Projects Portfolios
- Student Outcome Reports (most recent)
- Industrial Advisory Board Information
- **School Meeting Agendas and Minutes**
- **Department Meeting Agendas and Minutes**
- LSSU Catalog (electronic only)
- Senior exit interviews

CRITERION 7. FACILITIES

A. OFFICES, CLASSROOMS AND LABORATORIES

The program is housed within the School of Engineering and Technology, which is located entirely in the Center for Applied Science and Engineering Technology (CASET) Building. Built in 1980, the three-story structure is home to the areas of Engineering, Engineering Technology, Mathematics, Computer Science, and Fire Science. Two additional non-academic facilities associated with Information Technology are also located in the building: Enterprise Application Services and University Support Services.

The School of Engineering and Technology has approximately 30,000 sq. ft. of usable space, which includes offices, storage areas, labs, and work areas. Details of the classrooms, laboratories, and offices follow.

A.1 Classrooms

The CASET building has five classrooms and one lecture room that are assigned by the Registrar's Office, with engineering, engineering technology, mathematics, computer science and fire science courses receiving the highest priority. Room size and capacity are shown in Table 7-1below.

Table 7-1: University-Allocated Classrooms in CASET Building

Room	Type	Size (sq.ft.)	Capacity
CAS-119	Classroom	880	48
CAS-205	Classroom	1,010	40
CAS-207	Classroom	690	30
CAS-210	Classroom	1,100	56
CAS-211	Classroom	585	27
CAS-212	Lecture Room	1,265	76

The School of Engineering and Technology also has three dual use laboratories/classrooms for additional lecture space when needed. These are shown below in Table 7-2.

Table 7-2: Engineering-Allocated Classrooms in CASET Building

Room	Type	Size (sq.ft.)	Capacity
CAS-106A	Classroom/Lab	1,140	22
CAS-310	Classroom/Lab	1,320	30
CAS-311	Classroom/Lab	1,320	24

All classrooms are equipped with a whiteboard or chalkboard, a computer, a document camera, a projector, and a screen. The rooms are arranged in a typical fashion with desk and chairs arranged in rows. The lecture room has fixed desks and chairs arranged in a stepped fashion. Since most engineering courses have enrollments with less than 40 students, the classroom facilities within the building are adequate, and nearly all engineering classes take place in the CASET building. Elsewhere on campus, several large classrooms with capacities up to 165 students are available within a five-minute walk of the engineering facilities.

A.2 Laboratories

Laboratory experiences are a central component of the engineering curriculum at LSSU. Most technical courses contain labs. The chemistry and physics labs are located in Crawford Hall; the remainder of the lab facilities used in the engineering program are located in the CASET building. Table 7-3, below, shows a summary of the lab facilities available to all engineering and engineering technology students, with those used within the program are denoted as such.

Table 7-3: Laboratory Facilities in the School of Engineering and Technology

Room	Name	Size (sq. ft.)	Capacity	ME
CAS-105	Data Acquisition / Microscopy Lab	370	12	☒
CAS-106A	Materials Testing Lab	1,140	22	☒
CAS-106B	Engineering Design Center	1,140	30 (6 Teams)	☒
CAS-106C	Thermal Fluids Lab	900	10	☒
CAS-120	Machine Shop	5,180	20	☒
CAS-120A&B	Welding Lab &Foundry	1,760	10	☒
CAS-122	Plastics Molding Lab & Senior Projects Construction Area	2,240	20	☒
CAS-124	Vehicle Testing Lab & Surface Mount Assembly Lab	1,200	8	☒
CAS-125	Robotics and Automation Center	2,600	16	☒
CAS-209A&B	Computer Lab	1,100	28	☒
CAS-304	Digital Electronics Lab	1,080	14	
CAS-306	Analog Electronics I Lab	1,175	16	☒
CAS-309	Analog Electronics II Lab	1,175	16	☒
CAS-310	Electro-mechanical Systems Lab	1,320	30	
CAS-310A	Rapid Prototype Center	580	4	☒
CAS-311	Programmable Logic Controllers Lab	1,320	24	☒

The School of Engineering and Technology provides the necessary hardware and software tools required in the teaching of engineering and engineering technology students. Unlike more research-oriented institutions, LSSU labs are nearly all intended for use by the undergraduate engineering and engineering technology students for instructional purposes. All laboratory facilities are available to students during regular school hours, when they are not in use for lab instruction. Computer labs and some labs with security cameras are available for extended hours. Special access arrangements through University Security are regularly used to permit student access to labs during evening and late night hours. In general, laboratory section sizes are typically 16 students or fewer. If student enrollment in a section exceeds the suitable lab size, then multiple lab sections are provided.

Data Acquisition / Microscopy Laboratory (CAS-105)

The Data Acquisition / Microscopy lab (CAS-105) is contiguous with CAS-106A, and the two often serve together as a single large lab oriented towards various kinds of materials testing. It includes microscopes and photographic equipment to support materials characterization, strain gauge mounting and data acquisition equipment, dynamic data collection systems (for acoustic and vibration measurement), ultrasonic and other NDT test equipment, and plastics properties testing equipment. This lab is used primarily for ME and MfgET courses (esp. EGME276, EGME350 and EGME425). Students in the relevant courses have access to this lab from 8am-5pm but must be let in by a faculty/staff member.

Materials Testing Laboratory (CAS-106A)

The Materials Testing Lab (CAS-106A) contains equipment for tensile and compression testing, and hardness testing, as well as for polishing and etching in metallographic specimen preparation. Specifically, this laboratory houses a 400,000 lb. Tinius-Olsen compression/tensile testing machine, specimen mounting presses, belt sanders, and microscopy polishers. The lab is contiguous with CAS105, and many activities make use of both labs simultaneously. This lab is primarily used for ME and MfgET courses (esp. EGME276, EGME350 and EGME425). Students in the relevant courses have access to this lab from 8am-5pm but can only operate the Tinius-Olsen with faculty/staff present.

Engineering Design Center (CAS-106B)

The Engineering Design Center (CAS-106B) is a carpeted office space containing eight cubicles, each equipped with chairs, a computer, a phone, a whiteboard, and typical office desk furnishings. The room has a printer common to all cubicles, as well as a large conference table and chairs, a projector and screen for practice presentations, and a collection of supplier catalogs. All senior project teams are assigned their own cubicle where they work on their projects, keep their records, organize their information and make vendor communications (via e-mail or phone). The teams typically hold meetings, which may include the company contacts, suppliers and faculty advisors, at the conference table. This laboratory provides the Senior Project students with office space and conveys the look and feel of working in industry. All typical office supplies are provided. This lab is used exclusively for the senior Engineering Design Projects sequence EGNR-491 & 495. These students have 24-hour access to this lab via LSSU public safety.

Thermal Fluids Laboratory (CAS-106C)

The Thermal Fluids Lab (CAS-106C) contains equipment for examining thermodynamic principles as well as fluid flow. The main equipment are two thermal-fluid trainers with which students can explore the operation of turbines, heat exchangers, and centrifugal pumps. One of these trainers was updated by a 2017-2018 senior project team to provide more capabilities and automate the data acquisition. There is also a wind tunnel, wave tank, and refrigeration cycle trainer. This lab is primarily used for ME courses (esp. EGME432), but frequently serves as an overflow meeting room for senior project students as well, particularly since it has a large conference table and a telephone set-up for conference calls. Students in the relevant courses have access to this lab from 8am-5pm, senior project students can access this room from CAS-106B after hours.

Machine Shop (CAS-120)

The Machine Shop (CAS-120) contains a variety of manual manufacturing processing equipment (benches, hand tools, vices, drill presses, numerous lathes, mills, grinders, saws) and computer automated CNC machines (two lathes, two mills, a plasma torch). An adjacent computer lab is mainly used for CAM software (CREO) programming. The Machine Shop is also connected to various labs, a tool room, and other storage space. This lab is primarily used for ME and MfgET courses (esp. EGME110, but occasionally others as well), but also provide facilities that the senior Engineering Design Projects sequence (EGNR-491 & 495) can use to fabricate components. Students have access to this lab from 8am-5pm but can only operate the equipment with faculty/staff present.

Welding Laboratory and Foundry (CAS-120A&B)

The Welding Lab (CAS-120A) contains arc welders, MIG welders, a TIG welder, Oxy-Acetylene torches, eight arc welding booths, and ten torch welding booths, all of which are well-ventilated. The Foundry (CAS-120B) includes furnaces for melting and heat treating metals, mold benches, flasks, a metal pouring bench and numerous hand tools. This lab is primarily used for ME and MfgET courses (esp. EGME110), but also provide facilities that the senior Engineering Design Projects sequence (EGNR-491 & 495) can use to fabricate components. Students have access to this lab from 9am-5pm but can only operate the equipment with faculty/staff present.

Plastics Molding Laboratory and Senior Projects Construction Area (CAS-122)

The Plastics Molding Lab and Senior Projects Construction Area (CAS-122) includes three different plastics manufacturing machines, and benches. This room is primarily used as a build area for the senior Engineering Design Projects sequence (EGNR-491 & 495), but is also used as a work area for the SAE mini baja vehicle. Students have access to this lab from 9am-5pm but can only operate the equipment with faculty/staff present. Senior project students assigned to this area are given 24-hour access via LSSU public safety.

Vehicle Testing Lab & Surface Mount Assembly Laboratory (CAS-124)

The Vehicle Testing Lab (CAS-124) contains a two-wheel vehicle chassis dynamometer. This computer-controlled dynamometer can oppose the drive wheels with up to 268 hp and allows continuous operation at up to 100 mph. The data acquisition system allows for measurements of the tire torque and rpm as well as access to vehicle CAN network used for vehicle speed-torque (or speed-power) mapping, drivetrain vibration studies, vehicle on-board sensor monitoring, simulated towing load / drawbar / hill climb studies, etc. The lab contains a comprehensive safety interlock system (CO shut down, thermal shut downs, ventilation shortfall shutdowns, etc.) along with belt vehicle restraints with chain back-up help ensure safe operation. This lab is primarily used for EGME310 Vehicle Development & Testing. For safety reasons, students only have access to this lab with faculty/staff present.

The Surface Mount Assembly Lab (CAS-124) was equipped between 2009 -2010 through a Michigan Economic Development Corporation 21st Century Jobs Fund grant. Additional funding through the Michigan Initiative for Innovation and Entrepreneurship grant in 2013 augmented the facility with the establishment of the Electronic Products Innovation Center (EPIC). The lab is outfitted with two Surface Mount Technology robotic assembly machines. APS CS40 has a component placement rate of 2100 components per hour handling parts down to EIA 0603 (0.060" by 0.030") while the APS L40 handles EIA 0201 (0.020" by 0.010") components at a rate of 4800 per hour. Both accommodate boards up to 13.5" by 22". Supporting equipment includes 2 SPR-25 stencils and GF12HC reflow oven. Other equipment includes manual hot air rework stations and fluid dispenser for adhesives and solder paste. This lab is primarily used by PDC workers.

Robotics and Automation Center (CAS-125)

The Robotics and Automation Center (CAS-125) consists of four industrial robotic lines estimated to be worth about two million dollars. In all there are 15 industrial robots (equipped with multiple end-of-arm tooling options), 2 conveyor lines with pallets, 4 rotary index tables, 1 linear conveyor system, 4 Programmable Logic Controllers (PLC's), 7 vision systems, 18 computer stations, as well as numerous sensors and pneumatic devices. Essentially there are four types of flow lines with robot systems: 1) a big rotary index table with four FANUC industrial robots with an Allen Bradley PLC and HMI, 2) an oval line that uses a Bosch Rexroth Varioflow conveyor, housing 4 Staubli robots integrated with an Allen Bradley PLC, 3) an oval line that uses a Bosch pallet transfer conveyor with 4 FANUC robots integrated with an Allen Bradley PLC and HMI, and 4) a work cell that contains 3 KUKA robots and uses a liner conveyor and a rotary table integrated with an Allen Bradley PLC and HMI. The oval line with the FANUC robots and the work cell with the KUKA robots have vision systems integrated in all of the robots and also different tool change stations and end-of-arm tooling for the robots.

During the 2016-2017 and 2017-2018 academic years, a new robotics work cell was added to the lab. This work cell consists of 3 Kuka KR5-R1400 robots with multiple end-of-arm tooling options, a rotary index table, and a linear conveyor system. In addition it has 3 Cognex 7802 vision systems along with an Allen Bradley PLC and HMI. This work cell also implements safety systems commonly found in industry including 2 Keyence light curtains and a SICK area scanner to detect when a person enters the work cell. Students can program the cell via 3 computer stations. This new system and the rest of the robotics lab will help LSSU maintain the industrial robotics niche in its undergraduate engineering and engineering technology programs.

During the 2015-2016 academic year, the robotics lab went through a major upgrade. The FANUC oval line system was fully updated except for the Bosch conveyor. The oval line system incorporates 4 M10/iA FANUC robots that run on the latest R30iB controller platform, 4 FANUC iRVision 2D Vision systems, a FANUC 3DL Vision system, a FANUC force/torque system, two robot line tracking systems, an Allen Bradley PLC controller with ethernet configuration, 4 SCHUNK robot tool changers, several robot end-of-arm tools (grippers, suction cups, etc.), 4 Dell computers, and several sensors. 10

seats of the Roboguide robotics simulation software was also purchased. The entire system (engineering, hardware, software and installation) is estimated at $750,000.

During the 2009-2010 academic year, the robotics lab also went through a major upgrade. The Staubli oval line system was newly installed. The system incorporates 4 Staubli robots that run on the latest CS8 controller platform, a new Bosch conveyor system (Varioflow system with 8 pallet location stations), 4 Cognex Vision systems, an Allen Bradley PLC5 controller with device net configuration, 4 robot tool changers, several robot end-of-arm tools, and several sensors. The entire system (engineering, hardware, software and installation) was estimated at $500,000.

The Robotics and Automation Center is utilized by all Engineering and Engineering Technology degrees. Students in the relevant courses have access to this lab from 8am-5pm but can only operate the equipment with faculty/staff present.

This lab also used extensively for demonstrations for members from business and industry, K-12 students, visiting faculty, and the community. The Robotics and Automation Center is also the key facility that serves as the home for the summer Robotics Camps and Women in Technology programs. These programs that have been offered every summer since 1991 and each year have attracted between 50 to 100 gifted and talented middle school and high school students from Michigan, Ontario, and beyond. The programs have served well to attract bright young individuals to the engineering and technology fields.

Computer Laboratory (CAS-209B&C)

The Engineering Computing Labs (CAS-209B-209C) have 33 current PC-type workstations, two common printers, full network access, and all software that is taught in the curriculum. Computers Dell Optiplex 3020 computers with Intel i5 quad-core CPU, 8GB of RAM, a Quadro P600 GPU, and network access. Specialized software installed on these computers includes CREO, MATLAB, RoboGuide, Ansys Fluent, Arduino, and Witness. This lab is the primary computing lab for engineering and engineering technology students. Students from programs outside of the School of Engineering and Technology are not granted access to this room. Students have 24-hour access to this lab via LSSU public safety, except when it is being used for instruction (even then, it is divisible into two halves by an accordion wall, and only one half is ordinarily used for courses, leaving the other half available for open student use).

Digital Electronics Laboratory (CAS-304)

The Digital Electronics lab (CAS-304) has a fixed workbench in the center of the room with five computers and space for student circuit development. Additionally, this room has eight smaller workstations located around the perimeter of the room. Available in the room are, digital multi-meters, digital trainers, logic analyzers, FPGA evaluation boards, and portable oscilloscopes are available as needed. In addition, this lab also serves as an alternate computer lab with 13 computer stations. This lab is primarily used for CE, EE, and EET courses. All engineering and engineering technology students have access to this lab from 8am-5pm, students in the relevant courses have may receive additional after-hours access as needed.

Analog Electronics I Laboratory (CAS-306)

The Analog Electronics I Lab (CAS-306) has 8 work stations. Each station contains a power supply (Agilent/HP E3620), multimeter (Keithley 2110), signal generator (Keysight 33210A), oscilloscope (Keysight DSO-X2004A), and computer with LTSpice. This lab is primarily used by the introductory electronics courses for all engineering and engineering technology degrees. All engineering and engineering technology students have access to this lab from 8am-5pm, students in the relevant courses have may receive additional after-hours access as needed.

Analog Electronics II Laboratory (CAS-309)

The Analog Electronics II Lab (CAS-309) has 7 work stations. Each station contains two power supplies (Agilent/HP E3620 and BK Precision 1665), multimeter (Fluke 8846A), signal generator (Keysight 33210A), oscilloscope (Keysight DSO-X2004A), and computer with LTSpice. There is an additional "instructor station" that contains additional equipment including a programmable power supply (BK Precision 9201), a DC electronic load (BK Precision 8600), and a power analyzer (Tektronix PA1000). This lab is primarily used by the advanced electronics courses for all engineering degrees. All engineering and engineering technology students have access to this lab from 8am-5pm, students in the relevant courses have may receive additional after-hours access as needed.

Electro-mechanical Systems Laboratory (CAS-310)

The Electro-mechanical Systems Lab (CAS-310) has 5 Hampton electrical machine trainers and accessories. These trainers include AC and DC power supplies as well as AC and DC voltage, current, and power meters. The accessories include induction machines, synchronous machines, wound-rotor machines, single-phase machines, DC machines, resistive load banks, inductive load banks, capacitive load banks, torque meters, tachometers, and power analyzers. This lab is primarily used by EE and EET courses. For safety students are only allowed to use the equipment when faculty/staff are present. The lab is also used as a classroom when needed as it can hold 30 students.

Rapid Prototype Center (CAS-310A)

The Rapid Prototype Center (CAS-310A) is overseen by the Product Development Center (PDC) and serves as a laboratory for both PDC projects and Senior Project teams (EGNR-491 and EGNR-495). The majority of the equipment in the lab, with the notable exception of the Stratasys Dimension RP machine, was purchased by the PDC through a Michigan Economic Development Corporation 21st Century Jobs Fund grant. The equipment purchases occurred between 2008 and 2010.

A Stratasys Dimension 3D printer was purchased in late 2015 with donations largely from the IAB. Using ABS+ plastic, the printer can produce parts up to a size of 10"x 10"x12" using Fused Deposition Modeling. The printer is used in a variety of engineering courses (notably, making sample parts for assembly mock-ups in EGNR-491 and EGNR-495), as well as for projects from industry.

A Roland MDX40, a desktop milling machine, purchased in 2009, is used for many of the same activities as the RP machine. It serves as a virtual printer to the 3D CAD software. This device can mill woods, plastics, and soft metals other than aircraft aluminum and steel. This has a serviceable area of 12x12x4 inches and has a rotary axis as well. Prototype parts requiring materials other than ABS can be made on this machine.

A 2013 Michigan Initiative for Innovation and Entrepreneurship grant provided 10 seats of EAGLE Pro Circuit board development software used for creating schematics and printed circuit board artworks for electronic projects. Two licenses are in use by PDC and 8 are located in the computer LAB 209B.

A Next Engine 3D HD Laser Scanner purchased in October, 2009 is used to scan existing parts into a cloud-of-points and from there to 3D CAD. EGNR-491 and EGNR-495, along with the PDC, make use of this machine to scan parts that have no engineering drawing so that modifications or documentation can be made.

These major tools are supplemented by Dremel grinding, drilling and polishing tools and various hand tools. Two computer stations which are set up for CAD and engineering activities are also located in the lab. This lab is primarily used by the PDC workers.

Programmable Logic Controller (PLC) Laboratory (CAS-311)

The Programmable Logic Controller Lab (CAS-311) has eight work stations around the outer edge. Each station has a computer, an HMI (Allen Bradley PanelView 600) and a PLC (Allen Bradley ControlLogix L16) training station. There are also project machines (four "mixing stations" and four "part checkers") designed to provide students with more intense programming experiences similar to what they would encounter in industry. This lab is used primarily by EET, MfgET and ME degrees. The lab is also used as a classroom when needed (mainly for the lecture portion of the PLC course). Students in the relevant courses have 24-hour access to this lab via LSSU public safety.

Other Facilities

The CASET building has 27 dedicated office spaces for use by students, faculty, support staff, and the administration. Some of these offices are used to house student engineering groups or for storage. Additionally, the Engineering House, a living-learning community for approximately 30 students, is located about 100 yards from the CASET building and the SSMart Zone building is located about 1 mile north of campus. These areas are discussed in the following sections.

School Office

The School of Engineering and Technology office suite, has four specialty office spaces that include reception, conference room, photocopy/scan equipment and supplies, and a storage room.

Faculty Offices

Faculty offices are furnished with standard equipment that includes a desk and chair, additional chairs for guests, computer, telephone, bookcase(s), and filing cabinet(s). Offices being used for storage are available to house additional faculty members should enrollment and/or programmatic growth warrant.

Conference Rooms

The School of Engineering and Technology utilizes several areas for conference rooms. These common areas are used for faculty and student meetings. Four areas, CAS-106B, CAS-126, CAS-203, and CAS-205, are routinely used for conferences. Room sizes vary and can accommodate 6-15 people at one time.

Student Club Offices

Office space has been made available to the engineering student clubs. IEEE is housed in CAS-316. ASME is housed in CAS-309A. SAE is housed in CAS-117. SWE is housed in CAS-127. The Engineering and Technology Honor society and other student groups meet in the conference rooms.

Engineering House

The Engineering House is a residence on campus in which a select group of engineering and engineering technology students inhabit. The house is adjacent to a number of other living-learning communities from different academic areas. The house costs the same as traditional dorms, but offers many advantages including larger bedrooms, a kitchen, a laundry facility, as well as common areas where students are able to congregate. The house is open to all engineering and engineering technology students, both male and female (housed on separate floors with separate bathrooms).

There is a good mix of students at different points in their academic careers (from freshmen to senior). Many of the students will be in classes together, allowing them to easily work and study together. The upperclassmen will also have taken many of the same classes, and had many of the same experiences, making them a great resource for help and advice.

In exchange for these additional amenities, the students are required to participate in a group project above and beyond their normal course work. The subject of the project is decided upon by the students themselves, but must be approved by the house advisors. While this project does require some additional work, it is an excellent opportunity to gain experience working in an engineering team.

SSMart

LSSU and SSMart, a Michigan Smartzone, have a collaborative use agreement in place that provides access to students and SSMart entrepreneurial clients of the combined equipment owned by the two entities. Specifically SSMart makes available a CNC Lathe (Haas TL-1), a150W Laser cutter/etcher, a consumer grade CUBEX Trio Fused Deposition Modeling 3D printer and high resolution OBJET 30 Pro UV Polymer technology 3D printer.

B. Computing Resources

Lake Superior State University provides computer, network, and internet services to members of the campus community. These services are intended to assist faculty, staff, and students in the accomplishment of their University responsibilities and duties. The computing resources offered by the University adequately supplement those offered within the School of Engineering and Technology and meet the needs of the students in the program.

B.1 University-wide Computing Resources

The library hosts three computer labs. Each lab has 24 Dell computers. All computers are running Windows 10 Pro and have Microsoft Office 2016 installed. The standard software installation is available on all computers. A high-speed black and white LaserJet printer is available in the lab on the main floor. In addition to these labs, the library also provides access to 33 Dell computers in the general Learning Commons area, 29 of which are connected to both color and b/w laser printers. In total, the library provides access to 105 computers for student computing use during the hours listed in Table 7-4.

Table 7-4: Library Hours

Monday	8am - 12am
Tuesday	8am - 12am
Wednesday	8am - 12am
Thursday	8am - 12am
Friday	8am - 7pm
Saturday	11am - 7pm
Sunday	1pm - 12am

There are 4 Dell computers connected to a black and white laser printer. These computers are running Windows 10 Pro and Office 2016 along with the standard software installation. The Rathskellar is located in the Cisler Student Union and is open all operational hours of Cisler which vary by time of year and events, generally extending well into evening or beyond midnight as demand or events warrant.

B.2 Engineering Computing Resources

The primary computer labs used by engineering and engineering technology students are the Engineering Computing Labs (CAS-209B&C). Combined they have 33 current PC-type workstations, two common printers, full network access, and all software that is taught in the curriculum. The computers are Dell Optiplex 3020 computers with Intel i5 quad-core CPU, 8GB of RAM, a Quadro P600 GPU, and network access. Specialized software installed on these computers includes Creo, MATLAB, RoboGuide, Ansys Fluent, Arduino, and Witness.

In addition to the Engineering Computer Lab and the two general LSSU computer labs, there are various computer resources available to students located throughout the laboratories in the CASET building.

Engineering Design Center (CAS-106B)

The Engineering Design Center (CAS-106B) is equipped with up to eight computers (one for each senior project team). The computers placed in this room have full network access, engineering software, typically are at least Intel i5 dual-core with at least 4GB of

RAM, and are served by a common printer. Students enrolled in EGNR-491 & 495 have 24-hour access to these computers.

Robotics and Automation Center (CAS125)

The Robotics and Automation Center (CAS124/125) is equipped with 14 computers. The computers have full network access, are at least Core 2 Duo with at least 2GB of RAM, and are served by a common printer. Numerous software packages and programming languages are used in the Robotics and Automation Center. The Fanuc robots are programmed in the Karel programming language and Teach Pendant language and the Staubli robots are programmed in the VAL3 language. The ladder logic programming for the Allen Bradley PLCs are programmed using the Rockwell software RSlogix. The laboratory also provides access to simulation software packages including RoboGuide and WITNESS. Students in the relevant courses have access to this lab from 8am-5pm, but may receive additional after-hours access as needed.

Digital Electronics Lab (CAS-304)

The Digital Electronics Lab (CAS-304) is equipped with 13 computers. The computers have full network access, are at least Core 2 Duo with at least 2GB of RAM, and are served by a common printer. Specialized software installed on these computers includes Quartus (digital synthesis), GoLogic (logic analyzer), and Code Warrior. All engineering and engineering technology students have access to this lab from 8am-5pm, students in the relevant courses have may receive additional after-hours access as needed.

Analog Electronics Labs (CAS-306 and CAS-309)

The Analog Electronics Labs (CAS-306 and CAS-309) are each equipped with 8 computers and a printer. The computers have full network access, and have at least an i5 CPU with at least 4GB of RAM. Specialized software installed on these computers includes LTSpice. All engineering and engineering technology students have access to this lab from 8am-5pm, students in the relevant courses have may receive additional after-hours access as needed.

B.3 Computing Resources for Faculty

All faculty members have computers and network connections in their offices, and all faculty computers are at least at least Intel i5 dual-core with at least 4GB of RAM. The minimum software package on these computers includes Windows 7 or Windows 10, Office2010 or later and Internet Explorer, Google Chrome, or Firefox. Other software installed on the faculty computers is based on the courses that they teach.

All faculty members have full Internet access as well as Microsoft networking. There is at least one networked laser printer on each floor of the engineering building for faculty to use for printing. There are also several shared network drives for faculty to exchange information amongst themselves and with students.

Several web based packages are available for both faculty and student use:

a. Moodle is a course management system that allows faculty to supplement, or deliver wholly, the courses they are teaching. Students enrolled in courses with a

Moodle component have access to support materials posted by the instructor (using syllabi and assignments), links to Web-based materials, videos, handouts, discussion boards and chat rooms, online quizzing, etc.

b. The 'my.lssu' campus portal is beneficial to staff, students and faculty. It allows for single sign-on access to email, calendar, Moodle, Anchor Access (see item c. below) and FASS (student course scheduling systems). It also offers improved e-mail, groups, chat/message boards, course studio, file sharing, targeted announcements and customizable pages. The portal is role-based, hence users have access to tools and announcements related to their role as a student or faculty member.

c. Faculty and students regularly use Anchor Access, a self-serve computer system, accessible through the 'my.lssu' portal. Anchor Access is just one part of Banner, which also handles finance, advancement, financial aid and more. Through it, students are able to view and pay bills online, print copies of their schedules and view and print transcripts. Automated Graduation Verification has been implemented to assist students and staff in confirming the courses needed to complete a program of study. This component is used in tandem with paper-based verification. Notably, it allows students and their advisors to perform a "what if" analysis to see which courses would be required to complete an alternate degree program (a "what-if" analysis).

C. Guidance

LSSU takes great pride in the hands-on learning opportunities provided to its students. To ensure the safe operation of tools, equipment, computing resources, and laboratories, it is standard practice for faculty members to first discuss general safety procedures for a given laboratory in a classroom setting. These procedures are reinforced by demonstrations in the appropriate laboratory. For a particular laboratory exercise, the basics and theory surrounding a specific device or experiment is presented. Best practices for the operation of a particular device are subsequently discussed and demonstrated. Students then work under the tutelage of a faculty member or technician when operating the device for the first time, during which time they may ask questions or request a review of the procedure. A faculty member or technician remains proximate in any laboratory settings where the possibility of bodily harm exists. Once rudimentary mastery of a device has been learned, students are then able to use the equipment with faculty/staff guidance present throughout the rest of their courses. A more detailed example of guidance for a specific settings is provided below.

Example: Preparation for correctly and safely operating equipment in the Manufacturing Lab utilizes the following steps:

1) The safety procedures are covered in class, and again in lab
2) The assignment is explained and given in lab
3) The basics and theory of the experiment or assignment is covered in class (i.e., the cutting speed and rpm calculation for 1010 mild steel being cut with a high speed cutter), and then it is shown in lab as well
4) The operation of the equipment and the actual assignment is then demonstrated

5) The student is then instructed to do the assignment. If the student has any questions, they are to ask the instructor for further explanation, and if needed the procedure is covered again

C.1 Equipment

Use of lab equipment is described and demonstrated in the laboratory setting. The students are then required to demonstrate their proper use the equipment to a faculty/staff member. If the equipment poses a low injury risk student can then use the equipment for the remainder of their degree.

C.2 Software

CREO for CAD, Pro-Mechanica for FEA (projecting the adoption of COMSOL to replace it in the 2018-2019 academic year), MATLAB for general programming, graphical display, and signal analysis, Fluent for CFD (also to be replaced by a module in COMSOL), LTSpice for analog circuits, CARSIM for vehicle dynamics, ROBOGUIDE for robotics simulation, various others for operating robots and PLCs (see description of Room 125 above for a listing of these, many of which are specific to certain makes of robots), are all demonstrated in lab settings. The students are then required to use the software packages to pursue various projects and homework.

C.3 Laboratories

The safety procedures are covered in class, and again in lab. In addition, the safety rules for each laboratory are posted by the entrance. An example of these rules is shown below:

- **Always** assume all circuits are energized unless you know with certainty they are not.
- If you know or suspect that an accident has occurred, take immediate steps to de-energize all affected circuits.
- **Never modify an energized circuit.** Turn off the voltage source before modifying the circuit. Use one hand to make connections and **never** work on electrical circuits with wet or moist hands.
- **Do not** work on a cluttered lab bench. It is important for safety reasons for anyone to easily trace out your test circuit.
- **Think out**, ahead of time, the consequences of closing or opening a switch. **Do not** make adjustments to energized equipment unless specified in the lab and you have thought out the consequences. In addition, the circuit should only be energized for the time it takes to perform the measurements.
- Be sure you **understand** how to properly operate the equipment before you use it.
- If you are unsure of anything or have any **questions** make sure to ask the instructor before proceeding with the experiment.
- **Never** touch moving parts of machinery, and **avoid** standing in the plane of rotation of sprockets or belts. **Do not** wear loose fitting clothing or jewelry, that could contact electrical circuits and/or moving parts of machinery.

- **Never** look directly at electrical arcs; strong ultraviolet radiation can permanently damage your eyes.
- **Never work alone**. Always have at least one other person to help in case of an emergency.

D. Maintenance and Upgrading of Facilities

The University is committed to continually maintaining and improving the educational environment and facilities used to deliver education. Funding for facilities maintenance and improvement are contained in the University General Fund. Grants from NSF, MEDC, Perkins, and industry, along with donations have been instrumental in acquiring new and replacement equipment.

While there is no annual equipment budget, *per se*, for the School of Engineering and Technology, the laboratories are well equipped and receive adequate funding. The two main sources of revenue that support laboratory facilities via the University General Fund are the course fees and program fees that come from students taking engineering and engineering technology courses. Between the two, approximately $200k is generated per year. Equipment, software, and hardware are upgraded on an "as needed" basis, which has been sufficient.

Most courses have a course fee that depends on the cost of maintaining the equipment and software to support the course. In general, courses that have a lab component have higher course fees than those that do not. Approximately $54k was generated in course fees last year. All courses having the "EG" prefix have a differential tuition of $70 per credit hour, called a program fee. The portion of program fees allocated to the SET last year was approximately $144k.

D.1 Recent Upgrades

Major acquisitions made within the last six years are noted below.

Microscopy / Data Acquisition Lab (CAS-105)

Year	Item	Quantity	Status
2018	Shore D Durometer testers	2	new
2017	Shore A Durometer testers	2	new
2017	Digital camera for microscope	1	new
2017	Acoustic foam	1	new
2017	DAQ system (sound & vibrations) with anti-aliasing filter	1	new
2017	Lab-grade accelerometer (vibrations) & power supply	1	new

Materials Testing Lab (CAS-106A)

Year	Item	Quantity	Status
2018	Metallography Mounting Presses	2	new

Engineering Design Center (CAS-106B)

Year	Item	Quantity	Status
2014	I7 Desktop Computer	7	new

Thermal Fluids Lab (CAS-106C)

Year	Item	Quantity	Status
2018	Thermo-trainers	1	upgrade
2017	Fin cooling efficiency test stand	1	New
2016	Fogger for wind tunnel flow visualization	1	new
2016	Material heat conduction measurement test stand	1	New
2015	Fluid jet force measurement test stand	1	New
2015	Refrigeration trainer	1	Upgrade
2014	Pipe flow loss test stand	1	New
2014	Wave tank, and tanker vessel roll stability scale model experiment	1	new

Machine Shop (CAS-120)

Year	Item	Quantity	Status
2015	HASS CNC Lathe	1	new
2014	HASS CNC Mill	1	new

Robotics and Automation Center (CAS-125)

Year	Item	Quantity	Status
2012	Staubli RX60 Robot	1	new
2013	Fanuc LR Mate Robot	2	new
2013	Fanuc M1iA Robot	1	new
2013	Dell Computers	4	1 yr old
2013	Allen Bradley Panel View	1	new
2014	Roboguide Robotics Simulation software	10	new
2015	Fanuc M10iA Robot	4	new
2015	Allen Bradley PLC	1	new
2015	Fanuc 2d iRVision Systems	4	new
2016	Roboguide Robotics Simulation Software	5	new
2016	SCHUNK Robotics End-of-Arm Tooling	4	new
2016	SCHUNK Robotics Tool Change System	4	new
2016	Piab Vacuum End-of-Arm Tooling	4	new
2016	Dell Computers	5	new
2016	Fanuc 3DL iRVision System	1	new
2016	Fanuc Line Tracking System	2	new
2016	Fanuc Force/Torque Sensing System	1	new
2016	Allen Bradley Panel View	1	new
2017	Kuka KR5 R1400 Robots	3	new
2017	Allen Bradley PLC and HMI	1	new
2018	Cognex 7802 Vision Systems	3	new
2018	Rotary Table	1	new

Computer Lab (CAS-209B&C)

Year	Item	Quantity	Status
2015	I5 computers	30	new

2016	Core 2 duo computers	3	used

Digital Electronics Lab (CAS-304)

Year	Item	Quantity	Status
2013	Corobot – mobile robot	1	new
2013	Optiplex 745 – DELL PC	5	used
2013	Optiplex 780 – DELL PC	8	used
2014	Altera DE1-SoC boards	10	new
2014	Altera Cyclone V GX Starter Kit	1	new
2014	Acute TL2118E – Logic Analyzers	10	new
2015	Optiplex 3010 – DELL PC	5	used

Analog Electronics I Lab (CAS-306)

Year	Item	Quantity	Status
2017	Keysight DSO-X2004A oscilloscope	10	new
2017	Keithley 2110 Digital Multimeter	10	new
2017	Keysight 33210A Function Generator	10	new

Analog Electronics II Lab (CAS-309)

Year	Item	Quantity	Status
2015	Keysight DSO-X2004A oscilloscope	10	new
2017	Tektronix PA1000 Power Analyzer	1	new
2017	BK Precision 8600 DC Electronic Load	1	new
2018	BK Precision 9201 DC Power Supply	1	new

Electro-mechanical Systems Lab (CAS-310)

Year	Item	Quantity	Status
2017	3-Phase Variable Frequency Drives	2	new

Rapid Prototype Center (CAS-310A)

Year	Item	Quantity	Status
2013	EAGLE Pro Circuit Board Development Software	10	new
2015	Stratasys Dimension 3D Printer	1	new

Programmable Logic Controller Laboratory (CAS-311)

Year	Item	Quantity	Status
2013	Core 2 duo computers	8	new
2013	PLC Trainers, Desktop	10	new
2013	Panelview Trainers, Desktop	6	new
2013	Part Checkers	3	upgrade
2013	Mixing Stations	3	upgrade
2016	Additional PLC Trainers, Desktop	2	new
2016	Additional Panelview Trainers, Desktop	2	new
2016	Additional Mixing Station	1	new
2016	Additional Part Checker	1	new

2016	Additional Computer	2	used

E. Library Services

The Kenneth J. Shouldice Library and Learning Commons provide the core research materials needed to support the academic curricula offered by the University. The Library is headed by Marc Boucher, Director of Library Services.

In the fall of 1997, a 35,000 square-foot expansion and remodeling of the existing structure to the University Library was formally opened and full resources made available for faculty and student use. The facility includes ample space for study; over 32 personal computer stations with access to specialized library resource databases and the Internet; small and large study and conference rooms; an IT help desk; a small art gallery; the campus's center for testing, tutoring, mentoring and the Faculty Center for Teaching.

E.1 Collections

The collection consists of over 140,000 volumes and 850 periodical subscriptions (including both electronic and print), as well as 75,000 microforms. The library uses Ex Libris' Voyager integrated library system for physical item discovery.

E.2 Reference and Instructional Services

Reference service provided by professional librarians, is available every day and evening the Library is open, other than weekends. Information literacy and research instructional sessions are not only provided to University students, but local K-12 students, students from Sault Ste. Marie, Ontario, and the surrounding intermediate school district areas such as Paradise, St. Ignace, and Pickford. All research databases are accessible to the general public while on campus, and off-campus access restricted databases is provided to all campus students, faculty and staff.

E.3 Resource Sharing

Resource sharing has always been a prominent aspect of library operations at Lake Superior State University. A unique feature of this library is that it is open to the public (on both sides of the international border) and also offers users a joint library card that serves as both their checkout card for LSSU's library as well as all public libraries in the Eastern Upper Peninsula. Our library catalog is shared with Northern Michigan University. Users can locate materials by specific library or collectively. If patrons find materials that are not available at the campus library, library staff will locate it through Interlibrary Loan.

E.4 Resources, Special Facilities, and Services

Resources available to students include access to the Internet from any of the computers located in the Library; but more importantly, over 100 research databases (including Science Direct and Applied Science and Technology Full Text) which index thousands of resources, many of which provide full text access to scholarly journals. All of these research databases are available off-campus through the library's proxy server. There are many group study rooms located throughout the library and the main floor also serves as a space for group interaction through the intentional layout of comfortable furniture and accessible technology to enable group engagement. Throughout the year the library hosts several lectures that are open to the entire campus and community.

E.5 Reserve

The Library offers both physical and electronic reserves service for faculty to ensure availability of materials for their classes. This allows all students to access materials that are of limited availability. Faculty determine the loan period (one hour, in library use only, overnight, etc.). In most cases, materials are removed from reserve at the end of each semester.

E.6 Government Publications

The Library is a selective federal government depository library which means it does not receive all publications from the Government Printing Office (GPO), but select publications that are chosen in addition to those required by the GPO. Currently, the items selected represent about 16 percent of the total items available to us as a selective government depository, and are selected based on relevance to LSSU's academic programs.

E.7 Information Literacy Instruction

Library instruction is conducted in a variety of smart classrooms located throughout the Library. Students learn how to access and search the many electronic resources available through the library in addition to a wide variety of information literacy topics such as copyright, proper citations and intellectual property. While general instructional sessions are offered, most instruction targets access and databases that directly relate to the faculty members' special class needs. When not being used for information literacy instruction, these labs are open for general student use.

F. Overall Comments on Facilities

The School of Engineering and Technology currently has the facilities necessary to meet its program educational objectives and student outcomes. However, the addition of the Robotics Engineering degree program will require additional facilities and equipment when students presently entering the program reach the upper-level courses.

A general list of material to be available for review by the EAC of ABET team is shown below, with **bold text** indicating items of particular relevance to policies regarding facilities:

- Course Binders Containing all Course Information
    - Detailed Course Syllabus
    - Course Assessment Summary
    - Course Prerequisite Form (affidavit students sign testifying to satisfactory fulfillment of pre- and corequisite courses)
    - Course Handouts (possibly lecture notes, supplemental handouts, etc.)
    - Examples of Student Work (homework, exams, quizzes, lab reports and/or

worksheets, drawings, programs, etc.)

- Senior Projects Portfolios
- Student Outcome Reports (most recent)
- Industrial Advisory Board Information
- **School Meeting Agendas and Minutes**
- **Department Meeting Agendas and Minutes**
- LSSU Catalog (electronic only)
- Senior exit interviews

CRITERION 8. SUPPORT

A. Leadership

As described in Criterion 6 Section E, decisions on the overall direction of the program are indeed the province of the entire faculty of the School of Engineering and Technology (SET), but the primary responsibility for detailed oversight of the program rests with the four faculty members (and lab engineer) comprising the Department of Mechanical Engineering and the one faculty member who is coordinator of the EET and MfgET programs.

Because the entire School of Engineering and Technology is comprised of only ten faculty members, and there are three departments (ECE, ME, and ET) and five programs (CE, EE, ME, EET, and MfgET), the curricula are intertwined and there is considerable overlap in the leadership responsibilities for the various programs. Rather than attempting a somewhat artificial distinction between the various leadership roles that affect the Mechanical Engineering program, the *de facto* duties of each, the ME coordinator and the SET chair, relative to the Mechanical Engineering program are enumerated below.

It has been practice that the ME coordinator takes on the following responsibilities:

- to coordinate course assessment for all EGME, EGMT, EGNR, and EGRS listed courses which are either specific to the ME program, to the MfgET program, or to the ME *and* MfgET programs (i.e., without students from the EE, CE, or EET programs);
- to coordinate program (student outcome) assessment for the ME program;
- to serve as an approval authority for course substitutions, course waivers, and transfer credit evaluations for students in the ME program;
- to coordinate ME advising assignments;
- to mentor of the ME faculty in their advising roles;
- to advise the ME Department concerning curricular matters;
- to pursue curriculum and course change proposals related to the ME program at the University level;
- to set the agenda for meetings of ME Department in overseeing the ME and MfgET programs, and record these with minutes;
- to represent the ME faculty at bi-weekly "Chair" meetings (Dean, School Chair, program Coordinators);
- to plan ME faculty instructional assignments and load distribution;
- to assist the School Chair in scheduling of rooms and times for course offerings, and assigning instructors, in light of the preceding;
- to pursue necessary updates to that schedule;

- to organize and coordinate hiring committees for faculty vacancies in the ME department;
- to develop, and maintain currency of, advising documents and the advising spreadsheet tool;
- to conduct ME graduate exit interviews;
- to update the IAB on ME departmental matters and curricular development; and,
- to carry out other duties relative to the ME program which are difficult to comprehensively specify.

It has been the practice that the SET School Chair take on the following responsibilities:

- to coordinate the overall accreditation efforts for the programs of the School;
- to coordinate course assessment (in School faculty meetings) for courses common to both the ME and MfgET programs on one hand, and the EE, CE, EET programs on the other;
- to coordinate assessment of student outcomes;
- to serve as an approval authority, above the coordinator level, for course substitutions, course waivers, and transfer credit evaluations;
- to advise all SET freshman and transfer students at orientation;
- to write "program review" reports for all SET programs on a five-year cycle;
- to set the agenda and lead meetings of the School of Engineering and Technology;
- to set the agenda and lead weekly "Chair" meetings (dean, School chair, program coordinators);
- to represent the School of Engineering and Technology at monthly "Deans and Chairs Leadership Group" meetings;
- to lead discussion relevant to the entire School of Engineering and Technology at the Industrial Advisory Board meetings;
- to coordinate the scheduling of rooms and times for course offerings;
- to establish and maintain transfer equivalency ("articulation") agreements with community colleges;
- to provide leadership in School-level long term planning;
- to prepare, recommend, and administer the School budget; and,
- to collect and provide feedback regarding tenure and promotion decisions (for the School's, as opposed to the Dean's, portion of this responsibility);

Note, furthermore, that in contrast to what may be typical of "chair-level" positions at other institutions, duties related to faculty supervision are *not* part of either of these positions. Firstly, in accordance with concepts of academic freedom affirmed by the faculty-LSSU collective bargaining agreement (attached as Appendix N), neither of these positions involves supervision of instruction. Secondly, pursuant to that same agreement, since both positions are occupied by faculty, and as such, members themselves of the collective bargaining unit, neither position may involve responsibility for performance evaluation (besides in an advisory role as a peer evaluator) or for personnel decisions regarding other Departmental faculty.

There is also a Dean position for the College of Innovation and Solutions, of which SET is a part (shared with other Schools, as described in Section 8-C below). With respect to the Mechanical Engineering program, this position serves as a final approval authority on course scheduling (and changes to instructor, time, or room), course substitutions/waivers, and, of course, budget matters and purchases. The Dean also serves as an approval stage for curricular proposals (new courses, course changes, program changes, etc.) prior to submission to the University-wide Curriculum committee and thence the Provost's office for final approval. The Dean is also the formal supervisor for all faculty and staff within the SET, carrying out performance evaluations, and serving as an approval stage for hiring decisions recommended by Search committees.

The position of Associate Dean for the College of Innovation and Solutions, of which SET is a part, was put in place for only the 2017-18 academic year. This action was taken recognizing the additional duties of the Dean in serving as Interim Provost and VP of Academic Affairs. The Associate Dean performed a number of the functions previously outlined that affected the program such as participation in school meetings, course scheduling, course substitutions/waivers, budget matters and purchases, and curricular proposals. The Dean, by virtue of his role as interim Provost, retained final approval for many of these actions.

The position of Associate Dean will be discontinued July 1, 2018 as the newly hired Provost/VPAA begins his duties. Please see Appendix D for changes related to this new organizational structure.

B. Program Budget and Financial Support

B.1 Budget

The Chair of SET prepares budgets related to the school and submits them to the Dean. The Dean reviews the budgets from the schools of the College of Innovation and Solutions and in turn submits budget for the college to the Provost/VP of Academic Affairs for approval. Ultimately the combined Academic Affairs budget is submitted to the VP of Finance.

The Vice President of Finance receives department/school budget requests (one of which is for the SET) and prepares the overall General Fund Budget and Auxiliary Budget summaries. Recommendations are taken to the Senior Management Team for review and finalization prior to presentation to the Board of Trustees for approval.

Recurring LSSU funding for the School of Engineering and Technology, broken down by source, is shown in Table 8-1 below.

Table 8-1: Summary of SET Funding, Recent Years

Allocations	2014-15	2015-16	2016-17	2017-18
Base Operation	33,984	33,984	33,984	33,984
Carry Over	27,332	89,017	90,253	131,390
Course Fees	47,970	57,180	60,255	54,345
Program Fees	134,191	152,216	154,980	143,640
Total Allocation	243,477	332,396	339,359	363,359

The program receives funding from three University sources (base operation allocations, course fees, and program fees), represented by rows in the table. When bona-fide plans for expenditure are articulated to the CFO, funds not utilized in the previous academic year are carried over to the next year; that amount is also shown as a row.

CSSM funds are LSSU allocated funds for the basic operation of the unit. These basic operations would include paper, phones, office supplies, copying, travel, small office related equipment, and other similar items.

Students enrolled in Engineering or Engineering Technology courses also pay course fees and program fees, which the SET receives. The course fees vary from course to course but range from $10-$100, with a median of $60 (for those courses that have *some* course fee); these are set for each course considering the extent of that course's usage of laboratory equipment and expendables, large-volume printing (handouts), and/or renewable license software. The program fee is $70 per credit hour for courses beginning with an EGxx prefix. The School can adjust course fees yearly. Program fees and course fees are adjusted in consultation with the Provost, and require Board of Trustee approval.

As is evident from Table 8-1, the Base Operation component has been stable from year-to-year. On the other hand, course and program fees received are subject to change based upon enrollment.

As noted earlier, all degree programs are closely related, sharing all resources. Funding is not partitioned by program, but the School Chair and Program Coordinators work closely with the Dean to review the needs for each program and make appropriate allocations and purchases.

In addition, not shown in Table 8-1, but consistent enough to regard as "recurring", LSSU is annually eligible to receive a Perkins Voc-Ed Grant. Most years, SET receives $10K; every fourth year, however, SET receives $30K.

Regarding non-recurring, or irregularly recurring, sources of income, there have been equipment sell-offs and donations. Over the last several years, a few thousand dollars have been raised by selling retired equipment on e-bay. Several pieces of donated equipment have been utilized in our labs, including robots for instance.

Occasional targeted donations have been received. For instance, a $10k donation in 2013 donation paid for new PLC trainers. As another example, a fundraising campaign by the IAB in 2015 paid for a 3D printer. Through a collaboration with the Smartzone, SET houses and has access to both a Haas TL-1 CNC Lathe and an Objet 30 Pro high resolution 3D printer.

B.2 Teaching Support

Teaching is supported by the occasional use of student assistants, and by the availability of teaching workshops, both on-campus and nationally.

Student class assistants are used, occasionally, in some workshop and computer lab courses. Their roles have included assisting students during the labs with accomplishing the lab work (EGNR-101, EGME-141, EGNR-140), or in recitation/additional help hours (EGNR-265). These would be students who had previously taken the course, and done well enough to satisfy the current instructor.

More exceptionally, two student "graders" were provided in the Spring 2016 offering of the lecture course EGME275 Engineering Materials, which had a large enrollment (38 initially), to check/"pre-grade" homework (give comments and tentative scores to worked problems for the instructor's review). This may serve as a precedent henceforth, and the Dean had verbally-stated that it would be dependent upon enrollment numbers in courses. To some extent, the student workers in EGNR140 have also reviewed and written constructive remarks on homework.

Teaching workshops exist on campus, via the title-III grant-initiated "Faculty Center for Teaching"; three current SET faculty members have presented at these workshops but the full extent of participation by faculty connected with the program is uncertain. There are usually teaching-related workshops during the development week preceding the Fall semester; as classes are not yet underway at that time, attendance is relatively straightforward for most faculty members.

External workshops are also supported. Jaskirat Sodhi (2014) (no longer with LSSU) and Zakaria Mahmud (2015) each attended the NETI (National Effective Teaching Institute) workshop sponsored by ASEE. Andrew Jones attended (2013) "Enhancing Student Success through a Model 'Introduction to Engineering' Course", Carson, CA. David Leach (2016) attended an ABET IDEAL (Institute for the Development of Excellence in Assessment Leadership) workshop. David Baumann and Robert Hildebrand (2013) attended a one-day ABET workshop (Program Assessment Workshop). Jordan and David Leach (2017/2018) attended National Institute of Metalworking Skills certification training. . David Leach and Joe Moening will be attending the basic NETI workshop in the summer of 2018 while Zakaria Mahmud will attend the advanced NETI workshop. Masoud Zarepoor is attending an engineering education workshop at Bucknell in the summer of 2018.. Jordan Huff (2018) is attending welding certification training.

Finally, in indirect support of teaching, the University maintains a variety of student services, including counseling, library, placement, admissions, registrar, a learning center (instructing academic success strategies), and tutoring.

B.3 Infrastructure Support

Both course and program fees are used for major equipment purchases, computers, lab supplies, equipment maintenance, software, and other related items. Table 8-2 provides a summary of the expenses categories denoting how funds have been spent for the last few years.

Table 8-2: Expense categories and spending

AccountNumber	AccountDescription	Actual 2014	Actual 2015	Actual 2016	Actual 2017	YTD 2018
7001	Supplies-Office	4,198.41	3,622.33	1,134.21	3,022.28	3,328.12
7002	Reference Books	238.99	905.31	624.81	586.29	-
7003	Central Stores	1,958.00	1,700.00	2,200.00	1,184.25	1,433.00
7004	Supplies-Lab	22,427.06	21,372.44	18,254.11	21,058.71	12,507.32
7005	Supplies-Aud Visual	1,190.25	428.46	14.95	2.00	-
7006	Supplies-Photo-Print	-	-	-	-	-
7010	Awards-Plaques	395.61	493.09	374.45	347.94	789.80
7015	Supplies-LSSU Name-Logo Items	334.56	1,290.79	559.00	2,881.87	1,498.70
7020	Supplies-Other	5,295.99	16,490.33	5,495.88	19,635.19	31,490.73
7030	Copies	13,448.32	10,913.56	14,878.96	8,792.28	7,709.80
7031	Printing	1,399.99	1,134.52	3,056.32	2,026.82	2,155.98
7032	Photographic Service	-	-	-	61.60	-
7040	Postage	180.79	1,355.92	1,144.19	199.60	64.47
7050	Telephone	4,291.85	5,204.88	4,894.54	4,680.00	3,900.00
7055	Fax	-	-	-	-	-
7060	Software	-	57.90	5,000.00	204.16	3,120.00
7061	Software Licenses and Maintenance	19,217.45	15,076.84	5,238.00	11,195.00	17,321.95
7065	Computer Hardware	3,953.03	3,392.87	13,237.42	164.84	3,863.88
7070	Equipment <2500	21,040.30	12,034.77	26,497.60	23,588.26	22,883.23
7101	Travel in State	6,356.25	3,883.37	5,911.77	4,323.16	5,671.60
7102	Travel out of State	5,833.01	10,891.48	8,750.95	13,633.78	5,382.37
7103	Travel Students	53.00	-	-	828.05	8,844.57
7110	Meetings-Luncheons	5,128.36	4,864.81	10,776.89	7,988.62	12,082.72
7111	Guest Lodging-Meals	14.73	-	100.70	775.28	137.80
7112	Conferences	2,710.00	5,168.87	3,270.00	2,359.50	3,240.00
7130	Recruitment--Employee	-	-	-	235.05	-
7131	Recruitment--Student	302.88	244.19	1,473.30	1,062.06	52.76
7210	Rental-Media	-	-	-	-	200.00
7211	Rental-Equipment	-	-	1,300.00	3,738.60	4,338.41
7225	Rental-Other	-	-	2,536.50	-	-
7230	Product Development Center Services	-	-	-	-	-
7252	Honorariums	-	-	-	75.00	53.85
7253	Contracted Services	-	200.00	45,000.00	-	-
7261	Equipment Mtnce and Repair	4,078.76	550.00	-	10,831.00	3,984.94
7271	Legal	-	-	-	-	-
7272	Accreditation	-	-	-	348.06	-
7290	Linen Service	-	292.50	292.50	-	265.50
7320	License-Permits-Fees	-	-	539.50	6,748.00	-
7340	Memberships	2,923.00	2,671.00	3,041.04	5,843.44	4,995.00
7341	Subscriptions-Magazines	-	-	-	-	-
7345	Advertising	-	77.55	-		309.00
7365	Professional Development	619.47	1,928.50	5,447.00	5,873.36	550.00
7395	Miscellaneous	92.08	-	-	42.29	90.69
7520	Haz Material Dispose	-	-	1,406.58	957.27	-
7960	Capitalized Equipment Purch	55,900.00	22,470.90	41,990.08	42,787.72	39,876.59
Grand Total		**183,581.64**	**148,717.18**	**234,440.25**	**208,081.33**	**202,142.78**

B.4 Resource Adequacy for Teaching and Infrastructure

The budget has also allowed the School of Engineering and Technology to sufficiently meet the *teaching* needs of the program. Although teaching assistants or graders are rarely used, funding has been adequate for the occasional instances in which they were necessary.

The budget has also allowed the School of Engineering and Technology to sufficiently meet the *equipment* needs of the program. Although no comprehensive five or ten-year equipment replacement plan exists, funding has been adequate for critical and necessary upgrades as well as needed maintenance activities.

C. Staffing

The staffing of the School of Engineering and Technology is described in the following, in terms of compensated positions (full or part time; salaried, release-time, or stipend assignments); evidently, as is typical in academia, much additional work is also available in the form of service activities by faculty members. All of the positions described have some responsibility, to varying degrees, for the program (as well as other programs).

C.1 Clerical Staff

Throughout the vast majority of the last 6-year cycle, support staff (for the School of Engineering Technology) has included 1-1/2 full-time positions, i.e., a full-time Academic Assistant, and a half-time administrative assistant. Only very recently (indeed June 2016) was the half-time position discontinued.

The Academic Assistant provides clerical support to the faculty and Dean, manages day-to-day activities in the School's office, processes purchase requisitions and manages faculty cardholder accounts, organizes special events (e.g., annual School banquet), provides coordination support for Summer programs (camps for high-school-age and younger), and pursues various other duties as well.

The administrative assistant position had provided assistance for marketing and recruitment, implementation of Engineering admissions policies, and maintenance of assessment and accreditation records. These various duties have been shifted to the full-time Academic Assistant and the chair with some duties discontinued at the SET level (e.g. marketing moving to the university marketing personnel) or discontinued entirely.

Furthermore, there has continuously been a part-time student assistant in place to help the Academic Assistant, including during the summertime.

C.2 Administrative Staff

Dean. The School was administered by a Dean (see Criterion 8 Section A above for the Dean's role) whose responsibilities have been divided with the Lukenda School of Business under the auspices of a combined college. Beginning July 1 (the date of this report), a reorganization will place the SET together with both School of Mathematics and Computer Science and the Lukenda School of Business within the College of

Innovation and Solutions under a solitary Dean. The current Chair of the School of Mathematics and Computer Science will assume the role of Dean for the College; whether the Dean will continue to also maintain Chair duties for the School of Mathematics and Computer Science is yet to be finalized.

Chair. The Chair (see Criterion 8 Section A above for his/her role) is a 3-release load hour (1/4-time) appointment, plus the equivalent of 3 load hours converted to a stipend each for the Fall and Spring semesters (in the 2012 self-study, these were 3 actual load hours), and a $2,000 Summer stipend. That has been consistent during the entire 6-year cycle, except for the Summer stipend, which has varied from $1,000 in summer of 2012 to $2,000 currently, with Summer 2017 having been calculated at 2 load hours (slightly less than $2,000).

Coordinators. During some early portions of the 6-year cycle, both Coordinators (see Criterion 8 Section A above for their respective roles) received 2 release hours (out of 12 for full time) per semester, i.e., these were 1/6 time assignments. During the majority of the cycle the ME coordinators received 2 release hours per semester resulting in 1/6 time assignment and the ECE coordinator (as well as the Engineering Technology coordinator) received 1 release hour (1/12-time).

Director of Robotics. There is a 3-release hour (1/4-time) assignment for running the Robotics laboratory of the SET. Note that courses such as EGRS-381 (in the EET core) and EGRS-215, EGRS-430, and EGRS-481 (in the Robotics Technology minor) make extensive use of this laboratory. The director develops the robotics laboratory through industrial donations and grants, and plays a key leadership role nationally in the Robotics Industry Association.

C.3 Academic Staff

Instructional Staff. The ten full-time faculty positions (all tenured or tenure-track) have already been detailed in Criterion 5.

In addition, some usage is made of adjunct faculty. In particular, the two Laboratory Engineers frequently act in this capacity, and the courses they typically instruct (or co-instruct) courses including the lab components of EGEE-210 *Circuit Analysis*, EGME-110 *Manufacturing Processes*, and EGET-175 *Applied Electronics*, and occasionally both the lecture and lab components of EGRS-365 *PLC's*. More directly related to the program is their role of project advising in the capstone EGNR-491-495 sequence.

The PDC (Product Development Center) of the larger College also employs a full-time Engineer, and has employed two during the early portion of the 6-year cycle; these have sometimes served as adjuncts for EGNR-491-495 sequence course topics and team advising, EGEE-370 *Electronic Devices*, EGME-141 *Solid Modeling*, EGNR-245 *Calculus Applications for Technology*, and EGET-310 *Electronic Manufacturing Processes*.

Technical Staff. Two-full time Laboratory Engineers are assigned to the School of Engineering and Technology. An Electrical/Computer Laboratory Engineer is responsible for the maintenance and operation of all electrical and computer equipment in the laboratories. A Mechanical Laboratory Engineer is similarly responsible for the maintenance and operation of all mechanical equipment in the laboratories. Both Laboratory Engineers design and manufacture equipment for use by faculty in the laboratory, or the classroom. These positions are full-time, twelve month appointments.

C.4 Resource Adequacy for Clerical, Administrative, and Academic Staffing

The School of Engineering and Technology has had sufficient clerical staffing to meet the critical needs of the program. The loss of the half-time administrative assistant in 2016, however, has resulted in some diversion of teaching, administrative, and marketing resources away from the day-to-day needs of the academic programs.

Similarly, budgetary allocations are sufficient to meet the *immediate* administrative staffing needs of the program, but may not be sufficient to ensure the long-term sustainability and/or growth of the program. Although the School chair receives 25% release time supplemented plus the equivalent of 3 load hours converted to a stipend each for the fall and spring semesters and the equivalent of 2 load hours in stipend for the summer, that position encompasses administrative leadership for all 6 programs in the School; furthermore the release time for the ECE departmental coordinator (and the engineering technology program coordinator) has been reduced within the last 6 year cycle from 2 load hours per semester to 1 load hour per semester such that the amount of release time is not high enough to reflect the amount of time needed to fulfill the responsibilities of the position..

The School of Engineering and Technology currently has sufficient instructional and technical staffing to meet the needs of the program, provided the ten positions remain filled. Currently there is a search to replace the ECE faculty member last taught in the spring of 2017 (although the effective retirement date was December 2017). At the completion of that search the ten regular faculty members, supplemented by the aforementioned adjunct instructors, are able to deliver all the courses that are required to support the program. Furthermore, the two full-time laboratory engineers have the resources to maintain all equipment and facilities used by the program.

D. Faculty Hiring and Retention

D.1 Faculty Hiring Process

The reader is referred to appendix N, the contract between the faculty and the University, wherein its appendix B (appendix B of the Faculty Agreement, but appendix N of this document) provides a detailed description of the procedure for formation and conduct of a faculty hiring committee. This is a University-wide procedure to which the School adheres (in fact, this procedure for the whole University was modelled after our longer-standing practices in the School of Engineering & Technology), but it does not address some of the specific additional practices that have developed for, and the philosophy for the conduct of, searches in within the School of Engineering and Technology. There is one search in progress conducted to replace a retired ECE faculty member. There have been six searches for ME/MfgET faculty during the previous six years.

Consistent with the institution's primary mission of teaching, and the School's philosophy of maintaining an applied emphasis in its engineering and technology programs, the evaluation process employed in the hiring of new faculty accordingly places a greater emphasis on a candidate's promise as an instructor and on industrial experience than it does on academic research credentials (although the latter *is* also a factor of lesser weight). A faculty candidate is generally expected to have some teaching experience (either as faculty member or a teaching assistant) and to possess excellent communication skills.

After initial screening of CVs, the search committee typically extends invitations for phone interviews to up to a dozen candidates. These are contacted by a committee member, by phone, at which time, as a matter of transparency, the salary (usu. about $65,000 for these openings, which is considered low on the market) is related, as well as something of the geographical and climatological features of the region (rural and wintery), and the nature of the position (heavy teaching loads with little research emphasis). One or more of these factors may cause some of the candidates to withdraw at this point, saving them and the committee needless time expenditure. The remaining phone interview candidates then speak with the entire committee on the telephone for about 20 minutes to half-an-hour, at which time the search committee questions the candidate on teaching interests, inclinations to teach laboratories, capstone projects, etc. Up to 3 of those candidates, whichever are most promising (if enough are), are then selected for campus visits.

During the campus visit, candidates give a sample lecture (on a topic specified by the hiring committee chair and generally kept the same for all visiting candidates); this lecture is ordinarily given to both students and faculty (including those not participating in the search committee). Feedback is thereafter solicited from the students and faculty in attendance, and is given much weight in the subsequent hiring decision. Besides the guest lecture, consideration is also given to the candidate's performance in an informal research (or professional) presentation, to collegiality as observed at interactions throughout the day, including meals and one-on-one interviews (including with HR, the Provost, and sometimes the President, who convey their respective feedback), and to feedback from the candidates' references. However, it remains the guest lecture that most often proves decisive.

Historically (and into the early phases of the 6-year cycle), the search committee would select the best candidate, and also rank the other candidates in case of an offer being declined (as happens fairly frequently). The Dean and Provost then had formal authority to negotiate and hire, but tended to support the committee decisions. More recently, the search committees have been discouraged from selecting and ranking, in favor of merely indicating "qualified" or "not qualified.

D.2 Faculty Retention

Retention of qualified faculty is partially a matter of correct selection in the search and hiring process, i.e., by identifying a "good fit" faculty hire for the SET. The optimal faculty hire, given the relatively high instructional load, should be committed to instruction, rather than exclusively to research, as well as adaptable to the geographical and climatological particulars of Michigan's Eastern Upper Peninsula (i.e., relative remoteness in a wintery setting). Moreover, while such a person may well be a subject matter expert, the willingness to function as a generalist, and with bona fide laboratory and project skills, is ideal. Given these attributes, a faculty member is likely to find a degree of satisfaction in the work that is conducive to retention.

A School-specific PD fund (beyond that of the University), to bolster faculty retention, has also been available during the 6-year cycle, and still continues in a more restricted form. In 2012, subsequent to the EAC of ABET visit which had cited the various Engineering programs for issues of faculty retention, the SET committed to provide a fund for workshops/conferences, summer stipends for scholarly endeavors, and other PD activities. Accordingly, for a portion of the cycle, these funds have been available for the purposes described, and may be allocated to Engineering Technology-related PD just as well as to Engineering-related. In the last three years, however, stipends have been discontinued, so that the fund is now limited to travel reimbursement and materials/equipment.

Retention has remained an issue for the ME Department (see section 0-G for details), which has hired and lost six (one due to retirement) faculty members in the past six years). Retention has not, correspondingly, been an issue for the ECE Department, having retained all faculty members over the past six years aside from the one retirement

E. Support of Faculty Professional Development

The "Agreement" (ref. appendix K) between Lake Superior State University and the Faculty Association provides each faculty member with $1000 per academic year for professional development; at the beginning of the 6-year cycle (through 2013), this level was at $800, so it has undergone a $200 annual increase during the cycle. A faculty member's professional development fund can carry over from academic year to academic year, but not to exceed $4,000 (unchanged). Expenditures from professional development funds must be related to the faculty member's professional development or teaching objectives. In addition, faculty members, who are officers of professional organizations or presenters at national conferences, have received additional support to travel to workshops and conferences from departmental and/or Dean's budgets.

Note also the additional SET PD fund described in Criterion 8 Section D, and section 0-G in greater detail. For a couple of years during the 6-year cycle, this provided stipends for scholarly work, as well as travel and materials reimbursement. Although the stipends have been discontinued, the funding continues to exist for travel and materials.

The "Agreement" between Lake Superior State University and the Faculty Association also provides a total of up to three semesters of sabbatical leave at full pay per academic year (it had been four, through 2013). A tenured faculty member is eligible for a Sabbatical Leave after five (5) academic years of employment as a faculty member at the University, so long as s/he has not had a Sabbatical Leave within the previous five (5) years. A Sabbatical Leave Committee comprised of two Deans, appointed by the Provost, and six faculty members elected by the faculty shall consider the applications for sabbatical leave and make recommendations to the Provost. No engineering faculty member has been awarded a sabbatical during the last 6-year cycle. The last sabbatical award to an engineering faculty member was a full-time sabbatical for the 2011-2012 academic year, that being just prior to this 6-year cycle.

A general list of material to be available for review by the EAC of ABET team is shown below, with **bold text** indicating items of particular relevance to policies regarding support:

- Course Binders Containing all Course Information
    - Detailed Course Syllabus
    - Course Assessment Summary
    - Course Prerequisite Form (affidavit students sign testifying to satisfactory fulfillment of pre- and corequisite courses)
    - Course Handouts (possibly lecture notes, supplemental handouts, etc.)
    - Examples of Student Work (homework, exams, quizzes, lab reports and/or worksheets, drawings, programs, etc.)
- Senior Projects Portfolios
- Student Outcome Reports (most recent)
- Industrial Advisory Board Information
- **School Meeting Agendas and Minutes**
- **Department Meeting Agendas and Minutes**
- LSSU Catalog (electronic only)
- Senior exit interviews

PROGRAM CRITERIA

The program criteria for Mechanical Engineering comprise a stipulation on the curriculum, and a stipulation on the faculty. The former is addressed above in Criterion 5, specifically on pages 5-23 through 5-28. The latter is addressed above in criterion 6-A, specifically on page 6-7 and 6-8.

APPENDICES

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**School of Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**Degree Audit Form – BS-ME (F2018)** **Plan of Study Form – BS-ME (F2018)**
This documentation is relevant to Question number:	**15**
Briefly summarize the content of the file and its value as evidence supporting program review:	**These documents describe the program curriculum and advising tools for it.**

School of Engineering and Technology

BS Degree in Mechanical Engineering

(For Freshman Starting Fall 2018 or Earlier by Election)

Student Name: _____________________

Student ID #: _____________________

Intended Month of Graduation: _____________________

Advisor Approval: _____________ Date: _______

ME Coordinator Approval: _____________ Date: _______

SET Chair Approval: _____________ Date: _______

All information recorded below should match the student's most recent transcript and/or transfer evaluation.

GENERAL EDUCATION REQUIREMENTS

Communications

ENGL110 - 3 (C or better required) _____

ENGL111 - 3 _____

Humanities (2 courses, different disciplines; see catalog)

Elective _____ - ____ _____

Elective _____ - ____ _____

Social Science (2 courses, different disciplines; see catalog)

Elective _____ - ____ _____

Elective _____ - ____ _____

Computational Literacy (formerly "Mathematics")

(fulfilled by departmental requirements)

Natural Sciences

(fulfilled by departmental requirements)

Diversity (3 credits minimum; see catalog)

Elective _____ - ____ _____

Communications

COMM101, 201, or 225 COMM- ____ _____

☐ GEN-ED REQUIREMENTS MET BY MTA or MACRAO

DEPARTMENTAL REQUIREMENTS

CHEM115 - (4,3) 5 _____

EGEE210 - (3,2) 4 _____

EGEM220 - (3,0) 3 _____
(C or better required)

EGEM320 - (3,0) 3 _____

EGME110 - (2,3) 3 _____

EGME141 - (2,2) 3 _____

EGME225 - (3,0) 3 _____

EGME275 - (3,0) 3 _____

EGME276 - (0,3) 1 _____

EGME337 - (4,0) 4 _____

EGME338 - (3,0) 3 _____

EGME350 - (3,3) 4 _____

EGME431 - (3,0) 3 _____

EGME432 - (1,3) 2 _____

EGNR101 - (1,2) 2 _____

EGNR140 - (1,3) 2 _____

EGNR265 - (3,0) 3 _____

EGNR340 - (0,2) 1 _____

EGRS460 - (3,3) 4 _____

MATH151 - (4,0) 4 _____
(C or better required)

MATH152 - (4,0) 4 _____
(C or better required)

MATH251 - (4,0) 4 _____

MATH308 - (3,0) 3 _____

MATH310 - (3,0) 3 _____

PHYS231 - (3,2) 4 _____
(C or better required)

PHYS232 - (3,2) 4 _____

SENIOR CAPSTONE EXPERIENCE (complete 1 of these 3 columns)

Industrial Project	Cooperative Project	Research Project
EGNR491 - 3_____	EGNR450 - 4_____	EGNR260 - 2_____
EGNR495 - 3_____	EGNR451 - 3_____	EGNR460 - 4_____
	EGNR491 - 3_____	EGNR461 - 2_____

TECHNICAL ELECTIVE CONCENTRATION (complete 1 of these 3 columns)

Vehicle Systems (VS)
(C or better required)

EGME240 - 3 _____

EGME310 - 2 _____

EGME415 - 2 _____

EGME425 - 4 _____

EGEE280 - 4 _____

One of the following:

EGME442 - 3

or EGRS461-4

_____ - ____ _____

Robotics & Automation (RA)
(C or better required)

EGRS365 - 3 _____

EGRS385 - 4 _____

EGRS430 - 4 _____

EGRS435 - 3 _____

One of the following:

EGME240-3 or EGNR310-3

or EGMT216-3 or EGEE280-4

_____ - ____ _____

General

EGME240-3 _____

9 credits for any courses listed in VS or RA options or EGNR261 or 361

_____ - ____ _____, _____ - ____ _____

_____ - ____ _____, _____ - ____ _____ (total cred: ____)

5 credits from any 400-level courses listed in the VS or RA options

_____ - ____ _____, _____ - ____ _____ (total cred: ____)

Students must also satisfy the following for graduation:

☐ 2.0 Overall GPA, 2.0 Dept. GPA

☐ 32 credits Math (incl EGNR340)/Natural Science

☐ Residency (50% of 300/400 level credits in major = 24 cr.)

☐ 124 Total Credits (minimum)

☐ Residency (32 credits earned at LSSU)

BS Mechanical Engineering for Fall of 2018

MATH151	Calculus I	4	MATH152	Calculus II	4	
EGME141	Solid Modeling	3	CHEM115	General Chemistry I	5	
EGNR101	Intro. to Engineering	2	EGME110	Manufacturing Processes I	3	
ENGL110	First Year Composition I	3	EGNR140	Linear Algebra & Numerical Applns for Engineers	2	
	Diversity Elective	3	ENGL111	First Year Composition II	3	
2018	TOTAL	15	2019		17	32
MATH251	Calculus III	4	MATH310	Differential Equations	3	
PHYS231	Appl. Physics for Eng. and Sci. I	4	PHYS232	Appl. Physics for Eng. And Sci. II	4	
EGNR265	"C" Programming	3	EGME225	Mechanics of Materials	3	
EGEM220	Statics	3	EGME275	Engineering Materials	3	
	Social Sci / Humn / Comm	3	EGME276	Strength of Materials Lab	1	
				Technical Elective	3	
2019	TOTAL	17	2020		17	34
MATH308	Probability and Math. Statistics	3		Social Sci / Humn / Comm	3 - 4	
EGEM320	Dynamics	3	EGME337	Thermodynamics	4	
EGME350	Machine Design	4	EGME336	Fluid Mechanics	3	
EGEE210	Circuit Analysis	4		Technical Elective(s)	5 - 7	
EGNR340	Numerical Methods for Engineers	1				
	Technical Elective	0 - 2				
2020	TOTAL	15 - 17	2021		15 - 17	32 - 33
	Senior Sequence I	3		Senior Sequence II	3	
	Technical Elective(s)	4		Technical Elective(s)	3 - 4	
EGME431	Heat Transfer	3		Social Sci / Humn / Comm	3	
EGME432	Thermal-Fluids Lab	2		Social Sci / Humn / Comm	3	
EGRS460	Control Systems	4		Social Sci / Humn / Comm	3 - 4	
2021	TOTAL	16	2022		16 - 17	32 - 33
						129 - 131

VEHICLE SYSTEMS CONCENTRATION, REQUIRED TECHNICAL ELECTIVES (18 - 19 cr)

EGME240 Assembly Modeling and GD&T	3 (Spring)	EGME310 Vehicle Development and Testing	2 (Fall even yrs)
EGME415 Vehicle Dynamics	2 (Spring odd yrs)	EGME425 Vibrations and Noise Control	4 (Spring even yrs)
EGEE280 Introduction to Signal Processing	4 (Fall)	EGME442 Finite Element Analysis *or* EGRS461 Design of Control Systems	3 (Spring odd yrs) 4 (Spring odd yrs)

ROBOTICS AND AUTOMATION CONCENTRATION, REQUIRED TECHNICAL ELECTIVES (17 - 18 cr)

EGRS365 Programmable Logic Controllers	3 (Spring)	EGRS385 Robotics Engineering	4 (Spring)
EGRS430 Systems Integration & Mach. Vision	4 (Fall)	EGRS435 Automated Manufacturing Systems	3 (Spring)

One of the following: EGME240 3 (Spring) *or* EGNR310 3 (Fall odd yrs) *or* EGMT216 3 (Fall) *or* EGEE280 4 (Fall)

GENERAL CONCENTRATION, REQUIRED TECHNICAL ELECTIVES (17 cr)

EGME240 Assembly Modeling and GD&T (Spring) 3

and

9 total credits combined from any of the following: EGNR261 (Fall), EGNR361 (Fall odd yrs), and the technical elective courses allowed in the other concentrations (Vehicle Systems and Robotics & Automation, see above). 9

and

5 total credits of 400-level technical electives from the other concentrations (*not* also counted in preceding 9-cr requirement) 5

SENIOR SEQUENCE: SELECT ONE PATH

Industrial Project		*Co-op Project*		*Research Project*	
EGNR491 Engineering Design Project I	3	EGNR450 Cooperative Education Project I	4	EGNR260 Engineering Research Methods	2
EGNR495 Engineering Design Project II	3	EGNR450 Cooperative Education Project II	3	EGNR460 Engineering Research Project I	4
		EGNR491 Engineering Design Project I	3	EGNR461 Engineering Research Project II	2

Updated 5-17-18

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	Engineering and Technology
Document Title (if attached) or Filename (if emailed):	Senior Project Posters
This documentation is relevant to Question number:	16
Briefly summarize the content of the file and its value as evidence supporting program review:	Provides example(s) of projects involving students in this major.

Project Statement

The purpose of this project was to update one of the two thermal trainer units currently used in EGME 432 (Thermal and Fluids Lab), and housed in CAS-106C. More specifically, Team STS integrated both software and hardware upgrades, particularly to do with the Programmable Logic Controller's control of the system. In addition, the team converted the system with National Instruments data acquisition systems for all data collection and recording. Major stakeholders were the engineering students, both current and future, enrolled in Thermal and Fluids Lab as well as the involved faculty.

Two of the five laboratory exercises supported by the thermal trainer unit explore the efficiency of what is known as a Pelton turbine (pictured on the left) at variable loads. The system enables a user to select the number of nozzles they would like to use to expel water toward the turbine's cupped fins and, in addition, supports several different nozzle sizes. As this pressurized water strikes the turbine's fins, it causes the turbine to rotate, generating harnessable electricity. The turbine's efficiency can then be calculated using either angular velocity and torque or voltage and current output to a load.

Project Benefits

The thermal trainer's increased functionality now supports a total of five independent laboratory exercises. Each of these exercises fosters the study of unique principles in areas such as the characteristics of centrifugal pumps, turbine efficiency, cooling effects of forced convection, multi-stage energy conversion, and pump performance in single, series, and parallel configurations. The product enables students to quickly and easily configure the system to extract the data necessary to perform these studies at the push of a button.

STS

LAKE SUPERIOR
STATE UNIVERSITY

2017-2018

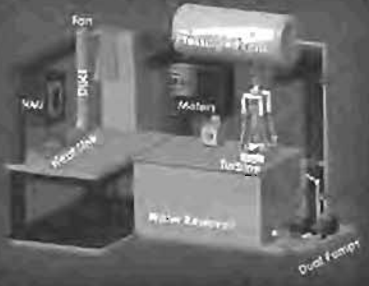
The Team

[redacted]

EE
ME
EE
MfgET
ME

Mr. Jeff King — Faculty Advisor
Dr. Zakaria Mahmud — Industrial Customer

3D Model:



Video at:

YouTube

Project Challenges

As with most projects, the biggest obstacle was completing all tasks and objectives within the confines of the timeframe. All team members had to maintain a balance between this project and other time commitments. Additionally, learning and successfully implementing the LabVIEW software used for data acquisition proved to be a unique challenge in that it is not widely used within LSSU's engineering and technology department. This lack of a local knowledge and resource bank pushed key team members to learn the software via experimentation and alternate means.

NATIONAL INSTRUMENTS
LabVIEW
PTC Creo
Allen-Bradley

The Product

This new and improved training unit features a current generation Allen Bradley PLC used in conjunction with a full-sized color Human Machine Interface. Multiple National Instruments data acquisition cards provide the platform needed for a dedicated computer to employ a software known as LabVIEW. This is done in order to capture and timestamp a plethora of incoming data streams generated by an army of sensors and transducers that monitor dozens of pressures, flow rates, velocities, torques, and temperatures, each contributing to the data required to complete lab exercises in key areas of thermal and fluid studies.

SUPERIOR BAJA RACING

Front Suspension Components

Several suspension components were replaced such as A-Arms, hubs, and spindles. Finite Element Analysis showed that the A-arm thickness could be reduced to reduce weight while maintaining adequate strength. The original spindles were machined from 1040 Carbon Steel and were proven to be too weak and yielded over time. These were replaced with lighter and stronger Yahama Raptor 700 spindles. Lonestar hubs were also implemented to reduce weight.

Find us on YouTube

CarSim

Carsim is a vehicle simulation software that was used to create a virtual model of the kart. With the finished product, future teams can use this to analyze design choices and personalize the kart for individual drivers. The simulation was validated by comparing procedure results with real world testing.

Clutch

Originally the kart was equipped with a belt driven CVTech clutch. The gear ratio for this clutch had a range from 3:1 to 0.43:1. This was replaced with a Comet Industries clutch, which has a gear ratio range of 3.3:1 to 0.5:1. The new clutch has a larger operating range and allows for better power and acceleration. The slight loss in top speed being traded for more low-end power is ideal as SAE event tracks are design such that karts do not operate at top speed for long periods of time during race events.

SUPERIOR BAJA RACING
LSSU Engineering Senior Project
2017-2018

LAKE SUPERIOR STATE UNIVERSITY

Team Members

[redacted]

Faculty Advisor
Dr. Robert Hildebrand

Industrial Customer
Dr. Zakaria Mahmud, LSSU SAE Faculty Advisor
Mr. Jordan Huff, LSSU Mechanical Lab Engineer

Project Statement

Team Superior Baja Racing (SBR) set out to improve components and sub-systems of the Society of Automotive Engineers (SAE) Club's mini-baja kart created by a previous senior project team. The three major systems improved on the kart were: suspension, brakes, and drive train. Testing with the use of a new data acquisition system was done to validate these changes.

Sponsors

Chippewa Motors, Inc.
"We can do it all"

Suspension

The shocks were changed from a Fox Podium 2.0 collover with a fixed spring rate, to the Fox Evol Float 3's. The Evol Float 3's have an adjustable air chamber which allows for a variety of spring and damping rates. Being able to adjust the pressure within the chamber allows for optimal settings for different events and maneuvers. At lower pressures the kart is able to withstand a much larger lateral acceleration, allowing for higher maximum speeds through curves. The shocks have a secondary chamber with a different pressure setting to protect the kart against bottoming out from large impacts.

Original Shocks: Fox Podium 2.0

Evol Float Dual Stage Compression Chart

New Shocks: Fox Evol Float 3.0

Data Acquisition System

The Data Acquisition System (DAQ) was replaced with an AIM Evos 4s racing system. It features a built-in 3-axis accelerometer, 3-axis gyroscope, and a GPS receiver. It also has 5 other available channels to add any sensors that may be needed to perform a test. The data collected was used to compare previous design performance to new design performance and justify the changes that were made. This data can also be used to validate the accuracy of CARSIM simulation.

LAKE SUPERIOR STATE UNIVERSITY

2017-18
Steering Column Effort Test

nexteer AUTOMOTIVE

SEA
SUPERIOR ENGINEERING AND AUTOMATION

Project Statement

Create a semiautomatic alignment process using a robot with vision capabilities on a steering column and collect minimal telescoping effort data.

Project Objectives

- More accurate data
- Faster data acquisition
- Faster overall process

Project Motivation

- Improve Nexteer's process for better testing results
- Reduce non-operation time in the validation stage for higher volume of part testing
- Availability of data to present to OEMs

SEA Compliance Device

Design Objectives

- Use Fanuc 3DL sensor to align tool frame of robot to column axis
- Utilize mechanical device to reduce radial loading
- Use visual basic code in conjunction with LabView to display live data (Force vs Distance)
- Minimize axial force distribution data
- Reduce cycle time to under 16 seconds

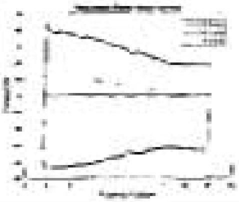
Team Members

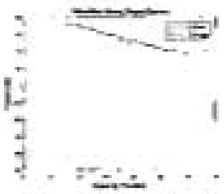
[redacted]

Faculty Advisor:
Dr. Masoud Zarepoor

Industrial Customers:
Tim Bennett, Fred Berg, Dave Prior, Scott White

DAQ Raw Data





DAQ Analyzed Data

smart vision lights

Customer Bio

Nexteer Automotive is a leader in the automotive industry with a multibillion dollar steering and driveline business delivering electric and hydraulic steering systems, steering and driveline components, automated driving, etc. to OEMs around the world. Nexteer has over 13,000 employees in over 50 countries. Their customers include Ford, GM, BMW and others.

Robot with Compliance and Camera Fixtures

Rake and Telescoping Steering Column

SEA Compliance and Camera Fixtures

Special Thanks

- Fanuc
- Sault Machine Works
- SmartVision
- LSSU POC
- LSSU Faculty

Learn More Here

K.R.U.

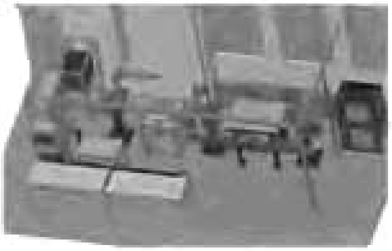
KUKA ROBOLINE UPGRADE

Senior Projects 2017-2018

Project Summary

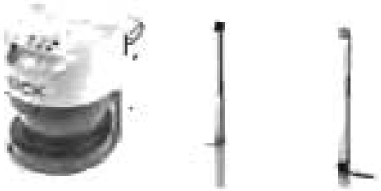
Team KUKA Roboline Upgrade (KRU) has implemented a third KUKA robot to the pre-existing two-robot KUKA workcell in LSSU's Robotics Lab. In addition to updating the workcell's controls, vision, and safety systems, Team KRU installed a rotary index table used to transport work pieces between two robots, a worktable, and end-of-arm tooling for the third robot. Team KRU also updated all documentation for the workcell and created two new lab exercises. Finally, a synchronized robotics motion project and a robotic deburring project were completed to demonstrate the capabilities of this workcell.

The KUKA Robotics Workcell



The fully completed robotics workcell now contains:

- 3 KUKA KRS R1400 robots
- A rotary index table and a linear conveyor system
- Multiple end-of-arm tooling for the each robot
- Automatic tool-change capability
- Ethernet/IP communications
- 3 Cognex vision systems
- Allen Bradley PLC (Programmable Logic Controller) with HMI (Human Machine Interface)
- 3 new computer stations
- Safety system with a SICK area scanner and 2 Keyence light curtains (shown below)



Faculty Advisor
Jim Devaprasad

Team KUKA Roboline Upgrade
[redacted]

Industrial Contacts
Eric Becks
Ron Bergquist

Vision System

Team KRU installed a Cognex 7802 vision system for each of the three robots. The vision system includes several advanced capabilities such as autofocus, integrated lighting and on-board processing. An image of the camera can be seen below

Project Benefits

The main project benefits are:

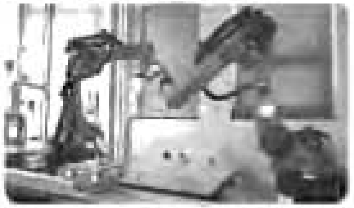
1) Addition of a new robotics platform to LSSU's Robotics Lab
2) Future LSSU engineering students can get lab experience on KUKA robots and Cognex vision software
3) New project demonstrations created to highlight LSSU Robotics capabilities to visitors
4) New platform for future senior and research projects
5) Experience for Team KRU members on robotics system integration

Synchronized Robotic Motion

Team KRU developed a piano demonstration using Autodesk's Maya software in conjunction with the Mimic software plugin and KUKA's ExtensionTech software. Maya is a 3D computer animation software that uses time based programming and has been used extensively in the production of films and video games. The Mimic plugin allows the time-based animation of KUKA Robots. Mimic then exports data as a program file which can be executed using KUKA's ExtensionTech software package. These technologies allowed the three robots to play two pianos in sync. An image of the robots playing the pianos is shown below

Robotic Deburring

Team KRU developed a demonstration that emulates the deburring process of marine boat propellers. The process utilizes a deburring tool manufactured by ATI. The RoboTeam software package was used to reverse the complicated geometry of the propeller blades. RoboTeam has many features including program and motion synchronization, collision avoidance, and operation of multiple robots from a single SmartPAD. An image of the robots performing the deburring sequence can be seen below.



Project Made Possible By:

KUKA
SCHUNK
LAKE SUPERIOR STATE UNIVERSITY
COGNEX
TEXTRON AVIATION

CORNING

AUTOMATION OF A PARTICULATE FILTER REPAIR STATION

2017-2018 Senior Projects

LAKE SUPERIOR STATE UNIVERSITY

Project Contributors

SMC

FASTENAL

Industrial Customer

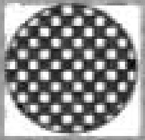
The industrial customer (IC) for this project is Corning Incorporated. Headquartered in Corning, New York and founded in 1851 they are responsible for some of the most advanced glass technologies. Boasting 107 locations in 24 countries they are truly a global company. Special thanks to Gail Dyer (LSSU Alumna) for her guidance on this project.

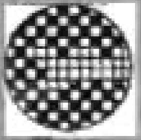
Project Benefits

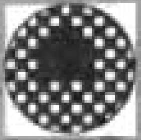
- Tested feasibility of automating the current manual process
- A small but safe work cell near high traffic areas
- More precise, consistent process achieved through use of automation
- Improved cycle times
- Learning experiance for students

Project Statement

Team Automated Repair Cell (ARC) was charged by Corning to create an automated robotic cell which integrates machine vision with a collaborative robot. The project automated a previously manual process at Corning of repairing ceramic diesel particulate filters. The vision system identified the imperfections in the filters and a custom built end of arm tool (EOAT) performed repairs on the filters. The EOAT punched out unwanted caps and filled in unwanted holes repairing the filter matrix which restored the perfect checkerboard pattern of holes and caps in the filter.







What is a Collaborative Robot?

Standard industrial robots require additional safety equipment such as light curtains, fencing, and area scanners in order to follow industry standard guidelines. Corning has provided the team with a FANUC Collaborative Robot that features contact stop capabilities. The FANUC CR-7ia/L robot automatically stops when unexpected contact is made. This allows the robot to be used without additional safety equipment while still following industry safety standards.

Team Members

[redacted]

ARC

Faculty Advisor:
Eric Becks

Industrial Customer:
Gail Dyer

Project Outcomes

Custom end of arm tooling was developed for the robot to complete both types of repair operations on the filter. The work cell utilizes an extremely high resolution camera to detect errors in the filter and validate proper repair of the filter. An Allen Bradley Programmable Logic Controller (PLC) was used to manage communications within the work cell.

Light Inspection System

(2017-2018)

ALVS
AUTOMOTIVE LIGHTING AND VISION SYSTEMS

ESYS
AUTOMATION

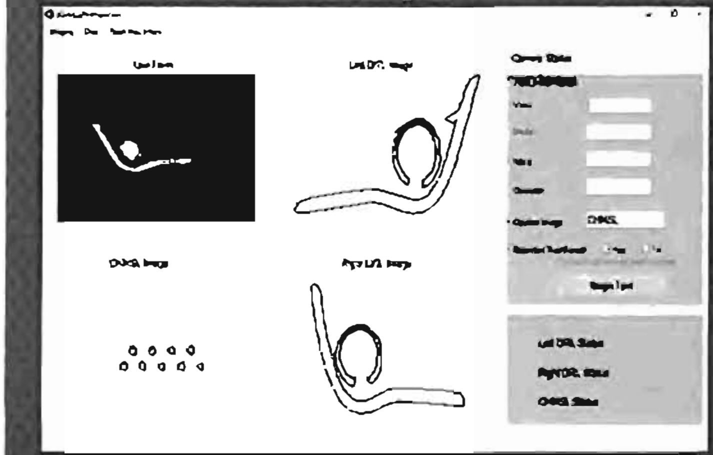
Project Statement

Team Automotive Lighting and Vision Systems (ALVS) was responsible for researching and developing a machine vision system to automate the inspection of light elements during automotive assembly. The project includes a high resolution machine vision camera, mobile test cart, light assembly stands, and a graphical user interface.

Graphical User Interface

The main focus in developing the user interface was to create a simple, user-friendly environment to interact with the hardware and vision software. The team designed a graphical user interface (GUI), and implemented the vision system software functionality directly into the code. With this interface, plant operators can set up configurations for new vehicle models and conduct tests on both the front headlight assemblies, and the rear center high-mount stop light while viewing all of them on the same basic screen. The program stores all of the information from each test and exports it into an external data file. Failed test results can be viewed easily within the interface via the error log tab in the toolbar. This feature will help manufacturers swiftly locate vehicles with faulty components in the assembly line.

GUI Layout



Esys Automation is an engineering and manufacturing systems integration firm located in Auburn Hills, Michigan. The company specializes in turnkey solutions that serve the automotive and manufacturing industries.

Team Members

[redacted]

Industrial Contact
Mark Compton

Faculty Advisor
David Leach

LAKE SUPERIOR
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Check us out
on YouTube!

Project Result

The Team researched and tested several potential vision techniques and methods prior to creating the algorithm that determines whether the lights are functioning properly. The end product is a fully adjustable vision system that can be easily adapted for use in different environments with different car models.

Setup and System Design

Fixtures were designed to be fully adjustable to accommodate a diverse range of testing scenarios. The team created fixtures to hold the light assemblies as well as the camera and laptop. The camera fixture was made to be mobile so it can move relative to the three light positions.

Test Equipment

LAKE SUPERIOR
STATE UNIVERSITY

Controls and Vision Systems
Engineering Senior Project 2016-2017

Controls and Vision Systems

Project Description: *Pharm-Assist*

The *Pharm-Assist* project is an automated prescription dispensing machine designed to assist pharmacy employees and increase the time they are available for customer service. Team CVS was tasked with Phase 2 of the *Pharm-Assist* project, where the main goal was to reduce the cost of the workcell. Building off the previous team's proof of concept workcell, team CVS designed and built a 3D gantry system which replaced the FANUC delta robot that was used in the previous iteration. Along with replacing the robot, team CVS converted a majority of the control of the system from PLC (Programmable Logic Controller) to Raspberry Pi (mini-computer). The main focus of Phase 2 was to build and test a rigid gantry design that would be reliable and fast (30 pills per minute). Other areas of focus for the project included reducing noise and vibration from the previous year's design, improving the security of the cell, and converting the power of the cell from 240 Volts to 110 Volts.

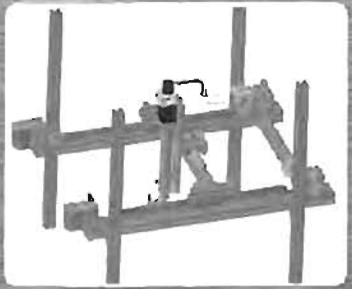
Team Controls and Vision Systems:

[redacted]

Dr. Joseph Moening (Faculty Advisor)

Gantry Design:

The team chose a "Core XY" design for the gantry system, as seen pictured below. This design allows the motors that drive the X & Y movement of the gantry to be stationary and mounted on the frame rather than having to move with the carriage. This reduces the weight that the motors need to move and therefore increases the maximum speed at which the XY plane of the gantry can move.



Company Background:

4D Systems, LLC. sponsored Phase 1 and Phase 2 of this senior project. 4D Systems is an automation integration company that automates production processes for their clients, as well as providing software and software services to the engineering community. This company is located in Flint Township, Michigan and has been open since 2011. Mr. Jean Pierre Rasaiah is the president and founder of the company. Mr. Rasaiah and Mr. Brett Newill, both alumni of Lake Superior State University, were the industrial contact for the project.

Project Benefits:

With the completion of Phase 2 of this project, many people will benefit. The team members of team CVS will benefit from working with 4D Systems and completing their senior project. This will allow them to gain valuable real world engineering experiences. 4D Systems will benefit by having a prototype which they can expand upon and eventually market to pharmacies and nursing homes. The users of the workcell will benefit by being able to spend more time with the customers, increasing customer service.

Project Outcomes:

- Designed, built, and tested rugged 3D gantry system
- Speed of pill dispensing: 30 pills per minute
- System delivers correct prescriptions 95% of the time
  - Accomplished by detecting if a pill is dropped from the End of arm tooling (suction cup)
- Total cost of project was under $10,000
- Improved security from previous iteration
  - Accomplished by the use of electronic locks and a fingerprint scanner
- The cell produces less than 65dB of noise (slightly louder than office conversation)
- Vibrations were reduced 25% from the previous iteration

Conveying Automation Solutions

KUKA Robotic Training Cell

Engineering Senior Design Project 2016-2017

LSSU

- [redacted]
- Faculty Advisor: Prof. Jim Devaprasad
- Industrial Contact: Prof. Eric Becks

Project Statement

Team Conveying Automation Solutions (CAS), along with Team Automation Controls Engineering (ACE), created a new training work cell using 2 KUKA KR 5 R1400 robots.

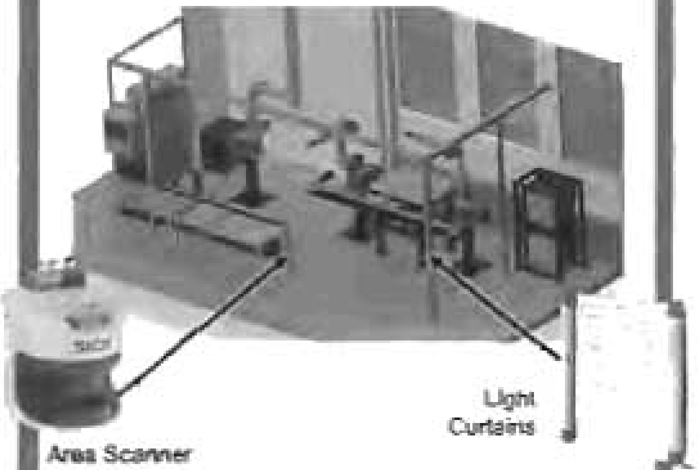
The new work cell is used as a platform for student learning, future senior projects, and research. The work cell features safety equipment, End-of-Arm Tooling, and robotic interaction that are unique to the LSSU robotics lab. Team CAS was responsible for designing, manufacturing, and implementing several mechanical components of the work cell.

Sponsors and Industrial Support

LAKE SUPERIOR STATE UNIVERSITY
KUKA
SCHUNK
JR AUTOMATION TECHNOLOGIES, LLC
Parker
AMT
mk
Baumer
COGNEX

Safety Features

The safety features include: emergency stop buttons, 3 light curtains, and an area scanner. All of these features are used in conjunction with the physical enclosure to ensure the safety of both users and observers of the work cell.

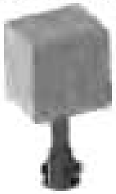


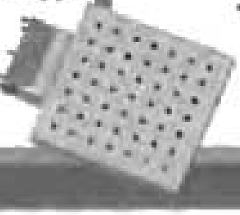
End-of-Arm Tooling

End-of-Arm Tooling allows the robots to manipulate and interact with their surroundings. The KUKA robots have a tool library that includes a centric 3-finger gripper, a single suction cup gripper, and a 3-finger expansion gripper. In addition to these End-of-Arm Tools, there is a pallet gripper that will be utilized for special projects, labs, and demonstrations.


Expansion Gripper


Centric Gripper


Suction Cup Gripper


Pallet Gripper

Robot Specifications

- 6 axes creating a 4 foot reach
- 5 kg (~11 lb) payload
- Rotational speed of 218°/s – 492°/s
- 170° of rotation about the base
- Capable of safe interaction with other KUKA robots

Special Cell Features

The work cell features a spring-loaded top plate mounted to a work table that protects both the table and the robots from being damaged. Attached to the table is a linear conveyor and specialty tool cribs. The tool cribs were designed to allow the quick exchange of End-of-Arm Tools without damaging the work cell components.

Special Thanks

Team CAS would like to extend special thanks to the following individuals for their support, technical expertise, and guidance in the completion of this project.

- Ron Bergamin – KUKA
- Jason Markesino – AMT
- Josh Bodell – AMT
- Eric Becks – IC & LSSU PDC
- Gibson Kramer – LSSU PDC
- Nick MacArthur – LSSU PDC

Please scan the QR code to learn more about this project.

WHEEL
INSPECTION
SYSTEMS

Rim Quality Inspection via Vision
Senior Project 2016-17

LAKE SUPERIOR
STATE UNIVERSITY

Sponsored By:

ESYS

Industrial Contact:
Mark Compton

Wheel Inspection Systems:

Team Members:

[redacted]

CE
ME
MET
ME
ME
EE

Faculty Advisor:
David McDonald

Project Statement:

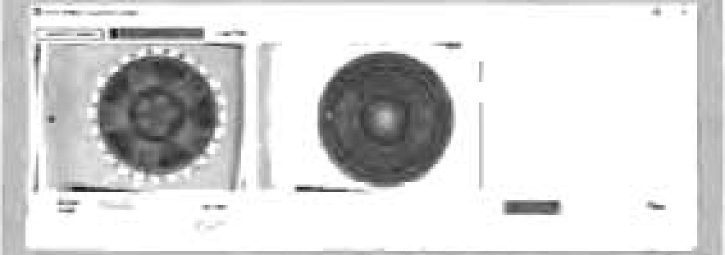
Team Wheel Inspection Systems (WIS) was tasked with researching and developing a system to automate the inspection of automotive rims using an industrial grade camera and machine vision software.

Company Background:

Esys Automation is a robotics integration company located in Auburn Hills, Michigan. The company was established in 1999, and it specializes in turnkey automation for the automotive industry.

GUI Interface:

The picture below shows the user interface of the vision system. Here, users can set up and run tests on automotive rims. The user can acquire an image of the rim via a camera, run a live feed from the camera, load a previous test image, reference an ideal image, and run the vision algorithm. The GUI will display the results of the test.

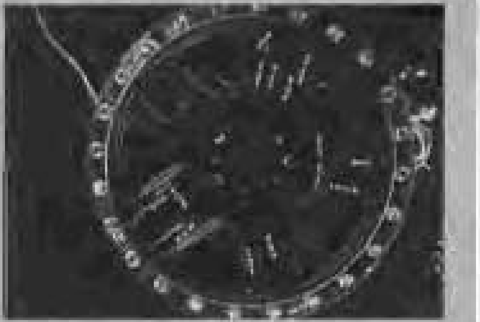


System Design:

The pictures to the right show Team WIS's shroud. The shroud is a chamber designed to block outside light and to scatter light inside the shroud. High-intensity bar lights, a high resolution camera , and a rim are mounted in the shroud. This system allows for a controlled testing area of vision algorithms on automotive rims.

Project Result:

The team researched the effect of different lighting positions and intensities on the surface of the rims. Based on the research, the team was able to create an algorithm using a visions system that could inspect automotive rims.



Lake State Automation

2016 – 2017 CNC Gantry Mill

Project Description

Team Lake State Automation has been sponsored by Mactech On-site Machining Solutions to design, build, and automate a prototype CNC milling machine. The project came about due to the desire for increased flexibility and functionality of the current machine. The project entails an upgrade on an existing gantry mill which was originally manually operated. This machine is designed to work in a wide range of applications from ship maintenance to bridge building. It may be mounted and operated while in any orientation, and is completely mobile.

The prototype machine features increased speed, accuracy and repeatability. New Fanuc hardware has allowed the machine to be operated by software which may be created off-site. Automation of the machine has greatly increased its capabilities and reduced human labor. The prototype design of the CNC milling machine is intended to be replicated by Mactech On-site Machining Solutions in the future. Team Lake State Automation has undertaken this project facing a fixed budget and a need to collaborate with multiple vendors.

Fanuc Controls

Team Members:

[redacted] l Engineer)
Engineer)
ng Engineering Tech.)
Engineering Tech.)
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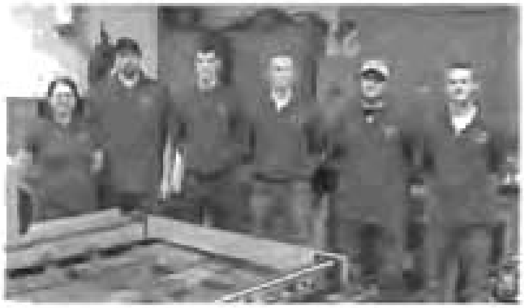


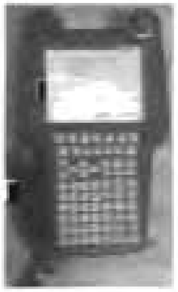
Faculty Advisors:
Professor David Leach
Professor Jon Coullard
Industrial Contacts (Mactech):
Mr. Joel Wittenbraker
Mr. Chad Peterson

Mactech On-Site Machining Solutions

Mactech was founded in 1974 in order to provide portable stress relieving solutions. The company expanded in 1985 in order to provide portable machine tools and on-site services. Mactech is a world leader in the production of portable machining and bolt tensioning equipment.

IPendant User Interface

- User friendly operation
- Touch screen interface
- Operate machine from more than 30 feet away
- Easily load G&M code programs via USB
- Manual and automatic operation



CNC Gantry Mill

LAKE SUPERIOR STATE UNIVERSITY

MACTECH ON-SITE MACHINING SOLUTIONS

FANUC

PART 2: Degree-Level Review

Degree Program: **Manufacturing Engineering Technology (BS) (ABET ETAC accredited 2016)**

Explain how the program works to address each of the following questions. For each question, respond with a narrative and supporting evidence.

Assessment (CC 4.B and CC 4.C)

13. Provide evidence that the degree-level program outcomes are clearly stated and are effectively assessed, including the "use of results." Attach the 4-Column Program Assessment Report.

14. Explain how results from degree assessments were used to improve the degree program. Include specific examples.

Program review and feedback from students indicated that they thought ethics (student outcome I) should be removed from senior projects. The recommended action was to create a new General Education course that would cover ethics, economics, and sustainability as it applies to the design and use of technology. This course would then allow for the removal of that material from senior projects giving student more time to focus on their project. For a number of reasons, the creation of this class was not possible. However, based on faculty discussions and student feedback it was decided to bring in an expert in ethics. Thus, Dr. Jason Swedene a Professor in Department of Humanities & Philosophy who specializes in ethics began teaching the ethics portion of senior projects in the spring of 2017. From the latest student outcome evaluation, there is no concern for outcome I. Student feedback regarding the ethics portion has overall been very positive. Some students indicated that they would prefer that ethics be moved to the fall semester of senior projects. The possibility of moving this topic is currently being explored and may occur in the future. Overall, it seems that bringing in Dr. Swedene was beneficial to the program.

Quality, Resources and Support (CC 3.A)

15. Explain how the program ensures that degree program-level and course-level learning outcomes are at an appropriate level. Attach evidence, including a degree audit for the program.

As copied from the 2016 ABET ETAC Self-Study Report, page 27, "The initial student outcomes for the MfgET program were determined by the School of Engineering and Technology faculty based on advice given by the ABET-EAC site visitation team in Fall 2012 and with the approval of the School of Engineering and Technology Industrial Advisory Board (IAB). The student outcomes may be revised by the School of Engineering and Technology faculty with advice from the IAB. The IAB meets twice every year, once in April and once in November, and provides advice to the School of Engineering and

Technology faculty at both meetings. The student outcomes, just as the program educational objectives, will be reviewed by the IAB every three years. "

The MfgET student outcomes are simply the ABET-ETAC student outcomes (a)-(k).

(a) an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities;

(b) an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies;

(c) an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes;

(d) an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives;

(e) an ability to function effectively as a member or leader on a technical team;

(f) an ability to identify, analyze, and solve broadly-defined engineering technology problems;

(g) an ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature;

(h) an understanding of the need for and an ability to engage in self-directed continuing professional development;

(i) an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity;

(j) a knowledge of the impact of engineering technology solutions in a societal and global context; and,
(k) a commitment to quality, timeliness, and continuous improvement.

A sample degree audit, syllabi, and course assessment summary is provided on the following pages.

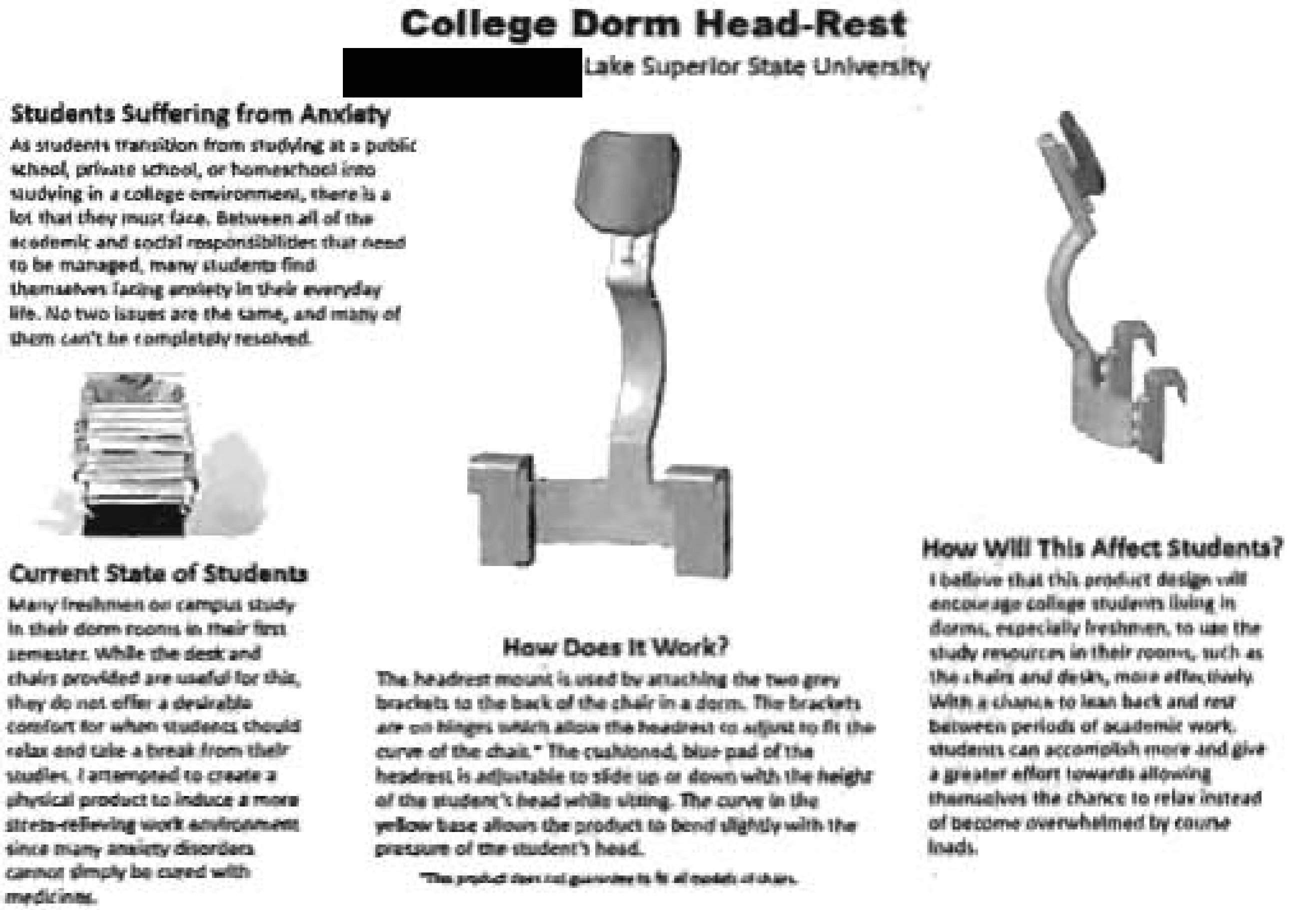
See the following Appendix attachments:

- Degree Audit for MET-BS
- Sample Syllabus – EGMT216 CAM with CNC Applications (F2018)
- Sample Course Assessment Summary – EGMT216 CAM with CNC Applications (S2018)

Intellectual Inquiry (CC 3.B).

16. Explain what the program does to engage students in collecting, analyzing, and communicating information; mastering modes of inquiry or creative work; developing skills integral to the degree program. Attach examples of undergraduate research, projects, and creative work.

A high percentage of the courses in the Manufacturing Engineering Technology (BS) plan of study have laboratory components as well as student projects. Laboratory experiences engage students in collecting and analyzing data, as well as reporting data in laboratory reports. In the EGME276 Strength of Materials Lab course, students collect testing data from material testing methods in stress, strain, bending, and shear. Data is then analyzed and communicated through detailed laboratory reports. In EGME141 Solid Modeling, first year and transfer students engage in a semester-long Human-Centered Design (HCD) project. Each student selects a community in need while building empathy, identifying important problems, brainstorming product ideas, narrowing down product options, and developing concepts. Using their creativity and data collection, students then design a final product using 3D parametric CAD software with the end goal of improving the condition of their community. Below are student samples of the final poster deliverable in EGME141:



College Dorm Head-Rest

[redacted] Lake Superior State University

Students Suffering from Anxiety

As students transition from studying at a public school, private school, or homeschool into studying in a college environment, there is a lot that they must face. Between all of the academic and social responsibilities that need to be managed, many students find themselves facing anxiety in their everyday life. No two issues are the same, and many of them can't be completely resolved.

Current State of Students

Many freshmen on campus study in their dorm rooms in their first semester. While the desk and chairs provided are useful for this, they do not offer a desirable comfort for when students should relax and take a break from their studies. I attempted to create a physical product to induce a more stress-relieving work environment since many anxiety disorders cannot simply be cured with medicines.

How Does It Work?

The headrest mount is used by attaching the two grey brackets to the back of the chair in a dorm. The brackets are on hinges which allow the headrest to adjust to fit the curve of the chair.* The cushioned, blue pad of the headrest is adjustable to slide up or down with the height of the student's head while sitting. The curve in the yellow base allows the product to bend slightly with the pressure of the student's head.

*This product does not guarantee to fit all models of chairs.

How Will This Affect Students?

I believe that this product design will encourage college students living in dorms, especially freshmen, to use the study resources in their rooms, such as the chairs and desks, more effectively. With a chance to lean back and rest between periods of academic work, students can accomplish more and give a greater effort towards allowing themselves the chance to relax instead of become overwhelmed by course loads.

Water Filter for Flint

[redacted]

Lake Superior State University

Flint, Michigan

Flint is a poor, crime-stricken city. Slightly over 40% of residents live below the poverty line, making them the second-most impoverished city in America. Flint is consistently in the "Top 5" for most dangerous cities in America (and has been #1 before) [1]. The struggles of this city only increased when, on February 26, 2015, the EPA informed Michigan officials that corrosion of the water pipes was contaminating Flint's water supply with lead. Governor Snyder declared a state of emergency in Flint, and supplies were immediately sent to the city, including thousands of cases of water bottles. In January of 2016 President Obama signed an emergency declaration for Flint and demanded the National Guard to aid the devastated city in any way possible [2].

[illegible]

The Product

The ongoing water crisis has led to the development of this water filter. This device can be attached to the faucet of a kitchen sink. The water will run through the piping of the unit into the filter itself, which will extract the lead and other minerals from the water. This filtered water is then poured out of the spout, and the user will then have access to clean water.

The technology within this unit allows the filter to identify unsafe minerals and remove them from the water.

Without this Filter

Although the city switched back to Detroit water in October of 2015, the water is still contaminated. Excessive amounts of lead have already been found in children's blood and will continue to significantly affect young people exposed to this lead. Legionnaire's disease will continue spreading throughout the city [2]. Flint's economy will continue to plummet as more and more people try to avoid the place. Altogether, Flint will have to deal with yet another issue that may bring the city to its knees.

[illegible]

The Future of Flint

This product is by no means the answer to Flint's water crisis. Continuous work is needed on both the city and state level to permanently solve this problem. For now, this water filter serves as a great temporary solution. Tap water can now be filtered, which saves people from having to constantly purchase cases of water. Flint residents can drink, brush their teeth, cook, and perform other actions without fear of contamination from lead. The city will have some hope and relief as they make their way through this crisis.

Sources:

[1] [illegible]
[2] [illegible]

Temporary Shelter for Disaster Response

Matthew Bowen, Lake Superior State University

Natural Disasters

Climate change is increasing the frequency of natural disasters all over the world. This means that we need more technology to assist in recovery efforts and more resources to help keep people safe and reconstruct damaged infrastructure and homes.

Goal

The goal of this project is to design a multipurpose shelter that is:

- Sturdy
- Lightweight
- Easy to deploy
- Versatile

This device must be easy to use without training

It must be light enough to be carried by a maximum of two people but also large enough to protect several people from wind and rain and snow.

This shelter must also be collapsible and compact while simple in design.

The Design

This expandable frame will have a tarp attached to protect from wind and rain.

The parts will be fabricated from aluminum and joints will be plastic.

Expanded, this structure will cover a [illegible] and when collapsed, can be carried by one person.

The Impact

This device will be an affordable and sturdy way for first responders to protect the people displaced by natural disasters. This device will be the first of many types that are specifically engineered as a tool for natural disaster response.

Adjustable mounts for schools in Turkey

Problem

The issue that the country of Turkey is currently one that other countries also have a problem with. They have a large population of refuge children that are currently lacking an education and are in need of one. The schools that will need to be built need a affordable multi-purpose way to mount devices to the ceilings and walls of the new schools.

Product description

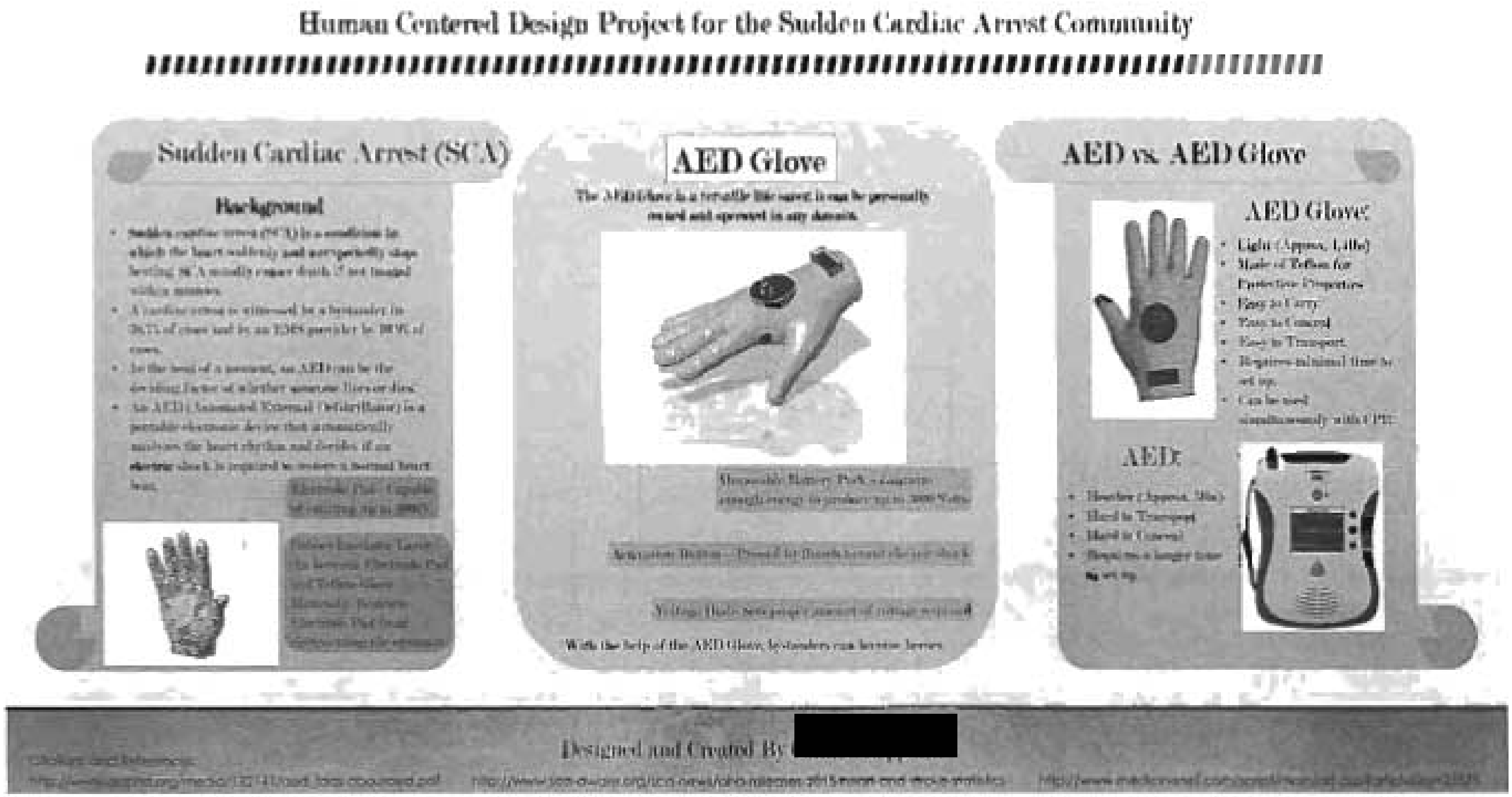
- This product is meant to be used as a mount on flat surfaces such as walls and ceilings.
- It can be used to mount a T.V to walls if needed and will act as a strong support.
- It can also be used to mount things from the ceiling such as a projector and is adjustable so that it is capable of fitting into any room or area.
- The whole product was designed around the area its being used in being a low income area or as a easy to use and affordable alternative to more expensive versions while also maintaining the multi-purpose aspect

Current of the communities before

The schools were having a hard time finding ways to make cuts on the costs of their construction. They needed to find more cost effective solutions due to the budgets the companies were given to construct the schools with and could not afford to go over. The small pieces to each room to make them more accessible and user friendly were the main focuses to the need to cut corners and save money due to all the little things needed to give students a proper class room to learn in, one main focuses was on the tools needed to mount objects and devices to ceilings and walls.

Community wide impact

This product allowed for the schools that were built or repurposed to be able to save money on the purchase of mounts for each room in the schools. In turn this allowed for the money to be spent else ware and allowed for the schools to put more money into getting more advanced learning materials. It also allowed schools to put money back into the communities themselves and to help the prosper.



Human Centered Design Project for the Sudden Cardiac Arrest Community

Sudden Cardiac Arrest (SCA)

Background

- Sudden cardiac arrest (SCA) is a condition in which the heart suddenly and unexpectedly stops beating. SCA usually causes death if not treated within minutes.
- A cardiac arrest is witnessed by a bystander in [illegible] of cases and by an EMS provider in [illegible] of cases.
- In the heat of a moment, an AED can be the deciding factor of whether someone lives or dies.
- An AED (Automated External Defibrillator) is a portable electronic device that automatically analyzes the heart rhythm and decides if an electric shock is required to restore a normal heart beat.

AED Glove

The AED Glove is a versatile life saver. It can be personally owned and operated in any domain.

With the help of the AED Glove, by-standers can become heroes

AED vs. AED Glove

AED Glove:

- Light (Approx. [illegible])
- Made of Teflon for Protective Properties
- Easy to Carry
- Easy to Control
- Easy to Transport
- Requires minimal time to set up.
- Can be used simultaneously with CPR

AED:

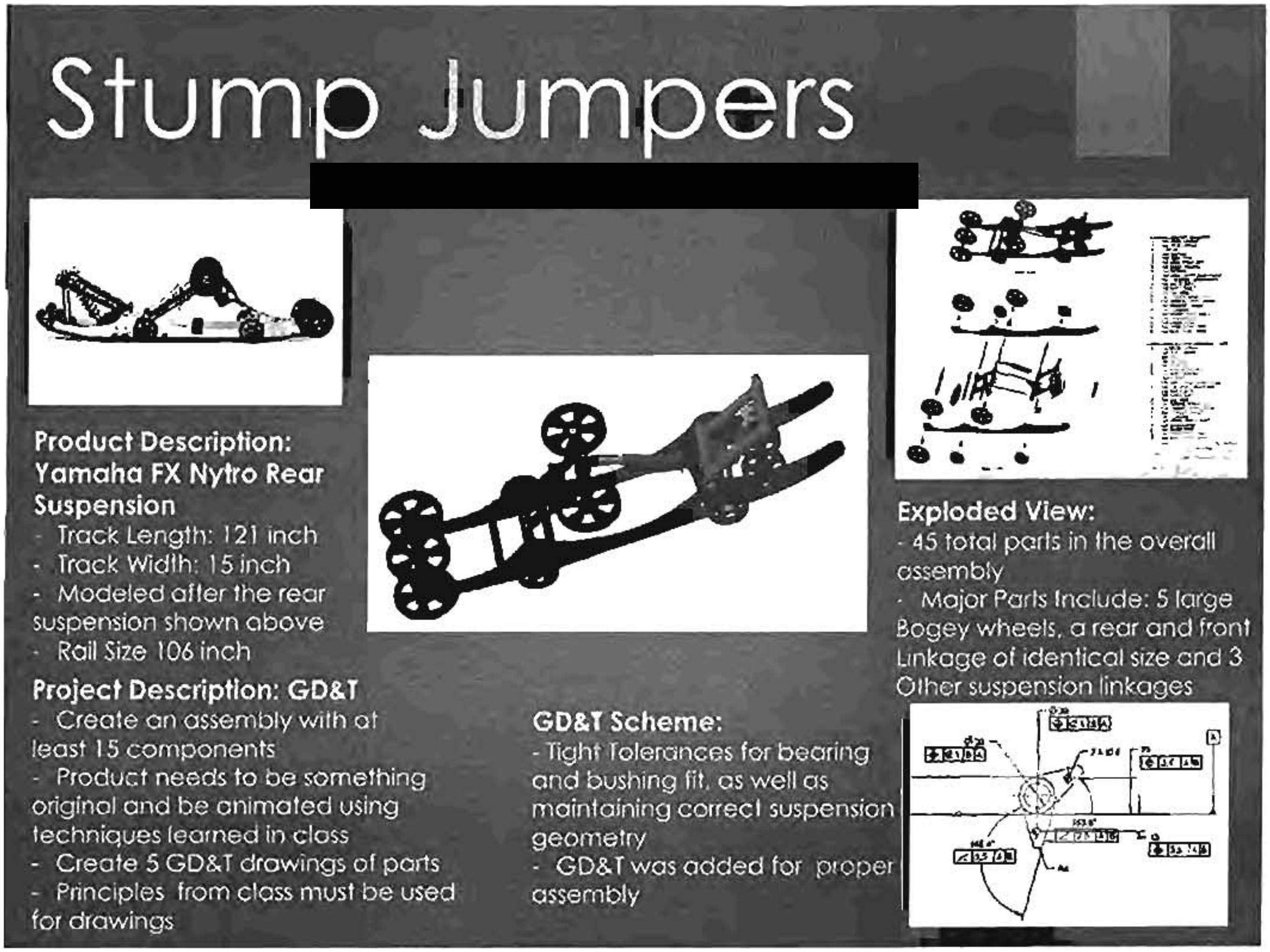
- Heavier (Approx. [illegible])
- Hard to Transport
- Hard to Control
- Requires a longer time to set up

Designed and Created By [redacted]

Citations and References:

[illegible] http://www.sca-aware.org/sca-news/aha-releases-2015-heart-and-stroke-statistics [illegible]

In EGME240 Assembly Modeling and GD&T, students work on a final project that culminates a semester-long course in assembly modeling and the application of geometric tolerancing and dimensioning. Sample final posters of student work are included below:



Stump Jumpers

[redacted]

Product Description: Yamaha FX Nytro Rear Suspension

- Track Length: 121 inch
- Track Width: 15 inch
- Modeled after the rear suspension shown above
- Rail Size 106 inch

Project Description: GD&T

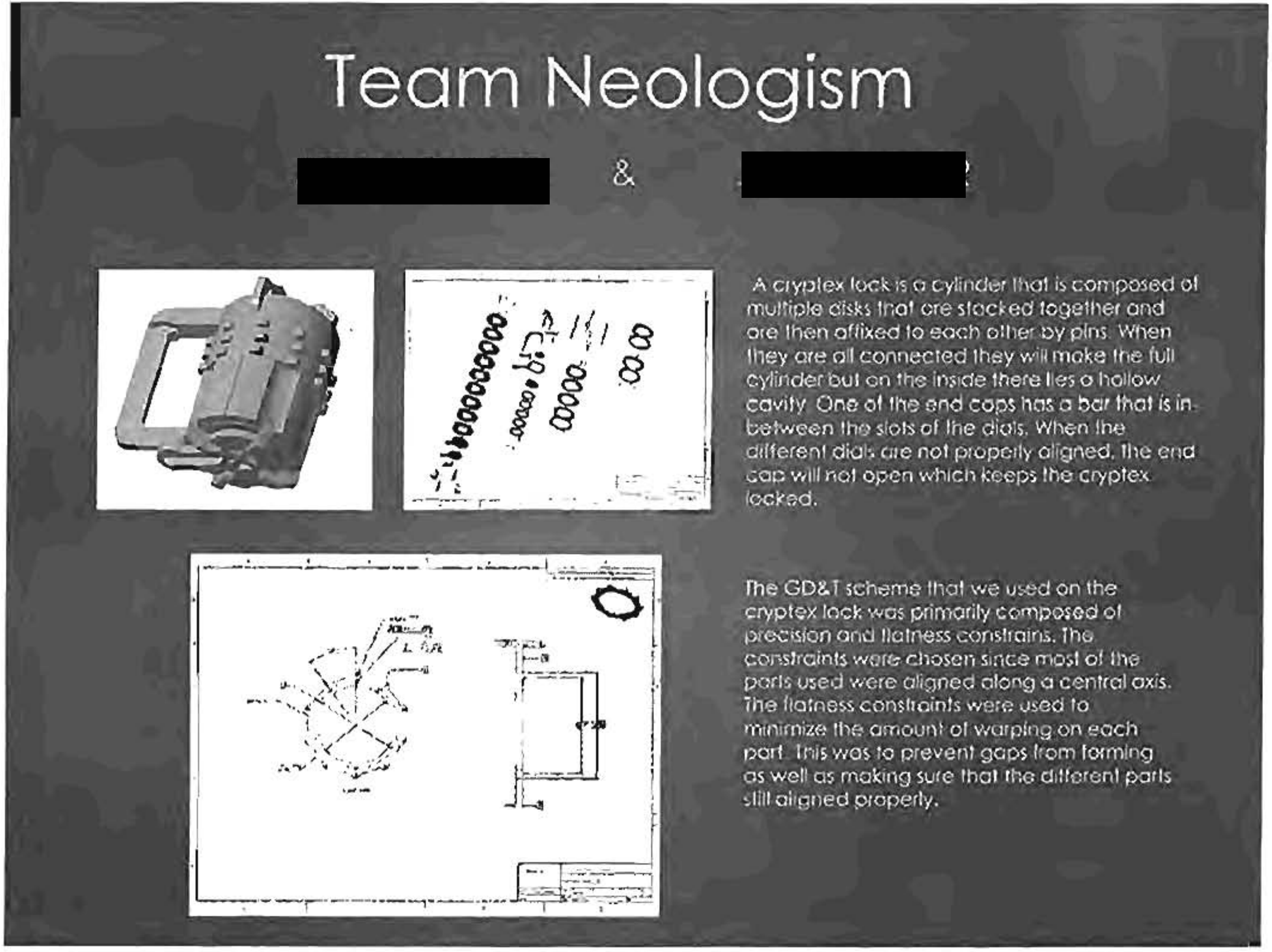
- Create an assembly with at least 15 components
- Product needs to be something original and be animated using techniques learned in class
- Create 5 GD&T drawings of parts
- Principles from class must be used for drawings

GD&T Scheme:

- Tight Tolerances for bearing and bushing fit, as well as maintaining correct suspension geometry
- GD&T was added for proper assembly

Exploded View:

- 45 total parts in the overall assembly
- Major Parts Include: 5 large Bogey wheels, a rear and front Linkage of identical size and 3 Other suspension linkages



Team Neologism

[redacted] & [redacted]

A cryptex lock is a cylinder that is composed of multiple disks that are stacked together and are then affixed to each other by pins. When they are all connected they will make the full cylinder but on the inside there lies a hollow cavity. One of the end caps has a bar that is in-between the slots of the dials. When the different dials are not properly aligned, the end cap will not open which keeps the cryptex locked.

The GD&T scheme that we used on the cryptex lock was primarily composed of precision and flatness constrains. The constraints were chosen since most of the parts used were aligned along a central axis. The flatness constraints were used to minimize the amount of warping on each part. This was to prevent gaps from forming as well as making sure that the different parts still aligned properly.

As part of a senior design experience, students can choose from three multi-course tracks: industrial project, research project, or cooperative education project. As taken from the 2016 ABET ETAC Self-Study Report, page, Thus, for most students, the senior design experience at LSSU involves participating in an intensive design project that spans two semesters. Students work on multidisciplinary teams (i.e., typically a mix of students from the disciplines MfgET, EET, ME, EE, and CE), often 4-7 students depending on the scope. They normally design and build a product for an industrial customer; some projects, however, are supported directly by LSSU. Typical project budgets are $5000 - $30,000, but have occasionally fallen out of that range on both ends. Examples of projects from the past few years which have involved MfgET students are:

Design and development of a robotics assembly line, incorporating four FANUC robotics, and end-of-arm tooling, and including a robotics-playing-tetris demo, for use in LSSU laboratory courses in robotics. Design and implementation of of a robotics workcell to simulate the dispensing of a wood filler product into railroad ties. A robot, using custom end of arm tooling and a machine vision system, locates the positions of spike holes on railroad ties as they move by on a continuous conveyor, serving as a proof-of-concept for future development of a wood product dispensing system in the railroad industry. A study of the development of an LNG barge to refuel freighters on the Great Lakes, including the building of a small (lab-scale) wave tank for capsize stability testing with sloshing liquid cargo. Design and build of an automated hydraulics control cart for offshore machining operations, and development/implementation of a method for hydraulic leak detection. Design, fabrication, and validation of an impact testing stand for automotive steering systems (tie rod impact). Design and development of a stand-alone robotics work cell to be used by local pharmacists to fill prescriptions.

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering and Technology**
Document Title (If attached) or Filename (If emailed):	**Four-Column Report**
This documentation is relevant to Question number:	**13**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Evidence that Four-Column Report was completed.**

Assessment: Program Four Column

Program (CoIS) - Manufacturing Eng Technology BS

Assessment Contact: Dr. Paul Weber, Chair

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
Criterion 3.a - Students will be able to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities. **Goal Status:** Active **Goal Category:** Student Learning **Institutional Learning:** ILO2 - Use of Evidence - Students will identify the need for, gather, and accurately process the appropriate type, quality, and quantity of evidence to answer a complex question or solve a complex problem.	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There are two performance indicators for Criterion 3.a. Performance Indicator #a1-the ability to use an industrial robot to automate a manufacturing process in EGRS-381 (Robotics Technology Lab) on a project report and robot code on setting-up a Staubli robot for automating an advanced palletization task or a machine tending task using VAL3 programming and I/O communications. Performance Indicator #a2-the ability to describe how to set-up G&M code using CAM software to machine a given part in EGMT-216 (CAM with CNC Applications) on the final exam question on setting up CAM file in CREO. **Criteria Target:** 3.0 out of 4 on at	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Performance Indicator #a1-No data. Performance Indicator #a2- 3.13 (08/30/2018)	**Use of Result:** For EGRS 381, we will assess in the Fall of 2018. For EGMT 216, we saw improvement over the last two offerings. The description/steps needed to meet the standard were reviewed during every lab lecture and in the course lecture. All CAM assignments involved the same steps in generating CAM files. This is a very repetitive exercise, but remains a key indicator for understanding the structure of CAM programs. We will continue to develop a laboratory manual that will document the steps for this performance indicator and can be reviewed during each laboratory CAM activity. (08/30/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** No Performance Indicator #a1-No data Performance Indicator #a2-2.5 (08/30/2017)	**Use of Result:** For EGRS 381 we will collect data in the Fall of 2018. For EGMT 216, there was slight improvement over the last offering. We will continue to develop a laboratory manual that will document the steps for this

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
	least one performance indicator, with no performance indicator below 2.0. **Schedule/Notes:** 1- Unacceptable, 2- Below Standard, 3-Meets Standard, 4-Exemplary		performance indicator and can be reviewed during each laboratory CAM activity. (08/30/2017)
Criterion 3.b - Students will be able to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Mid-Level (Analyzing/Applying) (Bloom) **Institutional Learning:** ILO3 - Analysis and Synthesis - Students will organize and synthesize evidence, ideas, or works of imagination to answer an open-ended question, draw a conclusion, achieve a goal, or create a substantial work of art	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There are two performance indicators for Criterion 3.b. Performance Indicator #b1-the ability to apply calculus of several variables in EGNR-245 (Calculus Applications for Technology) on a project on derivation of the formula for the least-squares line. Performance Indicator #b2-the ability to implement an iterative solution to a complex problem in metallurgy in EGME-275 (Engineering Materials) on a MATLAB exercise on cold work – annealing cycles. **Criteria Target:** 3.0 out of 4 on at least one performance indicator, with no performance indicator below 2.0. **Schedule/Notes:** 1- Unacceptable, 2- Below Standard, 3-Meets Standard, 4-Exemplary	**Finding Reporting Year:** 2017-2018 **Goal met:** No Performance Indicator #b1-No data Performance Indicator #b2- 2.54 (08/23/2018) **Finding Reporting Year:** 2016-2017 **Goal met:** No Performance Indicator #b1- no data Performance Indicator #b2- The MATLAB data was inadvertently lost. (08/23/2017)	**Use of Result:** For EGNR-245, we will collect data in the Fall of 2018. For EGME 275, the results were marginally acceptable overall given the small class size. We will need to see how this develops in the future before taking any decisions. (08/23/2018) **Use of Result:** For EGME 275, create a reminder in the grade-book spreadsheet, to retain copies of the needed MATLAB exercise. (08/23/2017)
Criterion 3.c - Students will have the ability to conduct standard tests and measurements; to conduct, analyze,	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Performance Indicator #c1- 3.0	**Use of Result:** In EGNR 310, in the next offering, emphasize the necessity to document and

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
and interpret experiments; and to apply experimental results to improve processes. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Mid-Level (Analyzing/Applying) [Bloom] **Institutional Learning:** ILO3 - Analysis and Synthesis - Students will organize and synthesize evidence, ideas, or works of imagination to answer an open-ended question, draw a conclusion, achieve a goal, or create a substantial work of art.	ABET report. There are two performance indicators for Criterion 3.c. Performance Indicator #c1-the ability to develop a valid and reliable experimental procedure that will validate a product EGNR-495 [Engineering Design Project II] on the design review on final product testing. Performance Indicator #c2-the ability to use statistical methods to plan an efficient, yet effective, program of experimentation, when the output variable studied is expected to depend on multiple input variables in EGNR-310 [Quality Engineering] on the term project technical report. **Criteria Target:** 3.0 out of 4 on at least one performance Indicator, with no performance indicator below 2.0. **Schedule/Notes:** EGNR 310 is an alternate year course. 1- Unacceptable, 2-Below Standard, 3-Meets Standard, 4-Exemplary **High Impact Program Practices 1:** Capstone Course(s), Projects	Performance Indicator #c2- 2.5 (08/23/2018)	explain methodology for construction of the test programme as part of the assignment. Although that was done verbally this time (in response to the same action plan after last offering), it needs perhaps more emphasis in the handout itself. In EGNR 495, given that all teams met standard and that there were no common weaknesses noted, there is no cause for concern. The present setup should be continued. (08/23/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** Yes Performance Indicator #c1- No MET students in this offering. Performance Indicator #c2-Alternate year course (08/23/2017)	
Criterion 3.d - Students will have the ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives.	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There are two performance indicators for Criterion 3.d.	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Performance Indicator #d1-3.0 Performance Indicator #d2- No data (08/23/2018)	**Use of Result:** For EGRS-481, we will collect date in the Fall of 2018. For EGNR 491, • All teams met standard and there were no common issues noted. There were no stand-outs

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
Goal Status: Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** High-Level (Creating/Evaluating) (Bloom) **Institutional Learning:** ILO2 - Use of Evidence - Students will identify the need for, gather, and accurately process the appropriate type, quality, and quantity of evidence to answer a complex question or solve a complex problem.	Performance Indicator #d1-the ability to reformulate implied customer needs as specifications and produce an acceptable design solution in EGNR-491 (Engineering Design Project I) on the product design review. Performance Indicator #d2-the ability to use a discrete event manufacturing simulation software to analyze and optimally improve the throughput of a manufacturing system in EGRS-481 (Manufacturing Automation Lab) on the lab report of Witness simulation of TV manufacturer factory.		but none were unacceptable either; they were all where they needed to be. From the in-person semester feedback, students indicated that most have had some experience in other classes prior to Senior Projects and the information is further reinforced here. • ICs attended all design reviews and their feedback was positive which provides a little bit of external validation. • There is no cause for concern; the present setup should be continued. (08/23/2018)
	Criteria Target: 3.0 out of 4 on at least one performance indicator, with no performance indicator below 2.0. **Schedule/Notes:** 1- Unacceptable, 2- Below Standard, 3-Meets Standard, 4-Exemplary	**Finding Reporting Year:** 2016-2017 **Goal met:** Yes Performance Indicator #d1-3.0 Performance Indicator #d2-No data (08/23/2017)	**Use of Result:** • No modifications needed; almost all students have had some experience in other classes prior to Senior Projects and the information is further reinforced here. The current setup should continue to be used and all team evaluations should be collected. • There is no cause for concern. (08/23/2017)
Criterion 3.e - Students have the ability to function effectively as a member or leader on a technical team. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Level 4 (Extended Thinking) (Webb) **Institutional Learning:** ILO4 - Professional Responsibility -	**Indirect - Report/Audit - Internal -** Assessment of this criterion is documented in Appendix G of the ABET report. There is one performance indicator for Criterion 3.e. Performance Indicator #e1-the ability to provide constructive criticism of team members in EGNR-	**Finding Reporting Year:** 2017-2018 **Goal met:** No Performance Indicator #e1- 2.8 (08/23/2018)	**Use of Result:** Five out six met standard. Taking the EGNR 495 class as a whole, while there are a few outliers that were below standard or unacceptable, 87.5% of the students met standard or were deemed exemplary. There is no cause for concern. The current setup should be continued. (08/23/2018)

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
Students will demonstrate the ability to apply professional ethics and intercultural competence when answering a question, solving a problem, or achieving a goal	495 (Engineering Design Project II) on peer evaluations **Criteria Target:** 3.0 out of 4 on at least one performance indicator, with no performance indicator below 2.0. **Schedule/Notes:** 1- Unacceptable, 2-Below Standard, 3-Meets Standard, 4-Exemplary **High Impact Program Practices 1:** Capstone Course(s), Projects	**Finding Reporting Year:** 2016-2017 **Goal met:** No Performance Indicator #e1-2.9 (08/23/2017)	**Use of Result:** A large majority of the responses (35 out of 39) were 3 or higher, so the average of 2.9 vs 3.0 does not seem statistically significant. • The completion of these 3 times during the year seems to help reinforce the ability to complete such evaluations. There is no need for modification. • There is no cause for concern. (08/23/2017)
Criterion 3.f - Students have the ability to identify, analyze, and solve broadly-defined engineering technology problems. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** High-Level (Creating/Evaluating) (Bloom) **Institutional Learning:** ILO3 - Analysis and Synthesis - Students will organize and synthesize evidence, ideas, or works of imagination to answer an open-ended question, draw a conclusion, achieve a goal, or create a substantial work of art.	**Indirect - Report/Audit - Internal -** Assessment of this criterion is documented in Appendix G of the ABET report. There are two performance indicators for Criterion 3.f. Performance Indicator #f1-the ability to identify possible reasons that a product or process may fail to function well, and categorize these in EGNR-310 (Quality Engineering) on homework on fishbone chart exercise. Performance Indicator #f2-the ability to calculate stress and strain in axial loading of a bar in EGMT-225 on exam 3, axial loading problem. **Criteria Target:** 3.0 out of 4 on at least one performance indicator, with no performance indicator below 2.0.	**Finding Reporting Year:** 2017-2018 **Goal met:** No Performance Indicator #f1- 2.75 Performance Indicator #f2- 2.0 (08/23/2018) **Finding Reporting Year:** 2016-2017 **Goal met:** No Performance Indicator #f1- Not offered Performance Indicator #f2- No data (08/23/2017)	**Use of Result:** In EGNR 310, there were only four students, three of whom scored a 3. There are no large concerns. However, it was noted that we should annotate grade roster with highlighting to prompt copying and retention of the records. In EGMT 225, there is definitely a cause for concern since only two out of seven student work samples were "Meets Standard" or higher, while the coverage is extensive and expectation for achievement is high. (08/23/2018)

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
	Schedule/Notes: EGNR-310 and EGEE-355 are alternate year courses. 1- Unacceptable, 2-Below Standard, 3-Meets Standard, 4-Exemplary		
Criterion 3.g - Students are able to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Mid-Level (Analyzing/Applying) (Bloom) **Institutional Learning:** ILO1 - Formal Communication - Students will develop and clearly express complex ideas in written and oral presentations.	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There are two performance indicators for Criterion 3.g. Performance Indicator #g1-the ability to make formal engineering presentations in EGNR-495 [Engineering Design Project II] on the final project presentations. Performance Indicator #g2-the ability to write prose containing technical information in EGME-276 [Strength of Materials Lab on the lab 3 (metallography II) technical report. **Criteria Target:** 3.0 out of 4 on at least one performance indicator, with no performance indicator below 2.0. **Schedule/Notes:** 1- Unacceptable, 2-Below Standard, 3-Meets Standard, 4-Exemplary **High Impact Program Practices 1:** Capstone Course(s), Projects	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Performance Indicator #f1- 3.0 Performance Indicator #f2- 2.67 (08/23/2018)	**Use of Result:** For EGME 276, two out of the three students in this program scored a 3 and the other student scored a 2. No corrective action is required. For EGNR 495, • The teams get a lot of practice between the scope presentation, update presentations, and these final presentations and it shows. This is also externally validated to some degree by the ratings of the external reviewers (e.g. IAB members). • There is no cause for concern. This setup should be continued. (08/23/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** Yes Performance indicator #g1-3 Performance indicator #g2-2.5 (08/23/2017)	**Use of Result:** In EGNR 495, the teams get a lot of practice between the scope presentation, update presentations, and these final presentations and it shows. There is no cause for concern. In EGME 276, three out of the four students in this program scored a 3 and the other student scored a 1. There will be no actions taken at this time, but we will continue to monitor this outcome. (08/23/2017)

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
Criterion 3.h - Students demonstrate an understanding of the need for and an ability to engage in self-directed continuing professional development. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Level 4 (Extended Thinking) [Webb] **Institutional Learning:** ILO4 - Professional Responsibility - Students will demonstrate the ability to apply professional ethics and intercultural competence when answering a question, solving a problem, or achieving a goal.	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There is one performance indicator for Criterion 3.h. Performance Indicator #h1-the ability to define and clarify customer needs through technical investigation in EGNR-495 (Engineering Design Project II) on the FA evaluation of each team member at end of semester. **Criteria Target:** 3.0 out of 4 **Schedule/Notes:** 1- Unacceptable, 2- Below Standard, 3-Meets Standard, 4-Exemplary **High Impact Program Practices 1:** Capstone Course(s), Projects	**Finding Reporting Year:** 2017-2018 **Goal met:** No Performance Indicator #h1-2.8 (08/23/2018)	**Use of Result:** • Though the average of the MET students is slightly below 3.0, the overall average has been slightly over 3.0 (meeting standard) for the last two years and self-evaluation of this outcome has been relatively high on the Senior Exit Surveys, so no individual assignment is deemed necessary at present. • There is no cause for concern. (08/25/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** Yes Performance Indicator #h1-3.1 (08/23/2017)	**Use of Result:** Based on the assessment results from the last offering, some slides in the first lecture were added to provide expectations and guidance in this area. There was a small improvement in the overall average rating, but it is difficult to discern if there was a causal relationship due to the small sample size. If this is an issue in the future, an individual assignment may be needed. There is no concern. (08/23/2017)
Criterion 3.i - Students have an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Level 4 (Extended Thinking) [Webb]	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There is one performance Indicator for Criterion 3.i Performance Indicator #i1-the ability to apply perspectives from	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Performance Indicator #i1- 3.2 (08/23/2018)	**Use of Result:** All teams met standard or were deemed exemplary. There is no cause for concern. Students continued to report higher levels of engagement in the material with Dr. Swedene teaching it. The present setup with Dr. Swedene should be continued. See the

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
Institutional Learning: ILO4 - Professional Responsibility - Students will demonstrate the ability to apply professional ethics and intercultural competence when answering a question, solving a problem, or achieving a goal.	established ethical philosophies in the analysis of a case study in EGNR-495 [Engineering Design Project II] on the ethics essay **Criteria Target:** 3.0 out of 4 **Schedule/Notes:** 1- Unacceptable, 2-Below Standard, 3-Meets Standard, 4-Exemplary **High Impact Program Practices 1:** Capstone Course(s), Projects		comments in course report for minor adjustments. (08/25/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** Yes Performance indicator #I1-3.1 (08/23/2017)	**Use of Result:** This year in an effort to improve this outcome, Dr. Jason K. Swedene, Professor of Philosophy and Humanities at LSSU, taught the engineering ethics portion (which is contains the contemporary topics aspects) and it seemed to go well. The students found his teaching style engaging, which is especially important for a topic that students sometimes view as peripheral rather than essential. The outcomes were satisfactory. This setup should be continued in the future. There is no cause for concern. (08/23/2018)
Criterion 3.J - Students have a knowledge of the impact of engineering technology solutions in a societal and global context. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Level 4 (Extended Thinking) [Webb] **Institutional Learning:** ILO4 - Professional Responsibility - Students will demonstrate the ability to apply professional ethics and intercultural competence when answering a question, solving a problem, or achieving a goal.	**Indirect - Report/Audit - Internal -** Assessment of this criterion is documented in Appendix G of the ABET report. There is one performance indicator for Criterion 3.J. Performance Indicator #J1-the ability to recognize the impact of engineering technology solutions in a societal and global context in EGME-275 [Engineering Materials] on the final exam question on plastics recyclability **Criteria Target:** 3.0 out of 4 **Schedule/Notes:** 1- Unacceptable, 2-Below Standard, 3-Meets Standard,	**Finding Reporting Year:** 2017-2018 **Goal met:** No Performance indicator #j1- 2.93 (08/23/2018)	**Use of Result:** Out of the 14 students, 10 met the standard or were exemplary. The action item from the last offering was to find an assignment or worked test problem more substantial than the simple multiple choice question used. This should be something requiring more in-depth consideration of societal impacts of a material selection. For instance, require a brief follow-up essay after the textbook problem 11.5, on the impact of long-term trends of reduced iron / increased aluminum usage in automobiles, reducing the

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
	4-Exemplary		average mass per vehicle; it would be useful to see whether the students make a connection to such societal impacts as net (societal) energy consumption. In this offering, the essay assignment was developed as described. No new action item seems to be necessary as the results are good, and because this is only a single year's data. (08/23/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** No Performance Indicator #j1- Concerns about the assessment as written were stated in the course report. (08/23/2017)	**Use of Result:** Find an assignment or worked test problem more substantial than the simple multiple choice question used. This should be something requiring more in-depth consideration of societal impacts of a material selection. For instance, require a brief follow-up essay after the textbook problem 11.5, on the impact of long-term trends of reduced iron / increased aluminum usage in automobiles, reducing the average mass per vehicle; it would be useful to see whether the students make a connection to such societal impacts as net (societal) energy consumption. (08/23/2017)
Criterion 3.k - Students have a commitment to quality, timeliness, and continuous improvement. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Level 2 (Skills and Concepts) (Webb)	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There is one performance indicators for Criterion 3.k.	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Performance Indicator #k1-3.3 (08/23/2018)	**Use of Result:** Already a subject of great emphasis, and no extensive problems in performance, so no changes recommended. (08/23/2018)
		Finding Reporting Year: 2016-2017	

Student Learning Outcomes	Assessment Criteria & Procedures	Assessment Results	Use of Results
Institutional Learning: ILO4 - Professional Responsibility - Students will demonstrate the ability to apply professional ethics and intercultural competence when answering a question, solving a problem, or achieving a goal.	Performance Indicator #k1-the ability to analyze, by methods of statistical process control, data representing output of a continuously monitored manufacturing process, in order to make early detection of any drift away from the target values of the output in EGNR-310 (Quality Engineering) on homework 5, control charts (statistical process control) **Criteria Target:** 3.0 out of 4 **Schedule/Notes:** EGNR-310 is an alternate year course. 1- Unacceptable, 2-Below Standard, 3-Meets Standard, 4-Exemplary	**Goal met:** Yes Performance Indicator #k1-Not offered (alternate year course) (08/23/2017)	

Appendix Cover Sheet

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering and Technology**
Document Title (if attached) or Filename (if emailed):	**Degree Audit Form – Manufacturing Engineering Technology – BS**
This documentation is relevant to Question number:	**15**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Degree Audit form with required courses listed for program completion.**

LSSU - School of Engineering and Technology – DEGREE AUDIT

B.S. Degree in Manufacturing Engineering Technology, Fall 2018 & Later

Name: ________________________ ID#: ________________________

________________________ Intended Month/Year of Graduation: ____________
Advisor Approval Date

All information below should be from the student's most recent transcript and/or transfer evaluation sheet. Attach substitution/waiver forms as necessary.

GEN-ED REQUIREMENTS (22 CREDITS)

Oral and Written Communication - (min. 9 credits)

ENGL110[1] - 3 ________

ENGL111 - 3 ________

COMM101, 201, or 225 - 3 ________

Humanities - (min. 6 credits, 2 courses from different disciplines)

____________ ________
____________ ________

Social Science - (7 credits, 2 courses from different disciplines)

ECON302[2,4] - 4 ________

2nd Soc Sci Course (not ECON)

____________ ________

Natural Science - (8 credits)

Fulfilled by Dept. Requirements

Cultural Diversity (3 credits)

____________ ________

Computational Literacy (3 credits)

Fulfilled by Dept. Requirements

☐ GEN-ED REQUIREMENTS met by MTA or macrao

Chair Approval ________________________

DEPARTMENTAL REQUIREMENTS (102 CREDITS)

CHEM108[4] - 3 ________
CHEM109[4] - 1 ________
ECON302[2,4] - 4 ________
EGEE125 - 4 ________
EGET110[1] - 4 ________
EGET175[3] - 4 ________
EGME110 - 3 ________
EGME141 - 3 ________
EGME240 - 3 ________
EGME275 - 3 ________
EGME276 - 1 ________
EGMT216[3] - 3 ________
EGMT225 - 4 ________
EGNR101 - 2 ________
EGNR140 - 2 ________
EGNR245[3] - 3 ________
EGNR265[6] - 3 ________
EGNR310[3] - 3 ________
EGNR491[5] - 3 ________
EGNR495[5] - 3 ________
EGRS380 - 2 ________
EGRS381 - 1 ________
EGRS365 - 3 ________
EGRS480 - 3 ________
EGRS481 - 1 ________
MATH102[1] -(4) ________
MATH111 - 3 ________
MATH112[4] - 4 ________
MATH131 - 3 ________
MATH207 - 3 ________
MGMT360 - 3 ________
PHYS221[4] - 4 ________

Tech. Elec[3] - 10

________ ______ ____
________ ______ ____
________ ______ ____

Free Elec. - 3 ________

______ 2.0 Overall GPA
______ 2.0 Dept. GPA
______ Min. 124 Tot. Credits
______ Residency
(min. 32 LSSU credits and min. 50% of LSSU 300/400 courses)

1Students placed in MATH102 should take the social science elective in a summer or later semester. The MATH102 course credits (4 credits) do not apply towards the total credits required for the B.S. degree program.

2These courses may be offered only every other year.

3For the **Minor in Robotics Technology:** *EGRS430 Systems Integration and Machine Vision (4 credits) course and EGNR496 Senior Directed Project (3 credits) course are required for the technical elective.* **Allowed Technical Electives (select 3 credits to complete Robotics Minor, 10 credits otherwise):** *EGNR250 Cooperative Education (2 credits), or EGRS215 Introduction to Robotics, or EGEE250 Micro-Controller Fundamentals (4 credits), or EGNR261 Energy Systems/Sustainability (3 credits), or EGME310 Vehicle Development & Testing (2 credits), or MGMT371Operations/Business Analytics (3 credits), or EGET310 Electronic Manufacturing Processes or other technical courses as approved by program advisor.*

4 The Chemistry, Economics, Physics and Math courses listed satisfy the general education and departmental requirements.

5Other approved senior project course sequences are:

Co-op: EGNR450 Proj I(4), EGNR450 Proj II(3), and EGNR491(3) OR
Research: EGNR260(2), EGNR460(4) and EGNR461(2)
6 Grade of C or better required.

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	Engineering and Technology
Document Title (If attached) or Filename (If emailed):	ABET Report
This documentation is relevant to Question number:	15
Briefly summarize the content of the file and its value as evidence supporting program review:	Main body of abet report. All appendices and supporting documents are available in CAS 203.

ABET
Self-Study Report

for the

Bachelor of Science
Manufacturing Engineering Technology Program

at

Lake Superior State University

Sault Ste Marie, Michigan

July 1, 2016

CONFIDENTIAL

Table of Contents

List of Appendices

A. *Course Syllabi (Abbreviated ABET Format)*

B. *Faculty Vitae*

C. *Equipment List*

D. *Institutional Summary*

E. *University Organizational Chart*

F. *Select Course Syllabi (Full Format)*

G. *Course Assessment Summary Reports*

H. *Student Outcome Evaluation Reports*

I. *Senior Exit Surveys*

J. *Sample Pre-Requisite Form*

K. *Faculty Agreement (Contract)*

L. *ME/MfgET Prerequisite Excusal, Sub and Waiver Policy*

Program Self-Study Report
for
ETAC of ABET
Accreditation or Reaccreditation

BACKGROUND INFORMATION

A. Contact Information

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B. Program History

Lake Superior State University (LSSU) was originally founded in 1944 as a branch of what is known today as Michigan Technological University, based in Houghton, Michigan. In 1969, the Sault Ste Marie campus gained autonomy from Michigan Technological University. Over time, three bachelor of science programs in engineering technology were introduced and accredited -- Mechanical Engineering Technology (1977), Electrical Engineering Technology (1981), and Manufacturing Engineering Technology (1987). The MET and EET programs received continuous TAC of ABET accreditation until 1999, but were eventually discontinued in favor of new programs in Mechanical an Electrical Engineering (now accredited through 2019, and joined by Computer Engineering). The MfgET program is still in place and is currently accredited by ETAC of ABET through 2017, and is joined by a companion program in Electrical Engineering Technology (reintroduced; i.e., not a continuation of the earlier EET program) which is up for its first accreditation visit in 2016.

Since the last general review, there have been no *major* changes to the program curriculum. The sequence of courses in the generic plan-of-study has been modestly revised to reflect switches of courses between Fall and Spring semesters-of-offering, the list of technical elective alternatives has added and dropped some courses, and there have been minor changes to individual core courses. For instance, EGME276 now requires EGMT225 as a *pre*-requisite, whereas previously it had been a *co*-requisite, the EGME312 course (CAM with CNC) is now called EGMT216 (change in number and designation), and the EGNR140 course revised its catalog description to better reflect content. But, there is no major change in the curriculum.

More substantially, the "program outcome objectives" (POOs) of the MfgET program, previously authored locally by the SET faculty, were replaced around 2013 with new "student outcomes" (SOs) that are identical to the ETAC of ABET criterion 3, (a) – (k) learned capabilities. (This was much at the advice of a visiting EAC of ABET team in 2012, reinforced by impressions obtained by some of the faculty leadership at an ABET program assessment workshop in early 2013.) Program Educational Objectives (PEOs) and the mission were updated about a year later, in 2014. Finally, there have been numerous changes in the actual faculty members closely connected with instruction of the MfgET program, since the last visit. But none of these changes has had a substantial impact upon the program curriculum itself, as noted above.

C. Options

There are no options or concentrations in the MfgET program at this time, although the program does offer a significant number of technical elective courses. However, students can, and often do, earn a minor in Robotics Technology while pursuing the MfgET BS degree; it can be obtained by a judicious selection of technical electives for the MfgET degree, but inevitably requires at least one extra course.

D. Program Delivery Modes

The MfgET program is delivered predominately as an on-campus program with face-to-face lectures and labs. Lecture and lab times have been weekdays from 8am through 10pm, but beginning in the 2016-2017 academic year, the 8am classes will be eliminated. Co-operative education is encouraged and one of the School faculty members (Paul Weber) serves a co-op coordinator to assist students who wish to pursue this option. Students may use up to three semesters of co-op and one senior project course (EGNR-491) to satisfy their capstone experience requirements.

A few courses had, as recently as 2013, been occasionally offered via distance education as well as traditional face-to-face instruction; these were:

EGNR-310: *Advanced Quality Engineering*
EGRS-380: *Robotics Technology*
EGRS-480: *Controls and Automation*
EGMT-225: *Strength of Materials*

However, with the discontinuance of an unaccredited Engineering Management program, this mode of delivery has fallen into disuse, and there is no expectation that it will be revived.

E. Program Locations

The MfgET program is offered exclusively on the main campus in Sault Ste Marie, Michigan.

F. Public Disclosure

The Mission, Goals, Program Educational Objectives, and Student Outcomes for the MfgET program are made accessible to the public on the LSSU web site at the following URL:

< http://www.lssu.edu/eng/mission.php>

The annual enrollment and graduation data, along with the above information, for the MfgET program are made accessible to the public on the LSSU web site at the following URL:

< http://www.lssu.edu/eng/SETtransparency.php>

G. Deficiencies, Weaknesses or Concerns Documented from the Previous Evaluation

The final statement from the 2010 TAC of ABET visit left unresolved a program concern-level finding relative to criterion 7 (facilities), and a couple of observation-level findings. An initial weakness relative to criterion 4 (continuous improvement) was resolved before the final statement. The unresolved items will be discussed in the following.

Concern, criterion 7. The concern-level finding noted that

> "… The program provides its students with a wide array of technical equipment, computing equipment, and equipment catalogs. However, some of the equipment is dated and may not reflect what graduates will encounter in industry and practice. While the current range of equipment available may be adequate, it is important that students be prepared for professional practice through exposure to the type of equipment they will likely encounter in industry. This finding remains a concern

> until the program demonstrates that its laboratory equipment is characteristic of that encountered in the industry and practice being served by the program."

The program responded with the intention "to increase student fees in the Fall of 2011 to fund laboratory upgrades over time", to which TAC responded, in the final statement, in repetition of the last sentence of the initial findings, that "the finding remains a concern until the program demonstrates that its laboratory equipment is characteristic of that encountered in the industry and practice being served by the program."

Nevertheless, it was *not* subsequently found prudent to increases "program fees", i.e., across-the-board per-credit differential tuition for Engineering Technology (or Engineering) courses. Individual course fees were, however, sometimes increased beginning with the Fall 2011 semester, or later, but not systematically. For instance, the course fee for EGME276, a major laboratory course in the MfgET program, remains in 2016 at the same $70 level as in 2010. But EGME110 Manufacturing Processes, also with a laboratory component, increased its fee from $70 to $80 over that time.

Regardless of the fees (increase or not in any given course), however, new equipment has been provided in various laboratories serving the MfgET and other programs. The workshop laboratory for EGME110, for instance (for which it was noted that fee increased by $10) has indeed benefited from the acquisition of a new CNC lathe and CNC mill since the 2010 visit. As another example, the EGME276 course has benefited from a retrofit, performed by our Mechanical Lab Engineer, of a press for mounting plastic around metallographic samples (for which some replacement parts were purchased), and, for the same course, an extensometer upgrade and calibration in Spring 2011.

Observation, administrative release time. TAC in its 2010 final report noted that

> "the department chair and program coordinator are given one credit hour of reduction in teaching load to administer the program. While this arrangement may currently suffice, it appears to be a small reduction in comparison to the additional administrative responsibilities. It is suggested that teaching and administrative responsibilities of the department chair and program coordinator be monitored to insure that adequate time is available for each component of their workloads."

The program responded that "a campus wide policy is currently being developed for release time for assessment".

It should be noted that the "department chair" position cited in 2010 (then for a Department of ME and MfgET) was changed to a "coordinator" for ME, alongside the MfgET coordinator also referred to in that statement. Since that time, there was an initial, brief increase to 2 release hours for each position, but then a return to 1 release hour for the majority of the 6-year cycle, and finally, beginning this year, the MfgET coordinator became an uncompensated position, and the 1-release hour for the ME coordinator was converted to $907-per-semester cash stipend (equivalent monetary value to 1-release hour, if at the overload rate, but less than the equivalent monetary value at full salary).

Observation, dated textbook for Robotics course. TAC in its 2010 final report noted that

> "the textbook used for EGRS480 Manufacturing Automation has a publication date of 1987. It is suggested that the program review its textbooks to insure that all texts are technologically up-to-date."

The program responded that it was "…considering replacing this textbook with a newer version", and further noted that "…specific pages from an updated textbook on the same material.." were being "…provided to the students through an agreement with the publisher".

Subsequently, the course switched to handouts in lieu of a textbook. The ETAC visitors will be able to verify at the time of the visit, however, there textbooks used the various courses comprising the MfgET program are quite current; these will be available as parts of the display materials.

GENERAL CRITERIA

CRITERION 1. STUDENTS

A. Student Admissions

Admission of First-Time-In College Freshmen into LSSU

LSSU is an "access institution" and has a relatively low standard for admission to the university. Admission is guaranteed with a 2.4 high school GPA and a composite ACT score of 19 or a total revised SAT score of 990. However, other factors such as higher grades, positive recommendations from counselors or other professionals, or time since high school graduation are taken into consideration if the student does not meet these standards.

From the university web site:

> ***Admissions Criteria***
> *The primary factors used to determine admission are cumulative grade point average (GPA), high school course curriculum, and ACT or SAT results. LSSU recommends that students follow a college preparatory curriculum mirroring the Michigan Merit Curriculum. The middle fifty percent of our entering freshman class have high school GPA's ranging from 2.9 to 3.6 and ACT scores ranging from 22-25. Students should feel free to submit any additional materials which may aid the Admissions Office in reviewing unusual circumstances which may have impacted high school performance. ACT or SAT scores will not be used in the admissions process if you graduated from high school two or more years ago.*

The average ACT score of all students enrolled in the MfgET program is shown below in Table 1-1. The average ACT score of all students enrolled in any degree program at LSSU is also shown for comparison.

Table 1-1: ACT Scores of MfgET Students by Academic Year

Year	ACT Scores of MfgET Students	ACT Scores of LSSU Students
2010-2011	22.6	21.6
2011-2012	22.2	21.7
2012-2013	20.7	21.8
2013-2014	22.3	22.0
2014-2015	22.3	22.1
2015-2016	22.2	22.1

Admission into the MfgET Program (Before Fall 2016)

Until Fall 2016, there was no standard for admission into the MfgET program beyond admission into the university. This resulted in students being admitted into the program needing remediation in reading (READ-091), English (ENGL-091), and mathematics (MATH-087-088). Such students stood little chance of completing the MfgET program.

Admission into the MfgET Program (Fall 2016 and Thereafter)

Beginning with Fall 2016, the standard for admission into the MfgET program will be raised. The new admission standard for entry into the MfgET program will be:

> *To be admitted into the B.S. Manufacturing Engineering Technology degree program, a student must have all of the following:*
>
> *1. Acceptance into LSSU.*
>
> *2. Placement into MATH102 or higher (Currently an ACT Math minimum score of 21 or an ACT minimum score of 18 and a COMPASS Algebra A minimum score of 46).*
>
> *3. High school GPA of 2.5 or higher or 19 or more earned credits of university coursework.*

This will result in no students needing mathematics remediation being admitted into the program and far fewer needing reading or English remediation. The admitted students should all have a decent chance of completing the MfgET program.

B. Evaluating Student Performance

Course Grades

Student performance in a course is evaluated by the course instructor, who assigns, at the completion of the course, a grade on an A-F scale, where F is a failing grade; i.e., no courses in the MfgET program are graded on a pass-fail basis, except possibly, at the student's discretion, the free elective 3 credits.

Pursuant to concepts of academic freedom, which are affirmed by the faculty-LSSU collective bargaining agreement, the School of Engineering and Technology does not mandate any methodology by which instructors are to arrive at grades, nor any distribution of grades, etc. Instead, grading policies are left to the judgment of the individual faculty member; the assurance of quality and consistency in grading is therefore *not directly* by virtue of common policies, but rather *indirectly* by virtue of the care taken in the process of making faculty appointments to ensure that the faculty candidate has a mastery of his/her field and is a person of judgment (refer to section 8.D for discussion of this process). Moreover, the Dean prepares performance evaluations of faculty members, as discussed in Criterion 6, and issues of fairness and accuracy of grades could be addressed, and feedback given, if necessary. The student can appeal to the instructor of a course for a grade change, after which there is a well-defined due process procedure involving first the Chair, then the Dean, and finally an ad hoc Grade

Review Board of upper-class students, faculty members, and a dean (each from another area on campus), which recommends to the Provost after hearing all perspectives. With the exceptions noted below in Table 1-2, for a course to satisfy any course requirement in the MfgET program, a student must obtain a passing grade in that course. The exceptional courses are considered to be foundational for further course work in the MfgET program.

Table 1-2. Exceptions to General Grade Rule

MfgET Core Course	Degree Requirement
EGNR-265 "C" Programming	C or better
MATH-111 College Algebra	C or better
MATH-112 Calculus for Business & Life Sciences	C or better
MATH-131 College Trigonometry	C or better

All efforts are made to monitor student performance *during*, and not merely after, a course in order to be in a position to take corrective action, *i.e.*, to encourage better study habits and learning approaches, when appropriate. Thus, instructors are encouraged to submit midterm grades, which not only apprise a student of his/her performance midway through a course, but also alerts the academic advisor and academic support units of the University when that student is not performing well. The *IPASS* program (see Criterion 1 Section D), in particular, can provide an academic intervention in such a scenario.

Course Prerequisites

The MfgET curriculum has a fair amount of prerequisite structure. Thus academic advising, as outlined in Criterion 1 Section D, is especially important. There are, however, instances in which it is in the student's best interest to be allowed to take a course for which the prerequisite requirement has not been met. These are handled on a case by case basis in conjunction with the student, his or her advisor, and the course instructor. To assist in such cases, the ME Department (under which the MfgET program is directly administered) has a written policy with non-binding guidelines for the instructor; usually, if the student has promise to be successful, the waiver will be granted with the student's signed acceptance of the condition to take the prerequisite concurrently, maintain a minimum C grade at mid-term, and acknowledge (in writing) responsibility for self-learning as far as necessary to compensate the prerequisite deficiency. Appendix L contains a current statement of the departmental policy cited. If it is decided to allow the student to take the course, the instructor, or in his absence the School of Engineering and technology chair, will override the prerequisite requirement for that student for that course on the LSSU registration system. Furthermore, during the first session of each School of Engineering and Technology course, all students are required to complete a "Prerequisite Compliance" form, and any exceptions are noted on the form.

With the exceptions noted below in Table 1-3, for a course to serve as a prerequisite for another course in the MfgET curriculum, the student must obtain a passing grade in that course.

Table 1-3. Exceptions to General Prerequisite Rule

MfgET Core Course	Prerequisite Requirement
EGRS-380 Robotics Engineering	C or better in MATH-111 and MATH131
EGRS-480 Manufacturing Automation	C or better in MATH-112 and EGNR265
MATH-111 College Algebra	C or better in MATH-102
MATH-112 College Trigonometry	C or better in MATH-111
MATH-131 College Trigonometry	C or better in MATH-111

C. Transfer Students and Transfer Courses

Acceptance of Transfer Students

The admissions criteria outlined in Criterion 1 Section A applies equally to transfer students, except it is the *"or 19 or more earned credits of university coursework"* that applies rather than the *"high school GPA of 2.5 or higher"*.

Acceptance of Transfer Courses

Courses taken elsewhere with grades less than C- are not transferable to LSSU. For courses from accredited institutions with grades of at least C-, the Admissions Office completes transfer credit evaluations to determine whether the course concerned counts is equivalent to any LSSU course. The decision on courses and transfer credit granted may be appealed first to the academic dean and then to the provost.

It is LSSU policy that if a course taken at another institution is not offered at LSSU, elective credit may be granted for that course. Elective credits may be applied toward total credit requirements for a degree (124 credits for the MfgET program) but may not be used to satisfy any specific course requirement. For purposes of the MfgET program, there are only 3 credits of free elective to which such credit can be applied.

The engineering and engineering technology courses required in the MfgET program, or applicable to it as electives, may transfer in if the *content and prerequisites* are similar in the judgment of the Coordinator of Engineering Technology or the chair of School of Engineering and Technology; in such cases, the student must furnish an official course description from the institution which granted credit.

MACRAO Agreement Between Michigan Colleges and Universities (being phased out)

An agreement regarding the transfer of General Education credit exists between participating Michigan colleges and universities, but is being phased out. This is called the MACRAO transfer agreement. Since LSSU participates fully and without provision in the MACRAO transfer agreement, any transfer student who has completed the General Education requirements at any participating institution automatically meets all General Education requirements at LSSU. The details of this agreement are given below.

A minimum of 30 semester hours of coursework must be taken at one of Michigan's participating community colleges. The courses needed to satisfy the MACRAO requirements are as follows:

English Composition	6 credit hours
Science and Math	8 credit hours Courses must be taken from a minimum of two subject areas. At least one science course must include a laboratory.
Social Science	8 credit hours Courses must be taken from a minimum of two subject areas.
Humanities	8 credit hours Courses must be taken from a minimum of two subject areas.

MTA Agreement Between Michigan Colleges and Universities (now in place)

A new agreement regarding the transfer of General Education credit between participating Michigan colleges and universities has now been initiated. This is called the Michigan Transfer Agreement (MTA)

In order to satisfy the MTA, students must successfully complete at least 30 credits from an approved list of courses at a sending institution with at least a grade of 2.0 in each course. These credits, which will be certified by a sending institution, should be completed according to the following distributions:

One course in English Composition

A second course in English Composition or one course in Communication

One course in Mathematics

Two courses in Social Sciences (from two disciplines)

Two courses in Humanities and Fine Arts (from two disciplines excluding studio and performance classes)

Two courses in Natural Sciences including at least one with laboratory experience (from two disciplines)

Students who complete the MTA and transfer to Lake Superior State University will be considered to have met the general education core requirement (oral and written communication, computational literacy, social science, natural science, and humanities), but not the remainder of the general education requirement (cultural diversity and an oral and written communication elective). Students will still be expected to complete all other general education and degree requirements as required for the completion of their program.

Students who do not complete the entire block of courses required by the MTA will receive credit for the courses they do complete on the basis of individual course evaluation and established transfer equivalencies.

D. Advising and Career Guidance

The purpose of academic advisement is to provide guidance for students to succeed in their academic pursuits. This includes:

a) Advising students on the sequence of courses that should be completed to finish their degree in a timely manner.

b) Providing information on academic support services available on campus such as counseling, preparing resumés and seeking job opportunities.

c) Interpreting LSSU's policies on issues such as dropping courses, taking an "I" grade, transferring courses from other institutions, waiving courses, and substituting courses.

d) Fostering a sense of joint responsibility to lifelong learning.

Academic Advising

All students admitted into the MfgET program are assigned a faculty advisor who teaches courses in their major. Students are notified of their assigned faculty advisor prior to or during their first semester of residence. The School of Engineering and Technology office maintains an updated advisee list. Students may request a change of academic advisor, but the School of Engineering and Technology Chair is responsible for the approval of all advisor changes.

The faculty receives training, in weekly departmental meetings, to allow them to effectively advise their assigned students. Such training includes advising methods, transfer evaluations, degree audits, placement tests, substitution and waiver forms, policies and procedures relevant to student advising, and use of the LSSU academic advising web site, *Anchor Access*, which is based on *Banner*. Additionally such training has occasionally been offered through an all-day, University-wide advising workshop for new faculty (there has been one such during the 6-year cycle, at the end of 2010).

A student and his/her faculty advisor meet a minimum of once per semester.

a) The faculty advisor and student review the student's success toward meeting program objectives and review student progress toward the degree. The student's plan-of-study is updated every semester.

b) The faculty advisor and student plan the student's courses for the next semester. The faculty advisor ascertains that the student has completed prerequisites and is in good scholastic standing before scheduling into any new courses.

c) The School of Engineering and Technology chair and dean both approve all course waivers or substitutions.

Career Guidance

LSSU maintains a Career Center that provides extensive support designed to help students decide and meet their career goals. Some of the services provided include:

- periodic "Resume Workshops" and "Career Exploration Workshops" held throughout the academic year.
- yearly job fair held on the LSSU campus
- career testing and counselling
- on-line career tools

University Seminar Courses

LSSU also offers several courses that are designed to help students achieve their academic goals, succeed in pursuing their degrees at the university, and to select appropriate careers. These courses shown in Table 1-4, which do not count toward any academic School of Engineering and Technology degree but may be helpful to certain students, are listed below along with the associated course description that appears in the LSSU catalog. Few, if any, MfgET students take these courses.

Table 1-4. Seminar Courses for Academic and Career Success

SERV-100 University Success Strategies

Based on assessment of student inventories, students are provided the opportunity to improve their study skills, methods of time management, modes of memorization, note-taking techniques, and university examination preparation. Emphasis is placed on making the transition to university life by focusing on various academic strategies and exposing students to basic information on LSSU programs, policies and procedures. (1,0) I

SERV-125 Career Planning and Decision Making

Expanding awareness of personal strength and career option, this course will help students make realistic decisions relating to planning and implementation of academic and life. (1,0) I

USEM-101 Foundations for Success

Seminar I - This course focuses on academic skills and critical thinking, on knowledge of the institution and the role of higher education, and on personal skills for living, which together are requisite for student success and lifelong learning. Seminar I - Foundations for Success places emphasis on incorporation into university culture, time management, use of campus resources, written and oral presentations, development of critical thinking skills, and strengthening study skills for academic success. (1,0) I

USEM-102 Developing Critical Thinking

Seminar II - Developing Critical Thinking continues the goals of Seminar I while placing emphasis on the application of critical thinking skills to the academic setting. A reading anthology is used as the basis for regular written, and oral communication and a term research paper. While continuing to apply skills and techniques used in Seminar I, students additionally develop cultural literacy and incorporate greater computer usage, and explore campus organizations, community events and community service. (1,0) 1

USEM-103 Thinking about the Discipline

Seminar III - Thinking about the Discipline begins a more focused examination of the applications of critical thinking to the student's discipline. Each school selects a reading anthology suitable for analysis and discussion by its majors in order to examine such as current critical issues, social responsibility, ethics and cultural diversity from the perspective of the student's discipline. Continuing the activities of earlier seminars this course promotes ongoing participation in community events, application of academic success in skills and writing in the discipline. (1,0) 1

USEM-104 Professional Seminar

Seminar IV - Professional Seminar serves as the fourth and final in the series and focuses on introducing the student to their discipline with special emphasis on interviews with professional, examinations of career options, and overviews of the literature and research of their discipline. This course focuses attention on the skills and knowledge base of the profession, features of the work environment, development of resume and career developing activities. (1,0) 1

E. Work in Lieu of Courses

Besides regular course work, three types of experiences, Dual Enrollment, Departmental Examination, Advanced Placement, and College Level Examination Program, may count toward a degree in any LSSU program, including the MfgET program.

Dual Enrollment

High school juniors and seniors may take classes at Lake Superior State University through our High School Dual Enrollment program. These courses may count toward the MfgET program either as a core class (typically MATH-111 College Algebra or MATH-131 College Trigonometry) or as a General Education course. Attendance as a High School Dual Enrollee does not constitute admission into any four-year degree program at the University.

Only students who have received endorsements in Mathematics, Science, Reading, and Writing are eligible to take courses in those areas. All students are eligible to take courses in other areas. Grade point average is not a determining factor in eligibility to enroll.

Departmental Examination

A policy exists for students to "test out" of a course by taking a Departmental Examination. The department is free to administer its own examination for any course that it offers. The student must have the written approval of the School of Engineering and Technology chair to take the examination. The student must receive a grade of C or better on the examination in order to receive credit for the course, in which case the credit earned by exam is recorded as transfer credit on the student's transcript.

Although the policy for Departmental Exams exists, there has not been a single instance of its usage for an MfgET program core or elective course in the past six years.

Advanced Placement (AP)

Course credit is awarded to students who receive a score of 3-5 on any Advanced Placement exam listed in Table 1-5 below. The student will receive credit for the specified courses on the chart after being granted unconditional admission to Lake Superior State University. Note that Table 4 is not a complete list and only includes those courses which may count toward credit in the MfgET program.

Table 1-5: AP Courses for MfgET Program

Advanced Placement Exam	LSSU Course Equivalent	Type of Course in MfgET Curriculum
American Govern & Politics	POLI-110	General Education – Social Science
Art – History of Art	ARTS -250, ARTS-251	General Education – Humanities
Calculus AB	MATH-112	MfgET Core
Calculus BC	MATH-112, EGNR-245	MfgET Core
Chemistry - Score of 3	CHEM-108-109	MfgET Core
English – Language & Composition	ENGL-110, ENGL-111	General Education – Communications
English – Literature & Composition	ENGL-110, ENGL-111	General Education – Communications
European History	HIST-102	General Education – Social Science
French Literature	FREN-355, FREN-356	General Education – Humanities
French Language	FREN-351, FREN-352	General Education – Humanities
German Language	GRMN-241, GERM-242	General Education – Humanities
Human Geography	GEOG-201	General Education – Social Science
Macroeconomics	ECON-201	General Education – Social Science
Microeconomics	ECON-202	General Education – Social Science
Music – Listening & Literature	MUSC-220	General Education – Humanities
Physics C: Mechanics	PHYS-221	MfgET Core
Psychology	PSYC-101	General Education – Social Science
Spanish Language	SPAN-261, SPAN-262	General Education – Humanities
Spanish Literature	SPAN-380, SPAN-381	General Education – Humanities
United States Govern & Politics	POLI-110	General Education – Social Science
United States History	HIST-131, HIST-132	General Education – Social Science
World History	HIST-101, HIST-102	General Education – Social Science

College Level Examination Program (CLEP)

Course credit is also awarded to students who receive a passing score on any College Level Examination Program (CLEP) subject exam listed in Table 1-6 below. The student will receive credit for the specified courses on the chart after being granted unconditional admission to Lake Superior State University. Note that Table 5 is not a complete list and only includes those courses which may count toward credit in the MfgET program.

Table 1-6: CLEP Courses for MfgET Program

CLEP Exam – Passing Score	LSSU Course Equivalent	Type of Course in MfgET Curriculum
American Government – 50	POLI-110	General Education – Social Science
American Literature – 50	ENGL-110, ENGL-111	General Education – Communications
Calculus – 50	MATH-112	MfgET Core
College Composition – 50	ENGL-110	General Education – Communications
English Literature – 50	ENGL-110, ENGL-111	General Education – Communications
French Language – 58	FREN-251	General Education – Humanities
French Language – 66	FREN-251, FREN-252	General Education – Humanities
History of the US I – 50	HIST-131	General Education – Social Science
History of the US II – 50	HIST-132	General Education – Social Science
Introductory Psychology – 50	PSYC-101	General Education – Social Science
Introductory Sociology – 50	SOCY-101	General Education – Social Science
Principals of Macroeconomics	ECON-201	General Education – Social Science
Principals of Microeconomics	ECON-202	General Education – Social Science
Spanish Language – 58	SPAN-261	General Education – Humanities
Spanish Language – 66	SPAN-261, SPAN-262	General Education – Humanities
Western Civilization I – 50	HIST-101	General Education – Social Science
Western Civilization II – 50	HIST-102	General Education – Social Science

F. Graduation Requirements

The name of the degree awarded through successful completion of the MfgET program is Bachelor of Science in Manufacturing Engineering Technology.

Two semesters before the student plans to complete degree requirements and graduate, he/she submits a *Degree Audit* form and a *Declaration of Candidacy for Degree* form to the registrar's office. The *Degree Audit* denotes all previous coursework and lists the courses to be taken during the final two semesters. The faculty advisor, program coordinator, and school chair must approve the *Degree Audit*. The registrar determines the University requirements remaining for graduation, and the student is informed in writing of the remaining requirements. Any degree requirements not denoted on the *Degree Audit* are immediately brought to the attention of the school chair, program coordinator, and faculty advisor.

The *Degree Audit*, which is shown in the Criterion 5 Section A, contains all the requirements for the B.S. MfgET degree. Those requirements are summarized in Table 1-7 below.

Table 1-7: Summary of Requirements for the B.S. MfgET Degree

Course Requirements	
General Education (exc. as otherwise specified)	22 credits
MfgET Math & Basic Sciences	26 credits
MfgET Disciplinary Topics (of which 10 credits technical electives and 6 credits of capstone experience)	66 credits
Other (incl. free electives, management, and economics)	10 credits
	124 credits
Other Requirements	
General Education GPA	2.0
MfgET GPA	2.0
Overall GPA	2.0
Minimum Credits at LSSU	32 credits
Minimum 300/400 Credits at LSSU	13 credits

Recently, an automated process using the web based Banner system has been initiated to handle the *Degree Audits*. This process ensures that all requirements have been met. The Chair and Dean of School of Engineering and Technology have the ability to waive requirements and substitute courses.

G. Transcripts of Recent Graduates

There have been 19 graduates of the MfgET program within the last 6 year cycle, these listed in Table 1-8 below. We are prepared to provide transcripts for these students upon request (except as noted).

Table 1-8: Recent Graduates from the MfgET Program

Student	LSSU ID	Graduation	Minor
[redacted]	[redacted]	Dec. 2015	Robotics Technology
[redacted]	[redacted]	Apr 2013	Robotics Technology
[redacted]	[redacted]	Dec. 2013	None
[redacted]	[redacted]	Apr 2014	Robotics Technology
[redacted]	[redacted]	Apr 2015	Robotics Technology
[redacted]	[redacted]	Apr 2016	Robotics Technology
[redacted]	[redacted]	Apr 2013	Robotics Technology
[redacted]	[redacted]	July 2015	Robotics Technology
[redacted]	[redacted]	Apr 2015	Robotics Technology
[redacted]	[redacted]	Apr 2016	Robotics Technology

[redacted]	Apr 2016	Robotics Technology
[redacted]	Dec 2014	None
[redacted]	Apr 2011	None
[redacted]	Apr 2016	Robotics Technology
[redacted]	Apr 2011	None
[redacted]	Dec 2015	Robotics Technology
[redacted]	Apr 2014	Robotics Technology
[redacted]	Apr 2016	Robotics Technology
[redacted]	Apr 2011	None

The names of all degrees awarded, and any minors, appear in the header information of the transcript, along with personal identifying information. As the MfgET program has no options or concentrations, there is no applicable block in the transcript.

CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

A. Mission Statement

The University-level mission statement reads:

> "Our mission at Lake Superior State University is to help students develop their full potential. We launch students on paths to rewarding careers and productive, satisfying lives. We serve the regional, state, national and global communities by contributing to the growth, dissemination and application of knowledge."

This mission statement is published in the LSSU Catalog and on the University's web-site at the URL `www.lssu.edu/president/mission.php`, and the University catalog (now wholly on-line) links to it.

The School of Engineering and Technology has maintained a Mission Statement since 1996, when the School was formed. The School has reviewed and modified the Mission Statement periodically – most recently in February 2014. The Mission of the School of Engineering and Technology is:

> "To produce sought-after engineers and technologists by providing a rigorous undergraduate learning experience characterized by close student-faculty interaction."

This mission is published on the Engineering & Technology School web page at `www.lssu.edu/eng/mission.php`.

It is apparent by comparing the two mission statements that the mission of the School is supportive of that of the University as a whole, and does not conflict in any fashion. LSSU's statement calls for us to "help students develop their full potential", and the School of Engineering & Technology indicates *how* we accomplish that, i.e., by "providing a rigorous undergraduate learning experience characterized by close student-faculty interaction".

The School's mission is, moreover, further elaborated by a set of appended School goals (also periodically revised, most recently in February 2014), as follows:

A. Deliver an undergraduate education that is current and provides knowledge and skills to be successful in professional careers or graduate school.

B. Provide programs that focus on the applications of fundamental principles of engineering, technology, mathematics, science, and computing to benefit society.

C. Provide courses which incorporate and develop skills in communication, design, ethics, teamwork, technology, and capstone experiences relevant to the students' degrees.

D. Provide an education and opportunities for students with diverse abilities to enhance their professional growth and capacity for life-long learning.

E. Engage in continuous improvement activities through ongoing external and internal reviews.

F. Enable faculty, staff, and students to apply engineering solutions that support regional economic growth and develop intellectual property.

G. Maintain the School's viability, productivity, and effectiveness by supporting enrollment, retention, and placement initiatives.

H. Provide a supportive environment in which faculty, staff, and students are recognized as essential in the realization of the mission.

These goals elaborate and clarify the mission, providing a more detailed roadmap to accomplishing it, and then serve as a link between the School's Mission Statement and the Program Educational Objectives (PEOs) to be discussed in the following.

B. Program Educational Objectives

The School of Engineering and Technology, in accordance with its mission and goals, has the task to educate and prepare its students for successful professional careers in engineering and engineering technology. To provide statements defining what accomplishment of this task entails, for Engineering Technology in particular, the faculty have developed three Program Educational Objectives (PEOs). These are statements of what we might expect our alumni serving as practicing Engineering Technologists to have typically accomplished, or be active with, after three years of professional experience. The PEOs are applicable either to working graduates or to graduates pursuing advanced degrees. They are common to both the Manufacturing Engineering Technology (MfgET) and the Electrical Engineering Technology (EET) programs.

The PEOs are based on the needs of our graduates, as well as those of employers of our graduates. Ongoing evaluation by the faculty and input from our Industrial Advisory Board (IAB), graduates, and employers guide the continued improvement of these objectives. They were most recently revised in March 2014, are published at the School website at URL `www.lssu.edu/eng/mission.php`, and read as follows:

Graduates of the Electrical Engineering Technology and Manufacturing Engineering Technology programs having three or more years of experience:

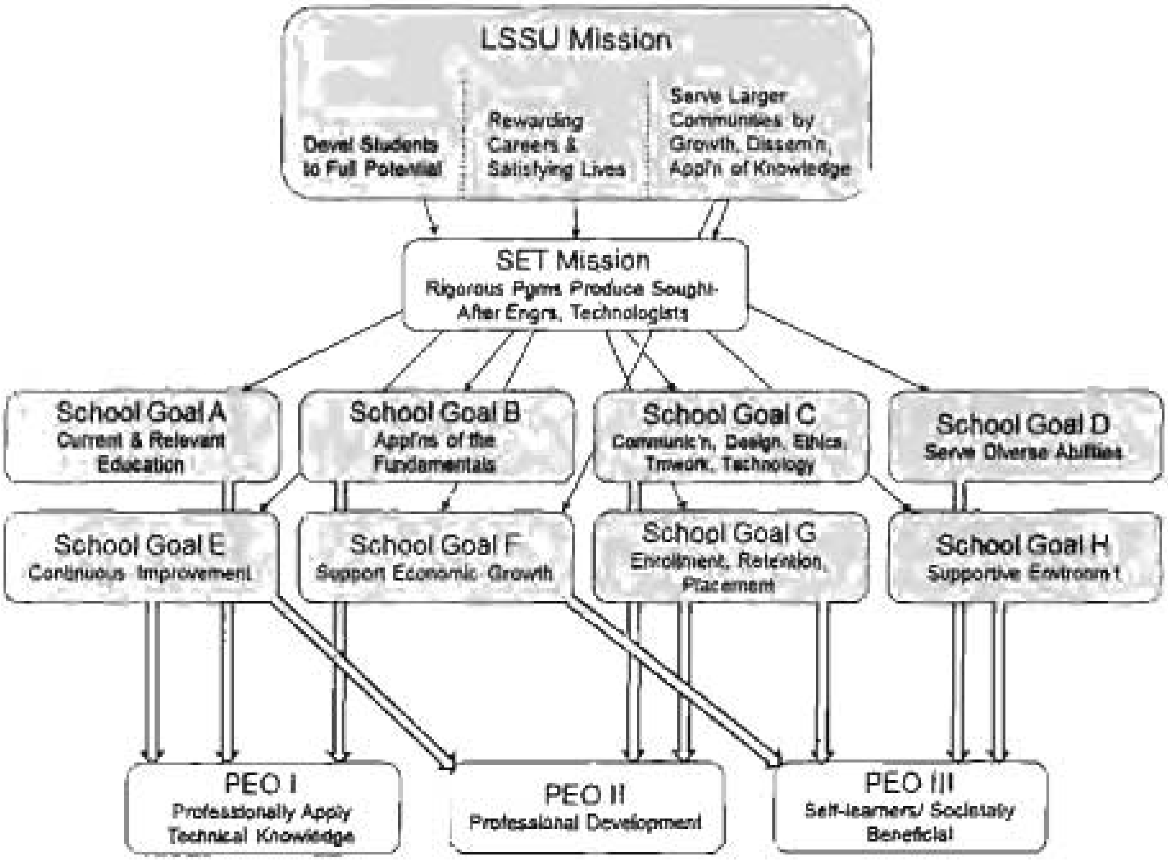
I. will have demonstrated professional application of technical skills and engineering judgment to solve problems in their profession subject to technical, practical and societal constraints.

II. will have set professional goals, experienced professional growth, and be engaged in ongoing professional development and learning activities.

III. will be capable self-learners and make meaningful contributions to society.

C. *Consistency of the Program Educational Objectives with the Mission of the Institution*

The critical focus of the MfgET program is to afford undergraduates of varying backgrounds and abilities every opportunity for achieving success in the MfgET profession. Specific emphasis in the MfgET program is given to professional and industrial related engineering technology practice. The relations between the Program Educational Objectives and the School Goals (and thence to the School and University missions) are depicted in Figure 2-1 below.



The School goals link the PEOs to the mission statement for the School, and thereby to that of LSSU. The Program Educational Objectives most directly correspond to the first four School Goals (A through D) which explicitly address knowledge, skills (both "soft skills" and technical skills) and abilities imparted by the academic programs, and the idea that these are imparted to all of our students, whatever their initial abilities. Clearly, the more the program is successful in imparting these attributes to this wide audience, the more propitious for alumni to ultimately accomplish the kinds of things, and possess the kinds of characteristics, called for by the PEOs.

The last four School Goals (E through H) are more indirectly related to the Program Educational Objectives, since they instead focus on faculty and institutional activities, rather than the delivery of the MfgET or other programs. Nevertheless, although indirect, they are quite relevant. Indeed, goal E relates to the assessment process whereby feedback is obtained that redirects some of the ways in which the program is constructed and delivered. Goal F relates to the School's economic development activities, which contribute to a stimulating environment in which the program is delivered. Goal G, specifically its aspect of support for placement, can be seen as promoting the opportunities alumni need to practice, i.e., a precondition for meeting the PEOs. And Goal H, finally, is explicitly about the quality of the environment in which the program is delivered, the good delivery of which is presumably, again, a precondition for the attainment of the PEOs.

D. Program Constituencies

The School of Engineering & Technology recognizes as its principal constituents, all of the following:

- Current Students
- Alumni
- Faculty
- Employers of graduates
- Industrial Advisory Board (IAB)

This is not an exhaustive list that precludes other, perhaps more situational, interest groups; for instance, the economic development roles of the College, which the School supports through goal F, would suggest including entrepreneurial and industrial customers of the Product Development Center, and even the wider population of the Eastern Upper Peninsula – Northern Lower Peninsula region, which can be regarded as a beneficiary of the economic growth objectives of the School. It would also include, situationally, senior project sponsors. Nevertheless, given the primary mission of the School to focus on offering quality academic programs, the list does identify those listed above as primary constituents.

The Industrial Advisory Board (IAB), in particular, was formed in 1985 and currently consists of approximately 30 members. IAB members possess a variety of professional experiences in the engineering and technology fields. The Board meets twice per year, once at a member company site, and once on campus for program review and critique.

E. Process for Review of the Program Educational Objectives

It is evident that PEOs represent a goal for the product of a slow process, i.e., an engineering technology professional developed first by a 4-year curriculum and then further by the first few years of a professional career. Hence, it is not desirable to make rapid or frequent changes to how the PEOs are defined. The PEOs are best seen as the foundation of a long-term plan for which stability is desirable. Renewing and/or changing them is accordingly fairly deliberative; they are reviewed by the faculty on a 3-year cycle, at which time decisions to renew, update, or establish new PEOs are undertaken. These decisions take account of feedback obtained, by various channels, from the constituencies listed in section D above, as described in the following.

The IAB, in particular, is solicited for PEO-specific feedback on the occasion of one of its biannual meetings, no less frequently than once every three years. This is documented in the minutes of that group and surely represents the most focused, PEO-specific form of external feedback that is obtained.

Alumni and their employers have a voice, partially through the IAB (as many or most of the IAB members are either employers of engineering technology graduates, engineering technology alumni, or both), but otherwise by feedback they may provide on other occasions when not systematically solicited. It should also be noted that the faculty has significant interaction with senior project sponsors, and sometimes with industrial clients of the Prototype Development Center, who again are frequently alumni and employers. These groups include additional alumni/employers who are not IAB members, or not active, so that yet another communication channel for the alumni and employer constituencies is thereby provided. In some instances, their perspectives have shaped our outlook on the PEOs.

Students have a voice through individual course feedback questionnaires and, finally, through graduate exit interviews. In neither case are the questions directed specifically at the PEOs, as recent graduates are not in a good position to accurately predict what kinds of professional attainment they might have reached after a few years, but the information provided on what they value in their programs, and especially anything about their career or professional aspirations, is nevertheless ultimately linked to the relevance of the PEOs.

The faculty of the School, by majority vote, have complete discretion over the PEOs.

Evidence, related to PEOs, to be available for review by the ETAC of ABET team is shown below:

- Industrial Advisory Board Minutes
- School Meeting Agendas and Minutes
- Fundamentals of Engineering Exam Results

CRITERION 3. STUDENT OUTCOMES

A. Process for Establishing and Revising Student Outcomes

The initial student outcomes for the MfgET program were determined by the School of Engineering and Technology faculty based on advice given by the ABET-EAC site visitation team in Fall 2012 and with the approval of the School of Engineering and Technology Industrial Advisory Board (IAB). The student outcomes may be revised by the School of Engineering and Technology faculty with advice from the IAB. The IAB meets twice every year, once in April and once in November, and provides advice to the School of Engineering and Technology faculty at both meetings. The student outcomes, just as the program educational objectives, will be reviewed by the IAB every three years.

B. Student Outcomes

The MfgET student outcomes are simply the ABET-ETAC student outcomes (a)-(k).

(a) an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities;

(b) an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies;

(c) an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes;

(d) an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives;

(e) an ability to function effectively as a member or leader on a technical team;

(f) an ability to identify, analyze, and solve broadly-defined engineering technology problems;

(g) an ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature;

(h) an understanding of the need for and an ability to engage in self-directed continuing professional development;

(i) an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity;

(j) a knowledge of the impact of engineering technology solutions in a societal and global context; and,

(k) a commitment to quality, timeliness, and continuous improvement.

The MfgET student outcomes are documented, along with School mission statement, School goals, and MfgET program educational objectives, on the LSSU web site at the following URL:

< http://www.lssu.edu/eng/mission.php>

C. Mapping of Student Outcomes to Program Criteria Outcomes

The eleven MfgET student outcomes (a-k) are related to the program criteria outcomes (a-d) as described in Table 3-1.

Table 3-1: Mapping of Program Criteria Outcomes to Student Outcomes

Program Criteria Outcome	Student Outcomes										
Graduates must demonstrate the ability to apply the following to the solution of manufacturing programs to achieve manufacturing competitiveness:	a	b	c	d	e	f	g	h	i	j	k
(a) materials and manufacturing processes;	x	x	x	x						x	
(b) product design process, tooling, and assembly;	x										
(c) manufacturing systems, automation, and operations;	x			x							
(d) statistics, quality and continuous improvement, and industrial organization and management.		x	x		x			x		x	x
Must have a capstone or integrating experience that develops and illustrates student competencies in applying both technical and non-technical skills in successfully solving manufacturing problems.	x			x	x	x	x	x	x	x	

D. Relationship of Student Outcomes to Program Educational Objectives

The eleven MfgET student outcomes (a-k) prepare student to attain the three MfgET program educational objectives (I, II, and III) through the course work as outlined in Criterion 5 Section A. A mapping of the student outcomes to each program educational objective is found in Tables 3-2, 3-3, and 3-4 below.

Program Educational Objective I

Graduates of the Manufacturing Engineering Technology program having three or more years of experience will have demonstrated professional application of technical skills and engineering judgment to solve problems in their profession subject to technical, practical and societal constraints.

Table 3-2: Mapping of Student Outcomes to Program Educational Objective I

Student Outcome	Level of Support
(a) ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities.	high
(b) ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies.	high
(c) ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.	high
(d) ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives.	high
(e) ability to function effectively as a member or leader on a technical team.	n/a
(f) ability to identify, analyze, and solve broadly-defined engineering technology problems.	high
(g) ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature.	moderate
(h) understanding of the need for and an ability to engage in self-directed continuing professional development.	n/a
(i) understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity.	n/a
(j) knowledge of the impact of engineering technology solutions in a societal and global context.	high
(k) commitment to quality, timeliness, and continuous improvement.	moderate

Program Educational Objective II

Graduates of the Manufacturing Engineering Technology program having three or more years of experience will have set professional goals, experienced professional growth, and be engaged in ongoing professional development and learning activities.

Table 3-3: Mapping of Student Outcomes to Program Educational Objective II

Student Outcome	Level of Support
(a) ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities.	n/a
(b) ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies.	n/a
(c) ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.	moderate
(d) ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives.	n/a
(e) ability to function effectively as a member or leader on a technical team.	high
(f) ability to identify, analyze, and solve broadly-defined engineering technology problems.	moderate
(g) ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature.	high
(h) understanding of the need for and an ability to engage in self-directed continuing professional development.	high
(i) understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity.	high
(j) knowledge of the impact of engineering technology solutions in a societal and global context.	high
(k) commitment to quality, timeliness, and continuous improvement.	high

Program Educational Objective III

Graduates of the Manufacturing Engineering Technology program having three or more years of experience will be capable self-learners and make meaningful contributions to society.

Table 3-4: Mapping of Student Outcomes to Program Educational Objective III

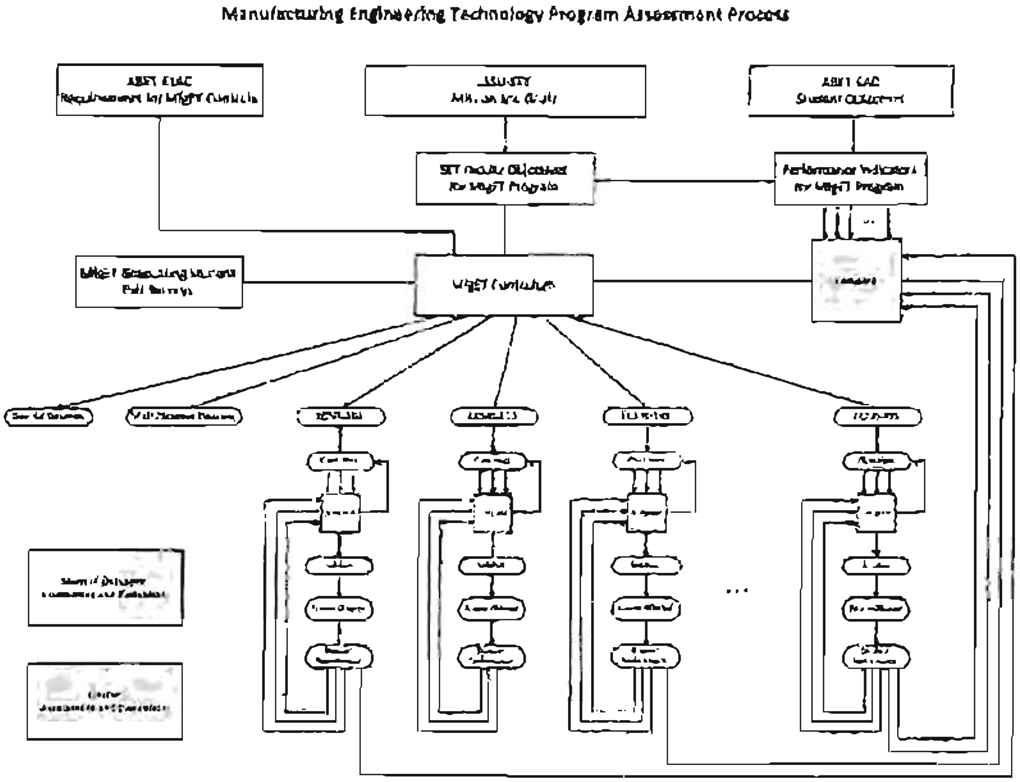
Student Outcome	Level of Support
(a) ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities.	moderate
(b) ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies.	moderate
(c) ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.	moderate
(d) ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives.	n/a
(e) ability to function effectively as a member or leader on a technical team.	moderate
(f) ability to identify, analyze, and solve broadly-defined engineering technology problems.	moderate
(g) ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature.	high
(h) understanding of the need for and an ability to engage in self-directed continuing professional development.	high
(i) understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity.	high
(j) knowledge of the impact of engineering technology solutions in a societal and global context.	moderate
(k) commitment to quality, timeliness, and continuous improvement.	high

CRITERION 4. CONTINUOUS IMPROVEMENT

A. Process for Continuous Improvement

The process for continuous improvement of the MfgET program is a combination of student outcome assessment and course assessment. This is pictured in the Figure 4-1 below. The inputs are the ABET-ETAC student outcomes (a-k) for all engineering technology programs, the ABET-ETAC requirements for MfgET curricula, and the mission and goals of the School of Engineering and Technology (SET). The data are student performance and student self-evaluation.

Figure 4-1: MfgET Program Assessment Process



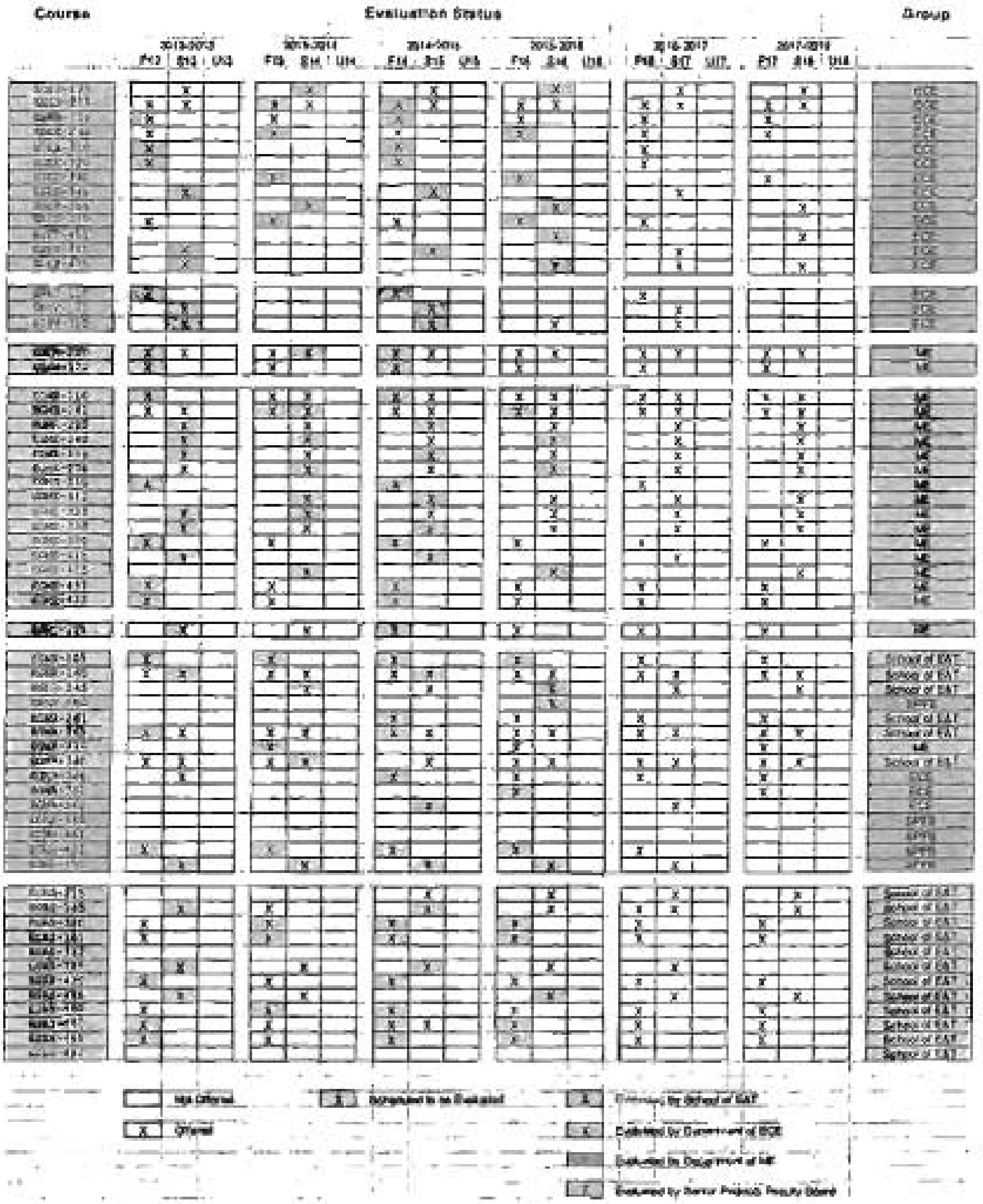
Manufacturing Engineering Technology Program Assessment Process

All decisions are made by the School of Engineering and Technology faculty with advice from the Industrial Advisory Board (IAB) on larger issues. Ultimately, the MfgET program is improved by small changes to courses (course layout, syllabi, grading structure, extent of coverage, *etc.*), changes to content in courses (alteration of objectives, topical content, *etc.*), and large curricular changes (course deletion, course addition, shifting material from one course to another, adding new material to the curriculum, *etc.*). The smaller changes tend to be made at the time of course evaluation while the more significant changes tend to be made at the time of program evaluation.

B. Continuous Improvement of Courses (Course Evaluation)

Each course that is taught within School of Engineering and Technology is assessed every offering and evaluated at least once every two years. The schedule for course evaluation is shown below in Table 4-1. This schedule includes all courses offered by the School of Engineering and Technology, not just those that are in the MfgET curriculum. It is intended to illustrate the pattern of course offerings and subsequent evaluation.

Table 4-1: Course Evaluation Schedule



At the completion of every offering, the course is assessed by the instructor and results in a course assessment summary report. The reports from the last two years may be found in Appendix G *Course Assessment Summary Reports*. In addition to other items, the reports include an analysis of students attainment of the course objectives, a brief analysis of the efficacy of the most recent course improvements, improvements planned for the next offering, and, if applicable, an analysis of any student outcome performance indicators that are tied to the course.

Each course is evaluated by the appropriate constituency. The Department of Mechanical Engineering evaluates the courses that appear solely in the ME, and/or MfgET cores. All other "cross-disciplinary" courses that are also contained in the CE, EE, and/or EET cores are evaluated by the School of Engineering and Technology as a whole.

C. Continuous Improvement of MfgET Program (Student Outcome Evaluation)

For each student outcome (a-k) of the MfgET program, one, two, or three performance indicators have been established by the Department of Mechanical Engineering. Each performance indicator is an activity in one of the core courses in the MfgET curriculum. Student attainment of the performance indicator is evaluated by the instructor and, in some cases, another knowledgeable faculty member. Additionally, graduates of MfgET program are surveyed regarding their attainment of each student outcome at the end of their final semester. Upon completion of the survey, each graduate receives an exit interview with the General Engineering and Technology coordinator. In order to evaluate attainment of MfgET student outcomes, and hence the efficacy of the MfgET program, the performance indicators and the student survey results are to be reviewed on a two-year cycle.

Establishment of Performance Indicators

For each course in the core of the MfgET curriculum, the faculty of the School of Engineering and Technology has determined the extent of coverage and expected level of attainment of each student outcome. This information, which is shown in Table 5-2, was essential to selecting the performance indicators used to assess and evaluate the MfgET program.

Because of the relatively small number of engineering technology (EET and MfgET) students, some of the performance indicators include activities that include students from both programs, and possibly Engineering students as well. The performance indicators for the MfgET program were established by the Department of Mechanical Engineering if they solely involved MfgET students, or both ME and MfgET students, and otherwise by the School of Engineering and Technology if they involved any CE, EE, or EET students.

The performance indicators for the MfgET program are shown below. For the sake of completeness and clarity, each student outcome is stated; then, for each student outcome, the associated performance indicators are listed. First the definition of the performance indicator is given then the sample of student work to be evaluated in light of that definition is given.

Student Outcome (a)

an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities

Performance Indicator (a1)

the ability to use an industrial robot to automate a manufacturing process

EGRS-381 – project report and robot code on setting-up a Staubli robot for automating an advanced palletization task or a machine tending task using VAL3 programming and I/O communications

Performance Indicator (a2)

the ability to describe how to set-up G&M code using CAM software to machine a given part

EGMT-216 – final exam question on setting up CAM file in CREO

Student Outcome (b)

an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies

Performance Indicator (b1)

the ability to apply calculus of several variables

EGNR-245 – project on derivation of the formula for the least-squares line

Performance Indicator (b2)

the ability to implement an iterative solution to a complex problem in metallurgy

EGME-275 – MATLAB exercise on cold work – annealing cycles

Student Outcome (c)

an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes

Performance Indicator (c1)

the ability to develop a valid and reliable experimental procedure that will validate a product

EGNR-495 – design review on final product testing

Performance Indicator (c2)

the ability to use statistical methods to plan an efficient, yet effective, program of experimentation, when the output variable studied is expected to depend on multiple input variables

EGNR-310 – term project technical report

Student Outcome (d)

an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives

Performance Indicator (d1)

the ability to reformulate implied customer needs as specifications and produce an acceptable design solution

EGNR-491 – product design review

Performance Indicator (d2)

the ability to use a discrete event manufacturing simulation software to analyze and optimally improve the throughput of a manufacturing system

EGRS-481 – lab report of Witness simulation of TV manufacturer factory

Student Outcome (e)

an ability to function effectively as a member or leader on a technical team

Performance Indicator (e1)

the ability to provide constructive criticism of team members

EGNR-495 – peer evaluations

Student Outcome (f)

an ability to identify, analyze, and solve broadly-defined engineering technology problems

Performance Indicator (f1)

the ability to identify possible reasons that a product or process may fail to function well, and categorize these

EGNR-310 – homework on fishbone chart exercise

Performance Indicator (f2)

the ability to calculate stress and strain in axial loading of a bar

EGMT-225 – exam 3, axial loading problem

Student Outcome (g)

an ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature

Performance Indicator (g1)

the ability to make formal engineering presentations

EGNR-495 – final project presentations

Performance Indicator (g2)

the ability to write prose containing technical information

EGME-276 – lab 3 (metallography II) technical report

Student Outcome (h)

an understanding of the need for and an ability to engage in self-directed continuing professional development

Performance Indicator (h1)

the ability to define and clarify customer needs through technical investigation

EGNR-495 – FA evaluation of each team member at end of semester

Student Outcome (i)

an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity

Performance Indicator (i1)

the ability to apply perspectives from established ethical philosophies in the analysis of a case study

EGNR-495 – ethics essay

Student Outcome (j)

a knowledge of the impact of engineering technology solutions in a societal and global context

Performance Indicator (j1)

the ability to recognize the impact of engineering technology solutions in a societal and global context

EGME-275 – final exam question on plastics recyclability

Student Outcome (k)

a commitment to quality, timeliness, and continuous improvement

Performance Indicator (k1)

the ability to analyze, by methods of statistical process control, data representing output of a continuously monitored manufacturing process, in order to make early detection of any drift away from the target values of the output

EGNR-310 – homework 5, control charts (statistical process control)

Evaluation of Performance Indicators

Each performance indicator tied to a specific assignment in a specific course. Each student's performance on that assignment is evaluated solely for the capability denoted by the performance indicator. Each sample of student work receives a score of 1, 2, 3, or 4 depending on how well the student meets the expected capability defined by the performance indicator. The meaning of the score is listed in Table 4-2 below. The evaluation is performed either by the instructor or instructors responsible for teaching the course or by them and an additional expert in the area.

Table 4-2: Scoring of Student Work for Performance Indicators

Score	Meaning
1	Unacceptable
2	Below Standard
3	Meets Standard
4	Exemplary

The performance indicators will be continually evaluated in that every time a course containing the associated student work is offered, that work will be evaluated. The results of the evaluation are reported in the course assessment summary that is written at the conclusion of each course. These can be found in Appendix G *Course Assessment Summary Reports*. Additionally, the actual student work that has been evaluated will be made available in binders at the time of the site visit.

The schedule for the courses associated with all MfgET student outcomes (i.e. each performance indicator) is shown below in Table 4-3. Since some of the courses are offered on an alternating year basis, the schedule for the past two years is indicated. Note that since this schedule was only initiated recently, some student work was not evaluated in the first year. However, in the future all student work associated with all performance indicators will be evaluated in the future.

Table 4-3: Student Work Samples for MfgET Student Outcome Assessment (Two Year Cycle)

Fall 2014

Class	Instructor	Assignment	Student Outcome	Status
~~EGNR-310~~	~~RH~~	~~term project technical report~~	~~c(EET,MfgET)~~	course not offered
~~EGNR-310~~	~~RH~~	~~homework on fishbone chart exercise~~	~~f(EET,MfgET)~~	course not offered
~~EGNR-310~~	~~RH~~	~~homework 5, control charts (statistical process control)~~	~~k(EET,MfgET)~~	course not offered
EGNR-491	SPFB(DB)	product design review	d(EET,MfgET)	not evaluated
EGRS-381	JD	project report and robot code on setting-up a Staubli robot	a(EET,MfgET)	not evaluated

Spring 2015

Class	Instructor	Assignment	Student Outcome	Status
~~EGEE-355~~	~~AJ~~	~~exam 1, hardware design problem~~	~~l(EET)~~	course not offered
EGET-310	EB	final exam question on identifying column and row information	a(EET)	not evaluated
EGET-310	EB	exam question on material identification	b(EET)	not evaluated
EGET-310	EB	lab exercise on obtaining data sheet from web search	d(EET)	not evaluated
EGET-310	EB	final project	g(EET)	not evaluated
EGET-310	EB	final exam question on impact of engineering practices	j(EET)	not evaluated
EGNR-245	DM	project on derivation of the formula for the least-squares line	b(EET,MfgET)	not evaluated
EGNR-495	SPFB(DB)	design review on final product testing	c(EET,MfgET)	not evaluated
EGNR-495	SPFB(DB)	peer evaluations	e(EET,MfgET)	not evaluated
EGNR-495	SPFB(DB)	final project presentations	g(EET,MfgET)	evaluated / in binders
EGNR-495	SPFB(DB)	FA evaluation of each team member	h(EET,MfgET)	not evaluated
EGNR-495	SPFB(DB)	ethics essay	i(EET,MfgET)	not evaluated

Fall 2015

Class	Instructor	Assignment	Student Outcome	Status
EGNR-310	RH	term project technical report	c(EET,MfgET)	evaluated / in binders
EGNR-310	RH	homework on fishbone chart exercise	f(EET,MfgET)	evaluated / in binders
EGNR-310	RH	homework 5, control charts (statistical process control)	k(EET,MfgET)	evaluated / in binders
EGNR-491	SPFB(PW)	product design review	d(EET,MfgET)	evaluated / in binders
EGRS-381	JD	project report & VAL3 robot code for setting-up automation process	a(EET,MfgET)	evaluated / in binders

Spring 2016

Class	Instructor	Assignment	Student Outcome	Status
EGEE-355	AJ	exam 1, hardware design problem	l(EET)	evaluated / in binder
EGET-310	EB	final exam question on identifying column and row information	a(EET)	evaluated / in binder
EGET-310	EB	exam question on material identification	b(EET)	evaluated / in binder
EGET-310	EB	lab exercise on obtaining data sheet from web search	d(EET)	evaluated / in binder
EGET-310	EB	final project	g(EET)	evaluated / in binder
EGET-310	EB	final exam question on impact of engineering practices	j(EET)	evaluated / in binder
EGNR-245	DM	project on derivation of the formula for the least-squares line	b(EET,MfgET)	evaluated / in binders
EGNR-495	SPFB(PW)	design review on final product testing	c(EET,MfgET)	evaluated / in binders
EGNR-495	SPFB(PW)	peer evaluations	e(EET,MfgET)	evaluated / in binders
EGNR-495	SPFB(PW)	final project presentations	g(EET,MfgET)	evaluated / in binders
EGNR-495	SPFB(PW)	FA evaluation of each team member	h(EET,MfgET)	evaluated / in binders
EGNR-495	SPFB(PW)	ethics essay	i(EET,MfgET)	evaluated / in binders

Evaluation of Student Outcomes (Program Evaluation)

Once every two years the Department of Mechanical Engineering will evaluate each MfgET student outcome by considering the results of all performance indicators tied to that outcome and the results of the senior exit surveys over the previous two years. The first such series of meetings were held in May 2016.

Plans for improvement to the MfgET program will be made as a result of the student outcome evaluation. Details of the most student outcome evaluation can be found in the MfgET Student Outcome Evaluation report found in Appendix H *Student Outcome Evaluation Reports*.

For the 2015-16 cycle, the main decisions made by the MfgET/ME group were to improve or replace some indicators (a not unsurprising result of the very first cycle using this assessment methodology), rather than any substantial changes to the program or constituent courses. However, under student outcome (*f*) ("*ability to identify, analyze, and solve broadly-defined engineering technology problems*"), it was noted that there could be some cause for concern, given poor student problem-solving skills as observed in a combined statics/strength-of-materials topic; however, given that this is the *first* cycle using this indicator, it was felt as if it would be an overreaction to develop an action plan when this has only been observed once, and that from a class of only 7 students. But were it to continue, the thought is that we might make the introductory computing course (EGNR140) a prerequisite course, forcing it earlier in the curriculum, as it should contribute to later problem solving courses.

A smaller outcome of the assessment cycle was the plan to invite the Universities Philosophy professor to participate in our Engineering Ethics instruction.

CRITERION 5. CURRICULUM

A. Program Curriculum

The MfgET BS curriculum at LSSU is designed both, firstly, to cover the subject matters called for in ETAC criterion 5 and the MfgET program criteria, and, secondly, to provide the necessary technical background, as well as experiences developing engineering judgment and the professional attributes ("soft skills" and self-learning habits), that lay the groundwork for graduating students to attain the student outcomes, and for alumni to be capable of meeting the PEOs by a few years into their careers.

Characteristic of the program, besides its laboratory focus, are particularly heavy topical emphases on manufacturing automation, design of / traditional production processes for ferrous metal components, and applications of programming and of CAE software.

The following will first detail the courses comprising that curriculum, and then address its relation to the aforementioned PEOs, student outcomes, and curricular and program criteria, student outcomes.

5. A.1 Plan-of-Study. Table 5-1, below, depicts the plan-of-study for students for students in the MfgET BS program, current as of the Fall 2016 semester; this would only vary in small details for any other year in the last 6-year cycle. The table constitutes a listing of the courses comprising the curriculum, indicating for each the number of credits, the curricular area (math/science, engineering technology, gen ed, other) it belongs to, and the recent offering schedule and class sizes.

It will be evident from the table that, while there certainly are some large classes (e.g. Introduction to Engineering, Chemistry or Physics, each around fifty), they are relatively few. The majority of lecture courses outside the discipline are in the 15 – 30 range, and within the discipline in the 10 – 20 range; most lab sections are in the 5 – 15 range. Over a span of years, the School of Engineering & Technology has had an average class size (regardless of instructional mode) of 14.

Recitations are a very marginal phenomenon at LSSU, and exist exclusively within the Engineering courses (some of which are parts of the Engineering Technology curricula); these are usually (with one or two exceptions) identical in enrollment to the associated lecture section.

The MfgET program, moreover, requires 124 overall *semester* credits, the majority of which are specified (i.e., required, "R"), but allowing for student choice of specified electives ("SE") for most of the general education components, as well as for 10 credits within the disicipline (the so-called "technical electives"). There are also 3 credits of free, unrestricted electives ("E").

1. *Table 5-1 Curriculum*

Manufacturing Engineering Technology Baccalaureate Program, for 2016-17

*Columns 3-6: Credits reported are *semester* credits (LSSU is on a semester system)

**Column 2: Required courses are required of all students in the program, elective courses are optional for students, and selected electives are courses where students must take one or more courses from a specified group

Course (Department, Number, Title) List all courses in the program by term starting with first term of the first year and ending with the last term of the final year	Indicate Whether Course is Required, Elective, or a Selective Elective by an R, an E or an SE	Curricular Area (Credit Hours)*				Last Two Terms the Course was Offered: Year and, Semester, or Quarter	Average Section Enrollment for the Last Two Terms the Course was Offered¹
		Math & Basic Sciences	Discipline Specific Topics	General Education	Other		
Key to Engineering and Engineering Technology Prefixes (others are self-evident): EGEE – Electrical Engineering, EGET – Electrical Engineering Technology; EGME-24.56Mechanical Engineering; EGMT-Manufacturing Engineering Technology; EGNR - General Engineering; EGRS-Robotics and Control Systems							
1st Yr, 1st Semester							
EGME141 Solid Modeling	R		3			F'15, S'16	11 (lec, lab)
ENGL110 First-Year Composition I	R			3		F'15, S'16	23.81
EGNR101 Introduction to Engineering	R		2			F'14, F'15	53.5 (lec) 26.75 (lab)
MATH207 Principles of Statistical Methods	R	3				F'15, S'16	22.63
1st Yr, 2nd Semester							
ENGL111 First-Year Composition II	R			3		F'15, S'16	36
MATH111 College Algebra	R	3				F'15, S'16	29
MATH131 College Trigonometry	R	3				F'15, S'16	16.67
EGME110 Manufacturing Processes	R		3			F'15, S'16	16.5 (lec) 8.25 (lab)
CHEM108 Applied Chemistry	R	3				F'15, S'16	50
CHEM109 Applied Chemistry Lab	R	1				F'15, S'16	12.33

Course (Department, Number, Title)	Required, Elective, or Selective Elective (R, E, SE)	Math & Basic Sciences	Discipline Specific Topics	General Education	Other	Last Two Terms Offered	Average Section Enrollment, Last 2 Terms
2nd Yr, 1st Semester							
PHYS221 Elements of Physics	R	4				F'14, F'15	49.5 (lec) 16.5 (lab)
MATH112 Calculus for Business and Life Science	R	4				F'15, S'16	27.75
EGNR140 Linear Algebra & Numerical Applications for Engineers	R	2				F'15, S'16	30 (lec) 12 (lab)
EGNR265 "C" Programming	R		3			F'15, S'16	23.5 (lec) 15.67 (rec)
EGET110 Applied Electricity	R		4			F'12, F'14	18 (lec) 12 (lab)
2nd Yr, 2nd Semester							
EGME240 Assembly Modeling and GD&T	R		3			S'15, S'16	13.67 (lec, lab)
Communications Elective	SE			3			
EGET175 Applied Electronics	R		4			S'13, S'15	18.5 (lec) 9.25 (lab)
EGEE125 Digital Fundamentals	R		4			S'15, S'16	26 (lec) 10.4 (lab)
EGNR245 Calculus Applications for Technology	R	3				S'15, S'16	11.5 (lec,lab)
3rd Yr, 1st Semester							
EGMT225 Statics & Strength of Materials	R		4			F'14, F'15	9
EGRS380 Robotics Technology	R		2			F'14, F'15	13
EGRS381 Robotics Technology Lab	R		1			F'14, F'15	7.33
EGNR310 Quality Engineering	R		3			F'13, F'15	24.5
Technical Elective	SE		3			F'15, S'16	
Social Science Elective	SE			3		F'15, S'16	

Course (Department, Number, Title)	Required, Elective, or Selective Elective (R, E, SE)	Math & Basic Sciences	Discipline Specific Topics	General Education	Other	Last Two Terms Offered	Average Section Enrollment, Last 2 Terms
3rd Yr, 2nd Semester							
EGRS365 Programmable Logic Controllers	R		3			S'15, S'16	22.5 (lec) 6.43 (lab)
ECON302 Managerial Economics	R				4	S'14, S'16	25
EGMT216 CAM with CNC Applications (formerly listed as EGME312 until S'16)	R		3			S'15, S'16	20 (lec) 8 (lab)
EGME275 Engineering Materials	R		3			S'15, S'16	31
EGME276 Strength of Materials Lab	R		1			S'15, S'16	8.57
Free Elective	E				3	F'15, S'16	
4th Yr, 1st Semester							
EGNR491 Engineering Design Project I	R		3			F'14, F'15	21.5 (lec, lab)
EGRS480 Manufacturing Automation	R		3			F'14, F'15	10.5
EGRS481 Manufacturing Automation Lab	R		1			F'14, F'15	7
Humanities Elective	SE			6		F'15, S'16	
Technical Elective	SE		4			F'15, S'16	
4th Yr, 2nd Semester							
EGNR495 Engineering Design Project II	R		3			S'15, S'16	21.5 (lec, lab)
Cultural Diversity Elective	SE			3		F'15, S'16	
Technical Elective	SE		3			F'15, S'16	
Humanities Elective	SE			3		F'15, S'16	
MGMT360 Principles of Management	R				3	F'15, S'16	27
Add rows as needed to show all courses in the curriculum.							
OVERALL TOTAL CREDIT HOURS FOR THE DEGREE	124						
PERCENT OF TOTAL		21%	53%	18%	8%		

5.A.2 Curricular Alignment to PEOs. The PEOs of the MfgET program (ref. ch. 2, above) call for alumni to have (in shorter paraphrase), after 3 years of practice, professionally applied technical knowledge of manufacturing (I), remain engaged in professional development (II), and be self-learners benefitting society (III). The curriculum contributes to each of these objectives in various ways.

PEO I. The first PEO concerns the professional application of technical knowledge; recall that it states that 3 years into a career, alumni "... will have demonstrated professional application of technical skills and engineering judgement to solve problems in their professions subject to technical, practical, and societal constraints." It is apparent from table 5-1 that some 53% of the curriculum, i.e., 66 semester credits, constitutes "discipline-specific topics"; these are primarily courses imparting the technical background knowledge that would later undergo "technical application...to solve problems (etc.)". This is evidently very ample, representing a total of more than 4 semesters of college at 16-credits per semester, if it were all (very improbably) to be taken as an isolated block.

But there is also the aspect of the *application of* that ample technical knowledge obtained. Indeed, the curriculum practices problem-solving skills which are generalizable to the application of not only that knowledge, but also other knowledge that may be later obtained as a professionally-practicing graduate. Towards this end, the capstone courses (EGNR491, 495), as well as many other courses with more modest term projects, place the students in situations requiring the *application of* the technical knowledge to real (in the capstone case) or hypothetical (mostly otherwise) manufacturing problems, with constraints of the kind described in the PEO language. The reader is referred to the detailed description of the capstone experience, below.

PEO II. The second PEO concerns professional development. Graduates after 3 years "...will have set professional goals, experienced professional growth, and be engaged in ongoing professional development and learning activities."

Again, the capstone course sequence (EGNR491 – 495) is a major contributor, in that it provides the kind of large-scale (the projects are such that they span an academic year) experience, a *professional* experience in all respects except that it is unpaid and managed in an academic setting, in which the students have opportunity to discover their own technical and managerial strengths and weaknesses and realize the need to compensate the latter and maximize the former. In other words, in this respect, the program serves as a motivator for professional development. Because the project is, moreover, pursued under the guidance of a faculty advisor and industrial contact, mentoring in project management and "soft skills" (communications, team dynamics, time management, etc.) is an ongoing process, so that an early stage of professional development is undertaken.

One should also not underestimate the smaller contributions here of earlier course term projects, which would also typically involve team dynamics (group work), time management, communications, and so forth.

The EGNR101 Introduction to Engineering course also makes a notable contribution here by introducing students to the LSSU student chapters of professional societies, such as SAE for example. Sustained involvement in these societies is expected to be a factor promoting professional growth, particularly to the extent the association with the corresponding national organizations continues after graduation.

PEO III. Finally, the third PEO concerns self-learning tendencies and societal contribution. Graduates after 3 years "...will be capable self-learners and make meaningful contributions to society." There are two aspects here: (1) self-learning tendencies; and, (2) aptness to make societal contributions.

Concerning the first aspect, self-learning, the curriculum is so constructed as to provide both the *tools* and the *attitude* necessary for sustained self-learning in the long run.

The primary *tool* is the coherence of knowledge, in the sense that advanced and/or applied knowledge (upper-level engineering technology courses, and capstone/design experiences) is rooted in fundamentals and derived from first principles; the development of first principles (e.g., Newton's laws, for example) into advanced principles (e.g., methods of analysis of structures, stresses in beams, etc.) within the curriculum instills the ability to see the larger picture and interconnectedness within the discipline, and the ability to extrapolate and develop competencies that go beyond the knowledge obtained directly from the curriculum. The depth of prerequisite structure emphasizes the linkages of "first principles" to advanced results, developing this tool.

The *attitude* promoting sustained self-learning is instilled, especially, by exposure to experiences that are interdisciplinary, e.g., the senior (capstone) project and the Introduction to Engineering project. The interdisciplinarity is suggestive to the student of the need to synthesize knowledge beyond that obtained directly in coursework by the student.

Concerning the *second* aspect of the PEO, societal contribution, it is clear that the technical and scientific know-how imparted by the curriculum, through the 66 credits of disciplinary topics and 21 credits of math and science, make one capable of contributing to the betterment of society-as-a-whole, given the predisposition to do so.

5.A.3 Curricular Alignment to Student Outcomes. The courses are mapped to the (a) – (k) student outcomes in Table 5-2. Each outcome is served by at least one, but usually several, of the courses in the curriculum. Indeed, the capstone courses EGNR491 and 495, taken together (and even just 495 on its own), contribute to all of the outcomes. And it's evident that certain other courses, such as EGME240 Assembly Modeling and GD&T, and EGNR310 Quality Engineering, contribute to a majority of the outcomes. Some outcomes, notably (a) and (b), are served by almost all courses in the curriculum. In summary, the student outcomes are well-integrated throughout the curriculum, for the most part.

Table 5-2. Alignment of Curriculum to Student Outcomes.

Core Engineering Technology Courses
Extent of Coverage and Expected Achievement of ABET-ETAC Student Outcomes

Course	Cores	a	b	c	d	e	f	g	h	i	j	k
EGEE-125	EET, MfgET	✓✓ •	✓✓ •		✓✓ •	✓✓ •		✓ •				
EGEE-250	EET	✓ •	✓ •									
EGEE-320	EET	✓✓ ••	✓✓ ••	✓ ••	✓✓ ••	✓✓ ••		✓ ••				
EGEE-355	EET	✓✓ ••	✓✓ ••	✓ •	✓ •	✓ ••	✓ •	✓ ••				✓ •
EGET-110	EET, MfgET		✓✓ •					✓ •				
EGET-175	EET, MfgET	✓✓ •	✓ •	✓ •								
EGET-310	EET	✓✓✓ •••	✓✓ •		✓ •	✓✓ •		✓✓ •			✓✓ ••	
EGME-110	MfgET	✓ •	✓ •									
EGME-141	EET, MfgET	✓✓✓ •	✓ •		✓ •							✓ •
EGME-240	MfgET	✓✓✓ ••	✓ •		✓✓ ••	✓✓ ••	✓ •	✓✓ ••	✓ •			✓ •
EGME-275	MfgET		✓✓✓ •••		✓ •		✓✓ ••				✓ •	
EGME-276	MfgET	✓✓ ••	✓ •	✓✓✓ •••		✓ •		✓✓✓ ••				
EGME-312	MfgET	✓✓✓ ••	✓✓✓ ••		✓✓ ••		✓ •	✓ •	✓ •			✓ •
EGMT-225	MfgET		✓✓✓ ••				✓✓✓ ••					
EGNR-101	EET, MfgET		✓ •		✓ •	✓ •		✓ •		✓ •		
EGNR-140	EET, MfgET	✓✓ •	✓✓ •				✓✓ •					
EGNR-245	EET, MfgET		✓✓✓ •									
EGNR-265	EET, MfgET	✓✓ •	✓ •									✓ •
EGNR-310	EET, MfgET	✓✓ ••	✓✓ ••	✓✓✓ ••	✓✓ ••		✓✓ ••	✓ •				✓✓ ••
EGNR-491	EET, MfgET	✓✓✓ •••	✓ ••		✓✓✓ •••	✓✓✓ ••	✓✓✓ ••	✓✓✓ •••	✓ ••		✓ •	✓ •
EGNR-495	EET, MfgET	✓✓✓ •••	✓ ••	✓✓ ••	✓✓✓ •••	✓✓✓ •••	✓✓✓ •••	✓✓✓ •••	✓ ••	✓✓ ••	✓✓ ••	✓ ••
EGRS-365	EET, MfgET	✓✓✓ ••	✓ ••		✓✓ ••		✓ •					
EGRS-380	EET, MfgET	✓✓ ••	✓ ••					✓✓ ••	✓ ••			
EGRS-381	EET, MfgET	✓✓ ••						✓✓ ••	✓✓ ••			✓ •
EGRS-480	MfgET	✓✓ ••	✓ ••				✓ ••		✓ ••			
EGRS-401	MfgET	✓✓ ••			✓✓ ••		✓✓ ••					✓✓ ••

	evaluated for EET
	evaluated for MfgET

	evaluated for EET and MfgET

✓	exposure (for instance, one graded assignment)
✓✓	stress (for instance, one course objective)
✓✓✓	focus (for instance, multiple objectives or course title)

•	foundational – ready for further development
••	developed – prepared for practical application
•••	high – approaching that of a practicing engineer

IP	Incorporation into course is "In progress

5.A.4 Prerequisite Structure. Figure 5-1 depicts the prerequisite structure of the MfgET BS degree program. Observe that the courses in the figure are arranged in columns that indicate the depth of prerequisite layering (the color-shaded regions, in contrast, indicate the courses that appear in the same year in the plan-of-study, Table 5-1).

In particular, note the following features of the program that this prerequisite diagram makes evident:

- it builds up to 5 layers of depth (the final capstone course, EGNR495, alone in the 5th column, but several courses in the 4th);

- the senior projects courses (EGNR491 and EGNR495) are indeed capstone courses in that these are at the deepest levels of the prerequisite structures (i.e., they synthesize knowledge from various courses throughout the curriculum);

- notably, C-programming (EGNR265) and the Trigonometry (MATH131) courses are prerequisites to much of the rest of the program (as these are vertices of rightwards-expanding sets of joining lines);

- other notable parallel chains of prerequisite structure within the curriculum are:

    - the EGME141, EGME110 grouping of introductory technical courses leads to the EGME240, EGMT216 set of higher level technical courses – groupings with a common theme of computer aided design and manufacturing;

    - the MATH207 – EGNR310 sequence develops a theme of statistical methods and their applications to quality control;

    - the CHEM 108/109 – EGME275 – EGME276 chain builds an understanding of substances, leading to materials and metallurgy competencies;

    - the (MATH131) – PHYS221 – EGMT225 – EGME276 develops a theme of solid mechanics;

    - the (MATH131 – PHYS221) – EGRS380 – EGRS480 chain develops a theme of automation and robotics, as applied to manufacturing;

    - the (MATH131) – EGNR265 – EGRS365 chain develops a theme of programming for machine control of manufacturing processes. Furthermore, beginning with EGNR365 and extending to EGNR491 and 495, a strong chain with a theme of professionalism and project management and communications skills is developed.

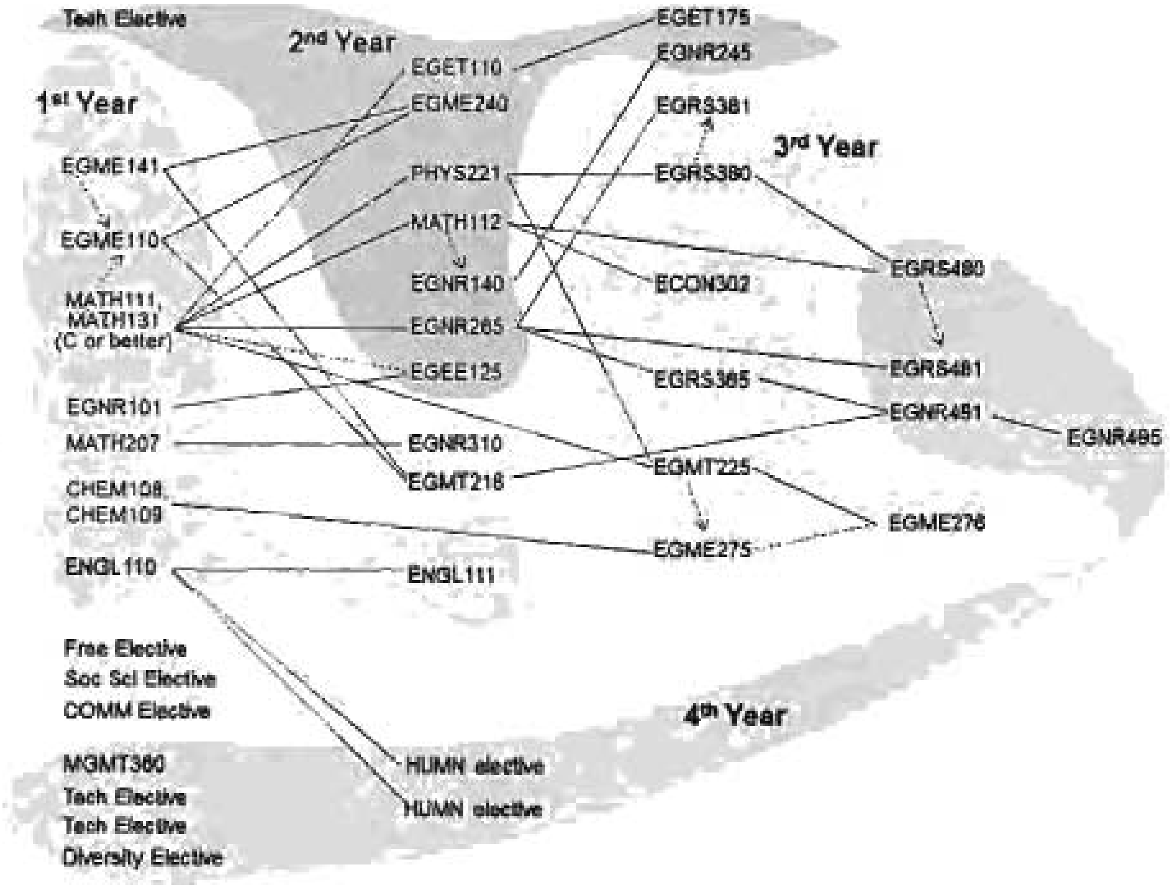


Figure 5-1. Prerequisite Flow Chart for the MfgET Program, effective Fall 2016. Vertically-aligned columns of courses indicate levels of increasing prerequisite "depth", towards the right. Color-shaded regions represent sets of courses belonging to the same academic year in the plan-of-study. Grayed-text courses: Credit towards completion of the program is not given for MATH102, but would be necessary for students that cannot place directly into MATH 111 and MATH131. The unspecified prerequisites for technical electives are often other courses within the program (for example, EGME310 is a common technical elective choice; it requires EGMT225 as a co-requisite and PHYS221 as a prerequisite, both of which are already required in the degree program); thus, there may be some prerequisite structure not apparent from the figure. There are no restrictions on the free elective, and conceivably this could be a course with prerequisites outside of the program. Solid line segments represent *prerequisite* sequences, i.e., they imply that the course at the left endpoint must be satisfactorily completed as a condition of enrollment in the course at the right endpoint. Dashed line segments represent *corequisite* sequences, i.e., they imply that the course at the left endpoint must either be satisfactorily completed *before, or must be enrolled in at the same time as*, the course at the right endpoint, as a condition of enrollment in the latter.

To enforce compliance with the prerequisite structure provided, the University's registration system is designed to disallow enrollment in courses for which students lack the prerequisites. In the event of a student failing or dropping a prerequisite course after registration has already taken place, the system automatically removes the student from the follow-up course. But as a second "line of defense" to these automated solutions, we also require students, at the beginning of any course, to complete and sign a statement that testifies to their having completed any prerequisite courses, and having enrolled in (or already completed) any co-requisite courses. Waivers of prerequisites are possible at the instructor's discretion, but the ME Department (under which the MfgET program is directly administered) has a written policy with guidelines for the instructor; usually, if the student has promise to be successful, the waiver will be granted with the student's signed acceptance of the condition to take the prerequisite concurrently, maintain a minimum C grade at mid-term, and acknowledge (in writing) responsibility for self-learning as far as necessary to compensate the prerequisite deficiency. Appendix J contains an example prerequisite compliance form, and appendix L a current statement of the departmental policy cited.

5.A.5 Alignment to ETAC Curricular and Program Criteria. The MfgET BS curriculum aligns both to criterion 5 of the ETAC general criteria, and more specifically to the program criteria for Manufacturing Engineering Technology, as will discussed, in turn, in the following.

5.A.5.1 General Criteria, Criterion 5, Curricular Alignment. ETAC criterion 5 addresses, specifically, the curricular areas of mathematics, technical, and physical/natural science.

5.A.5.1.A Mathematics Component. Table 5-3 summarizes the required mathematics courses and their credit counts, roughly in the order that these courses are taken:

Table 5-3. **Mathematics Component of Curriculum**

Course	**Credits**
Offered by Mathematics Dept.	
MATH207 Principles of Statistical Methods	3
MATH111 College Algebra	3
MATH131 College Trigonometry	3
MATH112 Calculus for Business and Life Science	4
Offered by School of Engrg & Techn.	
EGNR140 Linear Algebra & Numerical Applications for Engineers	2
EGNR245 Calculus Applications for Technology	3
Total	18

Some students entering Manufacturing Engineering Technology do not possess a sufficient mathematical background, initially, to be placed directly into MATH111 and MATH131. These students are instead placed in MATH102 Intermediate Algebra, or, as appropriate to their level of Mathematics preparation, in remedial courses that eventually lead to MATH102. This course does award 4 college credits, but does not apply toward any degree requirements of the Manufacturing Engineering Technology program; any remedial courses below MATH102 provide no college credit.

The program requires all students to complete the two-course math sequence, MATH111 and MATH112, as well as a MATH111 - MATH 131 - EGNR140 - EGNR245 sequence. EGNR140 and EGNR245 cover a variety of mathematical topics applicable to manufacturing engineering technologists and training in the use of mathematical software. EGNR245, specifically, expands on integral calculus, introducing multiple integrals and solutions to elementary differential equations. Students also take MATH207, a statistics course, which provides the mathematical foundation for EGNR310 Quality Engineering, a technical course in the MfgET program.

As is evident, the Mathematics component includes algebra (MATH111), trigonometry (MATH131), and integral and differential calculus (MATH112 and EGNR245)

The Mathematics background thus obtained in the curriculum provides skills necessary to solve technical problems in Manufacturing, as criterion 5 requires ("... the application of ... [mathematics beyond trigonometry/algebra] ... appropriate to the student outcomes and program educational objectives."). This becomes clear by way of the various technical and other courses which use the Math courses as pre or co-requisites, as illustrated by figure 5-2 (no distinction between pre- and co-requisites is made here, except between the Math courses themselves).

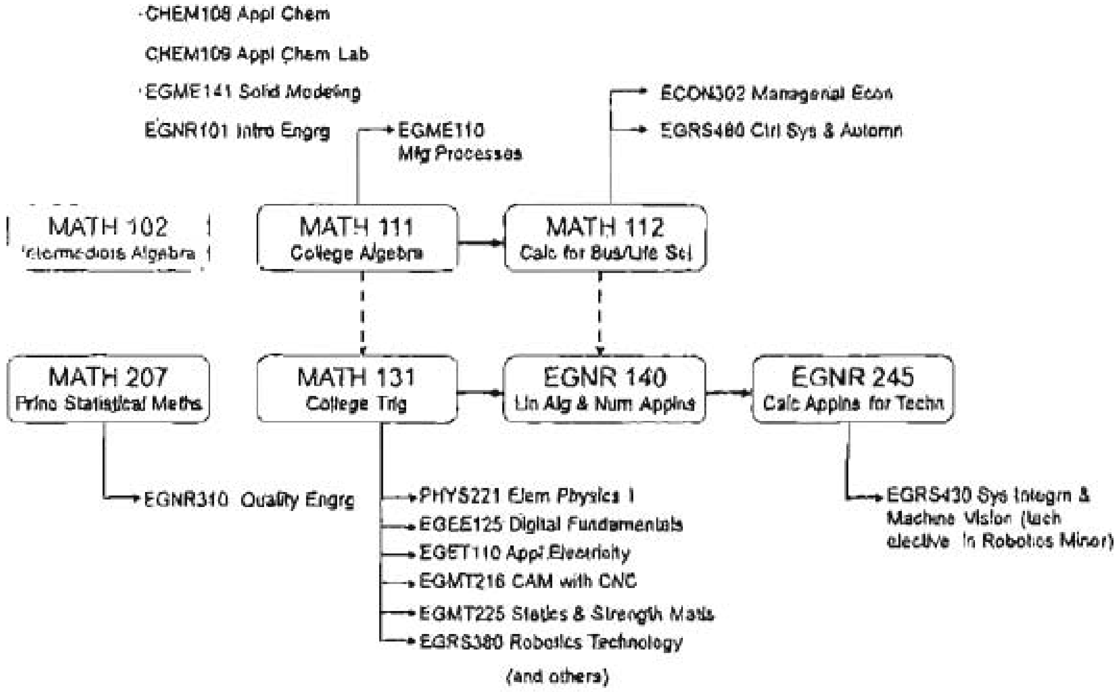


Figure 5-2. Internal Structure of Mathematics Component, and Relation to Technical Courses. The dashed lines indicate Mathematics courses that may be simultaneous (co-requisites) whereas the dashed lines indicate that they are taken sequentially (prerequisite sequence), but there is no such distinction made in indicating the relationships of the Mathematics courses to the technical courses.

Importantly, the figure shows how the mathematics content is then applied in following technical courses. These technical courses are not comprehensively listed here, but only examples of those directly following a given mathematics course (more advanced technical courses following these, of course, have the mathematics courses as *indirect* prerequisites, but are not listed here).

As is clear from the figure, the technical content of the curriculum makes use of mathematics, at levels appropriate to the particular technical subjects. These technical courses then, more directly, support the student outcomes and PEOs. So, the mathematics, accordingly, is applied in support of the student outcomes and PEOs as called for by criterion 5.

5.A.5.1.B Technical Content Component. The core of the discipline is, of course, the set of Engineering and Engineering Technology courses themselves. As noted above, this amounts to 53% of the total credits (66 credits) in the curriculum, falling between the 1/3 and 2/3 limits as called for by criterion 5.
Table 5-4 below lists these courses and their credits, organized into alphabetical subgroupings by 4-letter subject designation, and in increasing numerical order within subgroups.

Table 5-4. **Technical Component of Curriculum.**

Course	Credits
EGEE125 Digital Fundamentals	4
EGET110 Applied Electricity	4
EGET175 Applied Electronics	4
EGME110 Manufacturing Processes I	3
EGME141 Solid Modeling	3
EGME240 Assembly Modeling and GD&T	3
EGME275 Engineering Materials	3
EGME276 Strength of Materials Lab	1
EGMT216 CAM with CNC Applications	3
EGMT225 Statics and Strength of Materials	4
EGNR101 Introduction to Engineering	2
EGNR265 "C" Programming	3
EGNR310 Quality Engineering	3
EGNR491 Engineering Design Project I*	3
EGNR495 Engineering Design Project II*	3
EGRS365 Programmable Logic Controllers	3
EGRS380 Robotics Technology	2
EGRS381 Robotics Technology Lab	1
EGRS480 Manufacturing Automation	3
EGRS481 Manufacturing Automation Lab	1
Technical Electives	10
Total	66

As noted above, the program requires the selection of 10 credits of technical electives; the allowable technical elective courses are provided below in table 5-5. A Minor in Robotics Technology is readily available for a small number (3) of additional credits beyond the MfgET program. In that case, the student would select EGRS430 Systems Integration and Machine Vision and EGNR496 Senior Directed Project, for 9 of the 10 technical elective credits, plus another 4 credits from this list.

Table 5-5. **Technical Electives.**

Course	Credits
EGEE250 Micro-Controller Fundamentals	4
EGET310 Electronic Manufacturing Processes	4
EGME310 Vehicle Development & Testing	2
EGNR250 Cooperative Education	2
EGNR261 Energy Systems/Sustainability	3
EGRS215 Introduction to Robotics	2
EGRS430 Systems Integration & Machine Vision	4
EGNR496 Senior Directed Project	3
MGMT371 Business and Operations Analytics	3

An examination of the subject matter included in technical component, outlined above in tables 5-4 and 5-5, reveals a broad focus on manufacturing (manufacturing processes course, materials course, CNC course, etc) with somewhat of a lean towards automation aspects (note the EGRS listed course titles in table 5-4), software (e.g., "C" programming, but also much automation-related software in courses like EGRS381, 365, 481, etc.) and machine control (e.g., EGRS365). There are also themes of product improvement (hence courses in assembly modeling, GD&T, materials, quality engineering and mechanics for instance), continuous improvement (e.g., quality engineering course), and operations (e.g., ECON302 and EGRS480) present in the curriculum.

Importantly, note that criterion 5 calls for "a technical core…that prepares students for the increasingly complex technical specialties they will experience later in the curriculum." As a comparison table 5-4 with the prerequisite structure from figure 5-1 demonstrates, the "technical core" would consist of courses like EGME141 Solid Modeling, EGME110 Manufacturing Processes, EGET110 Basic Electricity, or EGNR265 "C" Programming, etc., upon which many later courses rely as prerequisites. Then, more advanced technical subjects like EGME240 Assembly Modeling and GD&T, EGMT216 CAM with CNC, EGRS365 PLCs, EGET175 Applied Electronics, or the automation courses EGRS380/381/480/481, all draw on this core.

The technical component of the curriculum, by way of its many laboratories (note from table 5-1 which courses have lab activities), exposes the students to the use of the equipment and tools of the manufacturing discipline. Some examples are:

Software

- CREO Parametric 3.0 (for CAD and CAM applications, and GD&T) in EGME110, EGME141, EGME240, and EGMT216, as well as BobCAD in EGME110.
- Roboguide, Witness and other robotics-simulation related software in the EGRS courses
- CARSIM (vehicle simulation software) in the EGME310 tech elective
- VAL3, TPP, and KAREL for controlling robots
- Microsoft Visual C# and ATS Smart Vision for machine vision

- RS Logix 5000 for programmable logic controllers, and Factorytalk View, for programming the panelview, in EGRS365
- MATLAB computational software (EGNR140, EGNR245)

Hardware, tools, techniques

- CNC and conventional machining centers, lathes, mills, etc in EGME110, EGMT216
- Materials testing, ultrasonics, and strain gauge hardware in EGME276
- Robotics hardware in the EGRS courses

5.A.5.1.C Physical and Natural Sciences Component. The MfgET program requires CHEM108 Applied Chemistry, CHEM109 Applied Chemistry Lab, and PHYS221 Elements of Physics I.

Additionally, a significant amount of material on electric circuits and electromagnetics, normally otherwise taught in a second-semester physics course, is covered in two technical courses, EGET110, Applied Electricity and EGET175, Applied Electronics.

The natural sciences component of the curriculum includes an appropriate laboratory component. CHEM109 is a purely laboratory course that accompanies 108, and PHYS221 has a 2-hour per week laboratory component as well.

Table 5-6 below briefly summarizes these courses and their respective credit counts.

Table 5-6. **Natural Sciences Component of Curriculum.**

Course	**Credits**
CHEM108 Applied Chemistry	3
CHEM109 Applied Chemistry Lab	1
PHYS221 Elements of Physics I	4
Total	8

Figure 5-3 illustrates how the natural science courses relate to the technical curriculum. As with mathematics, it's clear that the technical component of the curriculum is also built upon the foundation of the natural sciences.

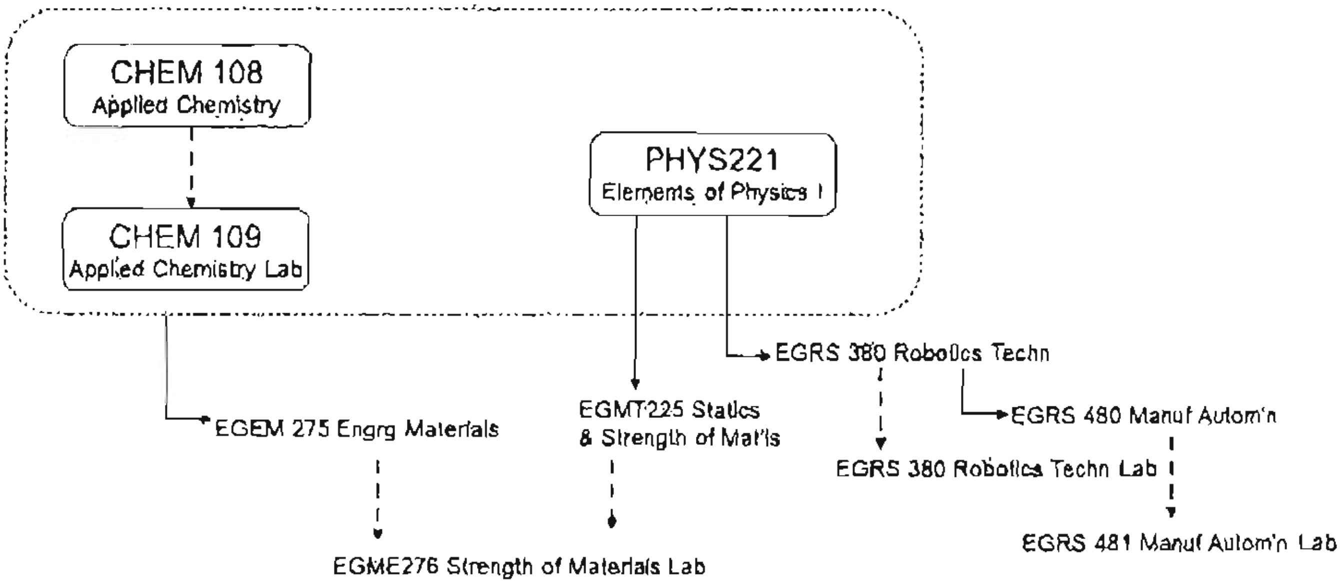


Figure 5-3. Natural Science Courses and their Relation to Technical Courses.

5.A.5.2 Program Criteria, Curricular Alignment. Besides the capstone experience (to be addressed below in section A.6), the program criteria for Manufacturing Engineering Technology call for competencies in the following subjects: *a*) materials / manufacturing processes, *b*) product design / tooling / assembly, *c*) manufacturing systems / automation / operations, and *d*) statistics / quality / continuous improvement, and industrial organization / management. Each of these is addressed, in turn, in the following.

5.A.5.2.A Program Criterion: Materials and Manufacturing Processes. The curriculum introduces these subjects through, firstly, the EGME110 Manufacturing Processes course, and then later the Chemistry-based EGME275 Engineering Materials course, accompanied by the lab course EGME276 Strength of Materials Lab.

EGME110 covers a breadth of traditional manufacturing methods at a descriptive level, including machining, forging, casting, and joining methods. In the laboratory, it practices machining more narrowly, but also sand casting briefly, as well as welding (joining).

EGME275 is a treatment of metals, ceramics, polymers, and composites, but with special emphasis on ferrous metallurgy.

EGME276 provides lab experiences on metals, plastics and NDT (among other topics). Further competence is obtained in courses like EGMT216 CAM with CNC, wherein the implications of materials for tool selection are studied. Ultimately, material selection, and selection of compatible manufacturing processes, is likely to be practiced in the capstone courses, to an extent depending on the nature of the project.

5.A.5.2.B Program Criterion: Product Design, Tooling and Assembly. Here it would be the courses EGME110 Manufacturing Processes (introduces tooling), EGMT216 CAM with CNC (further on tooling), EGNR310 Quality Engineering (as the robust design approach is covered, and practiced with a term design project), and the capstone courses, that constitute the curricular contributions.

5.A.5.2.C Program Criterion: Manufacturing Systems, Automation, Operations. Automation is a particular emphasis of LSSU's MfgET program. Courses that contribute are EGRS365 Programmable Logic Controllers, covering control of industrial machinery of a great variety, and then the robotics-focused courses EGRS380/381/480/481. Notably, the latter sequence does not merely concern industrial robots in isolation (although a certain focus on robots is part of it), but places special emphasis on their integration into larger manufacturing processes.

5.A.5.2.D Program Criterion: Statistics & Quality and Industrial Organization. The EGNR310 Quality Engineering course, based on its prerequisite of MATH207 Principles of Statistical Methods, applies Statistical approaches, such as control charts, hypothesis testing, and design-of-experiments methodologies, to issues of manufactured product quality.

The ECON302 Managerial Economics course, and the EGRS480 Manufacturing Automation course, each address management and operations of manufacturing organizations as parts of their respective course contents.

5.A.6 Alignment of Capstone Experience to Student Outcomes. MfgET students usually take the senior design course sequence, EGNR491 and EGNR495, as indicated in table 5-4 above; detailed syllabi for these courses are found in Appendix F. However, there are actually three possible paths for graduates to follow for their senior year capstone experience: *Industrial-based, Co-op, or Research-based*. All of these paths provide a realistic design experience in an academic environment. All students participate in the same initial course (EGNR491), with a strong emphasis on team and communication skills during the definition and proposal phase, and initial design phase, of a multi-disciplinary project. The majority of students then continue to work on multidisciplinary teams to implement and engineer, i.e., realize, a final design for an industrial customer (EGNR495). Alternatively, Cooperative Education students may substitute an equivalent design experience during their Co-op for the EGNR495 course (realization phase). Finally, a research-based project may also be substituted for the industrial-based project. Research-path students again participate in the team/communication skills area of the Senior Year Experience (EGNR491), but define and execute an academically-oriented research project under the direction of a faculty member. The Senior Year Experience for all of these paths requires the application of student knowledge and skills acquired in earlier course work to enhance their ability to accomplish required objectives.

In recent years, most students have chosen the EGNR491-495 sequence, with very few opting for the Coop - EGNR491 alternative. The research option, while remaining available in principle, has been completely inactive for many years.

Thus, for most students, the senior design experience at LSSU involves participating in an intensive design project that spans *two* semesters. Students work on multidisciplinary teams (i.e., typically a mix of students from the disciplines MfgET, EET, ME, EE, and CE), often 4-7 students depending on the scope. They normally design and build a product for an industrial customer; some projects, however, are supported directly by LSSU. Typical project budgets are $5000 - $30,000, but have occasionally fallen out of that range on both ends. Examples of projects from the past few years which have involved MfgET students are:

- Design and development of a robotics assembly line, incorporating four FANUC robotics, and end-of-arm tooling, and including a robotics-playing-tetris demo, for use in LSSU laboratory courses in robotics.
- Design and implementation of of a robotics workcell to simulate the dispensing of a wood filler product into railroad ties. A robot, using custom end of arm tooling and a machine vision system, locates the positions of spike holes on railroad ties as they move by on a continuous conveyor, serving as a proof-of-concept for future development of a wood product dispensing system in the railroad industry.
- A study of the development of an LNG barge to refuel freighters on the Great Lakes, including the building of a small (lab-scale) wave tank for capsize stability testing with sloshing liquid cargo.
- Design and build of an automated hydraulics control cart for offshore machining operations, and development/implementation of a method for hydraulic leak detection.
- Design, fabrication, and validation of an impact testing stand for automotive steering systems (tie rod impact).
- Design and development of a stand-alone robotics work cell to be used by local pharmacists to fill prescriptions.

More information regarding senior design projects, including more extensive descriptions of specific projects, can be found on the School's web site at the URL http://www.lssu.edu/eng/seniors/. The senior design courses are managed by a multidisciplinary team of faculty called the senior projects faculty board (SPFB). Figure 5-4 below depicts the major activities associated with the senior design courses. The display materials available at the time of the visit will also contain portfolios of the design projects.

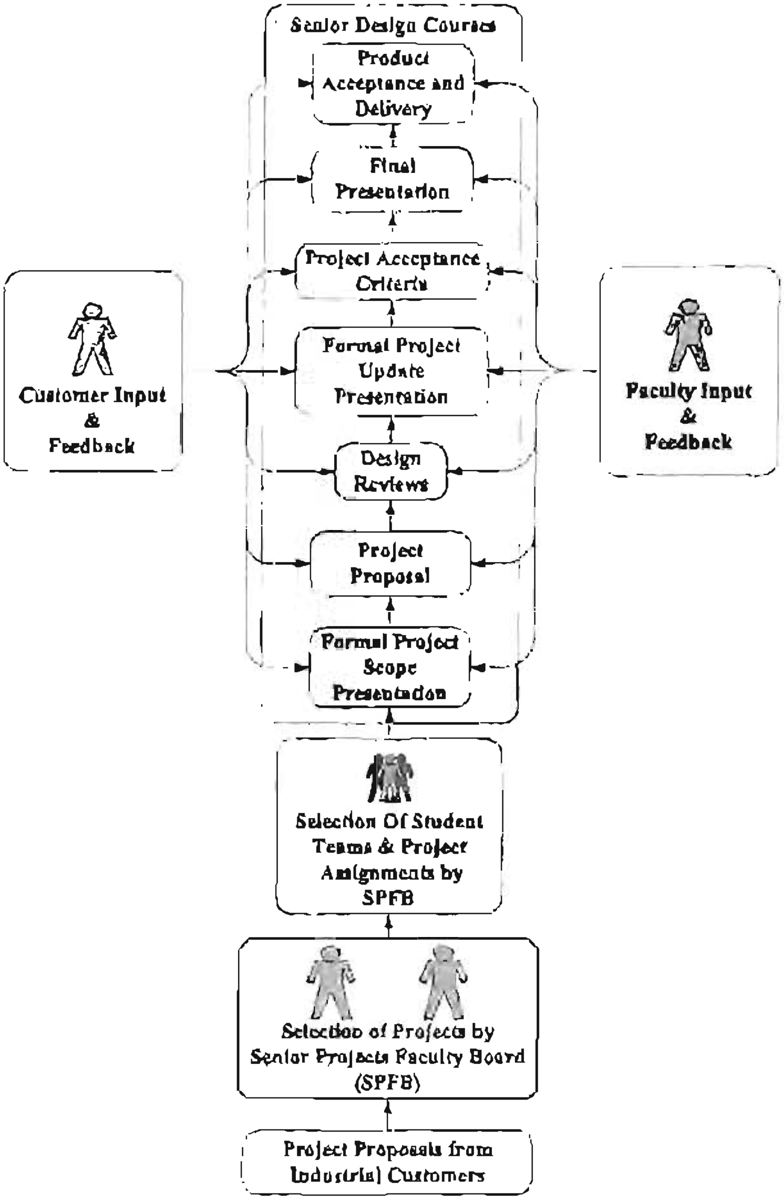


Figure 5-4. Overview of Senior Design Projects.

As is evident from the process illustrated, there are several identifiable phases that put a premium on non-technical skills: multiple presentations (scope, update, final) enhance oral communications skills; written documents such as the project proposal develop technical writing skills; customer meetings, team meetings, design reviews, etc. develop skills in running effective meetings and recording useful minutes; timeline software tools, action items and responsibility charts develop skills in time and resource management; all of these things as well as the project's design and implementation aspects, and various team assignments, all force the development of teamwork skills.

Evidently, as the projects are technical in nature, they require the application of the technical skills of the student throughout; clearly the required design and implementation tasks are the primary avenues for making use of technical skills.

Appendix F contain the detailed syllabi for the senior design experience courses EGNR491 and EGNR495, and attachments to these.

5.A.7 Cooperative Education Experience. Cooperative education opportunities exist for the engineering and technology students at LSSU, although relatively few students pursue them. The most basic co-op course is the 2-credit EGNR250, which may only be used as an elective in the MfgET program. This course requires that a student write a business report describing the Engineering Technology work accomplished at the employer. An evaluation of the work experience must also be written, and the supervisor's evaluation of the student's work performance is to be submitted..

There are also two upper level co-op courses, EGNR450 and 451, totaling 7 credits, which may replace EGNR495, the second semester of the conventional senior projects capstone experience (described above in section A.6). In this co-op experience, the students must complete a project at the co-op site that requires at least 60% of their time over the course of two semesters. The content of the project is approved by the co-op coordinator and the Senior Projects Faculty Board (SPFB). The academic requirements for the projects are very similar to those of the projects completed by the students in the senior design experience on campus, including graded presentations and written reports. The SPFB reviews the major documents submitted by the student to fulfill the course requirement.

5.A.8 Display Materials. Pertinent to criterion 5, the following will be made available for review by the ETAC of ABET team at the time of the visit:

- Course Binders Containing all Course Information
    - Detailed Course Syllabus
    - Course Assessment Summary Report
    - Course Prerequisite Form (affidavit student's sign testifying to satisfactory fulfillment of pre- and corequisite courses)
    - Course Handouts
    - Examples of Student Work (homework, exams, quizzes, lab reports or worksheets, drawings, programs, etc.)
- Senior Project Portfolios
- LSSU Catalog (on-line)

The reader may note that Table 5-2 is suggestive of which Student Outcomes are supported by each course in the curriculum. Given interest in a particular student outcome, the set of courses that correlate could then be consulted, in detail, using the course binders. In particular, those courses providing evidence of attainment of the student outcomes (shaded in T.5-2) will have discussion of the particular evidence in their respective course assessment summary reports (in the course binders), and the most relevant samples of work will be collected, further, in a binder dedicated to each student outcome.

B. Course Syllabi

Appendix A contains concise-format syllabi for each course used to satisfy the mathematics, science, and discipline-specific requirements required by Criterion 5, as well as the program criteria for Manufacturing Engineering Technology. In other words, this is the set of courses listed in Tables 5-3, 5-4, and 5-6. Alternatively, it is the set of courses listed in Table 5-1 that show credit in the third (Math/Basic Sciences) or fourth (Disciplinary) columns.

More detailed syllabi are provided for certain key courses in Appendix F; for example, the senior project capstone courses EGNR491 and 495 are provided with their full syllabi there, because these courses are tied to all of the Student Outcomes.

C. Advisory Committee

LSSU has an active Industrial Advisory board (IAB) comprised of approximately 30 members representing various industries throughout the Michigan, Ontario, and elsewhere. The Board meets twice a year. The spring meeting is held on the last day of the Spring semester, coinciding with the Senior Design Project presentations. In the Fall, one of the member companies hosts the meeting on the first Friday in November, or occasionally, this meeting has been shifted to campus. The IAB is led by an elected President, assisted by an elected Secretary.

Sub-committees are designated as needed when action items have been delegated during meetings for follow-up at the next meeting. By far, the most active sub-committee in recent years has been that for student recruitment. A binder was developed under its guidance to provide reference materials for the Admissions Counselors when they visit high schools including mini-CDs with a presentation that highlights the programs. Members participate at the various MACRAO evenings (college fairs) throughout Michigan, on behalf of LSSU Engineering & Technology. They assist the Admissions Counselors as needed and wear their company gear as they promote the LSSU engineering and technology programs to visiting parents and prospects. Members have also offered job shadowing to students considering Engineering and Technology.

In addition to the recruitment efforts, the IAB reviews and provides feedback regarding our curriculum.

Senior design projects have often been sponsored by an IAB member companies (although they are frequently sponsored by others, as well). Members participate in viewing, evaluating and grading the project presentations. Member companies have also provided opportunities for internships and cooperative work experiences.

A great many of the member companies are also final (permanent) employers of graduates, making it representative of the kinds of organizations served by our graduates, on-the-whole. Examples include Superior Fabrication (heavy duty steel components, Kincheloe, MI), Applied Manufacturing Technology (Robotics and Automation integrator, Lake Orion, MI), Continental Automotive (automotive brake systems, Brimley and Auburn Hills, MI), Essar Steel (Sault Ste Marie, Ontario), Nexteer Automotive (automotive steering, Saginaw, MI) and others.

Information about the IAB membership, and meeting minutes, can be found at www.lssu.edu/eng/iab.

CRITERION 6. FACULTY

The School of Engineering and Technology is comprised of ten (currently one is vacant) full-time faculty members, two full-time laboratory engineers, and two (currently one is vacant) consulting engineers. School, and departmental/program, leadership are discussed in detail in 8.A, but below the full-time Dean, the immediate leadership is by faculty with part-time or zero-time (uncompensated) Chair and Coordinator administrative assignments. The School faculty work very well together as a combined team on school related items. For purposes of program direction and planning, the School faculty members also meet as two separate departments: Department of Mechanical Engineering (really an informal ME / MfgET "group" that handles both ME and MfgET program curricular matters) and a Department of Electrical and Computer Engineering. The MfgET program is most directly the concern of the ME/MfgET group, which is comprised of five full-time faculty members, one laboratory engineer, and one PDC consulting engineer (vacant).

Because of its small size, the School of Engineering and Technology offers engineering curricula that are significantly impacted by the other engineering disciplines in the School. By the time they leave LSSU, MfgET graduates, for example, will have taken classes taught (or team-taught) by the entire ten-person School of Engineering and Technology faculty, and likely the lab Engineers and possibly PDC engineer(s) as well. Furthermore much of the continuous improvement process occurs at the School level, in which the entire School of Engineering and Technology faculty participate; certainly, this is the case for any decisions which impact most or all of the programs. Hence, the discussion provided on the faculty in this section will include all members of the School faculty; however, special attention will be paid to the faculty of the Department of Mechanical Engineering, and in fact the entire ME / MfgET group, which most directly administers the MfgET program.

LSSU is dedicated to its primary mission as a teaching institution by offering challenging undergraduate programs and services to students. In recognition of this mission, all members of the LSSU faculty are required by the university contract to devote 50- 75% of their efforts during the academic year toward teaching. The remaining 25-50% is apportioned between advising, scholarship, and service. The emphasis on teaching will come out in the subsequent sections, especially in Faculty Qualifications, Faculty Workload, and Authority and Responsibility of Faculty.

A. Faculty Qualifications

A careful analysis of this section will reveal that the faculty have a proper mix of competencies, that they are mutually complementary in this regard, and that these competencies correspond well to the programs offered, and specifically to the MfgET program; they demonstrate ownership of the program; and they endeavor to remain professionally competent and invest in the students, in their own professional development, in supporting other faculty, and in the Manufacturing Engineering Technology program.

The MfgET program can be characterized as having a heavy laboratory component that coordinates with the theoretical content. The faculty members instructing the program, consequently, generally share an interest in instructing and further developing laboratories, but not in isolation from theoretical content.

Consistent with the institution's primary mission of teaching, and the School's philosophy of maintaining an applied emphasis in its Engineering and Engineering Technology programs, the evaluation process employed in the hiring of new faculty accordingly places a greater emphasis on a candidate's philosophy of engineering education, promise as an instructor, and industrial experience, than it does on academic research credentials. This is further discussed in section 8.D.1.

SET

As was noted before, the MfgET graduates are affected by nearly all the faculty in the SET due to the small size of the School and the interwoven nature of the engineering disciplines. Some faculty primarily teach courses that are required in the MfgET program, while others interact with MfgET students through their participation in project-based courses such as EGNR-101 *Introduction to Engineering* or the EGNR-491-495 *Senior Design Projects I and II* capstone sequence, or by way of instructing courses common to multiple disciplines (e.g., EGME275 Engineering Materials, for both MfgET and ME, or EGNR245 Calculus Applications, for both MfgET and EET, etc). Background information is therefore presented for all faculty members in the SET in Table 6-1 below.

Table 6-1. Faculty Qualifications, Manufacturing Engineering Technology.

Faculty Name	Highest Degree Earned- Field and Year	Rank[1]	Type of Academic Appointment[2] T, TT, NTT	FT or PT[3]	Years of Experience			Professional Registration/ Certification	Level of Activity[4] H, M, or L		
					Govt./Ind. Practice	Teaching	This Institution		Professional Organizations	Professional Development	Consulting/summer work in industry
David Baumann	PhD – Electrical Engineering – 1992	P	T	FT	3	27	17	PE	L	M	M
Eric Becks	MS – Electrical Engineering/System Science – 1981	O	NTT	FT	31	5	5		M	L	H
Jon Coullard	BS Mechanical Engineering Technology – 1990	O	NTT	FT	6	20	20	Patent	L	L	M
Jim Devaprasad	MS – Mechanical Engineering – 1986	P	T	FT	1	30	30		H	H	M
Robert Hildebrand	PhD – Acoustics – 2001	ASC	T	FT	5	12	11		L	M	M
Andrew Jones	PhD – Electrical & Computer Engineering – 2002	ASC	T	FT	3	17	11	EIT	M	M	M
Jeff King	BS – Electrical Engineering Technology – 1996	O	NTT	FT	4	18	18		L	M	M
David Leach	MS – Mechanical Engineering – 2017 (anticipated)	I	TT	FT	18	3	8		H	H	L
Zakaria Mahmoud	PhD – Mechanical Engineering – 2003	ASC	TT	FT	1	10	2		H	M	L
David McDonald	MS – Electrical Engineering – 1971	P	T	FT	8	43	43	PE	M	H	H
Joe Moening	PhD – Electrical Engineering – 2010	ASC	T	FT		11	6		H	M	L
Sanjiv Sinha	PhD – Mechanical Engineering – 1994	AST	TT	FT	11	8	1		H	M	L
Paul Weber	PhD – Electrical Engineering – 2006	ASC	T	FT	1	9	9		H	H	M

1. Code: P = Professor ASC = Associate Professor AST = Assistant Professor I = Instructor A = Adjunct O = Other
2. Code: TT = Tenure Track T = Tenured NTT = Non Tenure Track
3. At the institution
4. The level of activity, high, medium or low, should reflect an average over the year prior to the visit plus the two previous years.

An overview of the ten full-time and four adjunct faculty members of the School of Engineering and Technology in Table 6-1 indicates the following:

- All faculty members have appropriate BS or higher degrees in Engineering or Engineering Technology
- All full-time faculty members either have or are pursuing appropriate advanced degrees in EE, ME, or CE to teach courses in the respective programs, and in MfgET and EET
- An average of 7 years of government and industrial experience
- An average of 16 years of teaching experience
- 30% of full-time the instructional staff are licensed Professional Engineers

ME/MfgET Group

As will be demonstrated in this section, the ME / MfgET faculty is complementary in their mix of competencies, which span the Mechanical Engineering and Manufacturing Engineering Technology disciplines as traditionally understood, and thereby provide the expertise needed to support the MfgET program. They bring a good blend of educational and professional experience. Given below is a brief description of each member of the MfgET faculty, along with his strengths and his relationship to curricular areas.

Dr. Robert Hildebrand (ME Professor)

Dr. Hildebrand has research and publication background in the areas of noise and vibrations, vehicle dynamics, and soil dynamics. He has a good mix of industrial, consulting, research and teaching experience. Accordingly, he strongly supports the program's emphasis on applications of fundamentals, on laboratory instruction, and on communications. He regularly teaches EGME-275 *Engineering Materials*, EGME-276 *Strength of Materials Lab* (co-taught), EGME-310 *Vehicle Development & Testing*, EGNR-310 *Advanced Quality Engineering*, EGEM-320 *Dynamics*, EGME-350 *Machine Design*, EGNR-340 *Advanced Numerical Methods*, EGME-415 *Vehicle Dynamics*, and EGME-425 *Vibrations & Noise Control*, regularly serves as a senior project faculty advisor, and team-teaches MATH-310 *Differential Equations* with the Math department. Dr. Hildebrand is the coordinator of the Department of Mechanical Engineering.

Prof. James Devaprasad (ME/MfgET Professor)

Prof. Devaprasad has been a professor in the School of Engineering and Technology at LSSU for 30 years. His areas of teaching emphasis include robotics and automation. He was the Coordinator or Chair of Manufacturing Engineering Technology for much of that time, and has also served as Chair of the School of Engineering and Technology for a time while the Dean position was vacant. He is currently the coordinator of General Engineering and Technology as well as the director of LSSU's Robotics Center.

Prof. Devaprasad has been the leader in developing the robotics laboratory through industrial donations and grants, and has been in key leadership roles nationally in the Society of Manufacturing Engineers (SME) and the Robotics Industries Association. He normally teaches several robotics courses in both the engineering and engineering technology curricula and often serves as the advisor or customer for robotics senior projects. He also supports the Robotics Technology minor available for the Engineering Technology students and Computer Science students. He is a recipient of the Outstanding Young Manufacturing Engineer award from SME and the distinguished faculty award from the Michigan Association of Governing Boards of universities. He serves as the director of the Women in Technology summer camps and the Robotics summer camps that he and his colleague founded over 25 years ago.

Mr. David Leach: (ME Instructor)

Mr. Leach started working for the LSSU Product Development Center in 2008, and became a full time faculty member in 2014. He has a BS ME degree from Michigan Technological University, and is currently enrolled in MTU's Graduate School and will earn an MS ME degree in May of 2017. Mr. Leach primarily teaches solid modeling, assembly modeling and GD&T, manufacturing processes, CNC with CAM applications, statics and strength of materials, and assists with senior projects. He has automotive industry experience in product and quality engineering for Class A exterior plastic trim. Mr. Leach is the advisor for LSSU's student chapter of ASME.

Dr. Zakaria Mahmud (ME Professor)

Dr. Mahmud has a BS in Mechanical Engineering from Bangladesh University of Engineering and Technology (Dhaka, Bangladesh), MS in Sustainable Energy Engineering from The Royal Institute of Technology (Stockholm, Sweden), and PhD in Engineering Science and Mechanics from the University of Alabama (Tuscaloosa, Alabama). After graduation, he taught for one year in Aerospace Engineering Department at Texas A & M University (College Station, TX). He then led NASA SBIR phase II project as Principal Research Engineer at Techsburg Incorporated (Blacksburg, VA). Dr. Mahmud then taught in Mechanical Engineering Technology program at Georgia Southern University (Statesboro, GA). Before joining in LSSU since Fall 2014, he taught for seven years in Mechanical Engineering at North Dakota State University (Fargo, ND). His primary research interests are in the areas of experimental aerodynamics and micro-fluidics. He regularly teaches the following courses at LSSU: EGNR 101 Introduction to Engineering, EGNR-140 *Linear Algebra and Numerical Applications*, EGME-337 *Thermodynamics*, EGME-338 *Fluid Mechanics*, EGME-431 *Heat Transfer*, and EGME-432 *Thermal Fluids Laboratory*. Dr. Mahmud is serving as a co-advisor for Engineering house and advisor for the Society of Aumotive Engineers (SAE).

Mr. Jon Coullard: (ME Lab Engineer)

Mr. Coullard is a full-time laboratory engineer for the School of Engineering and Technology. He has a BS MET degree from LSSU, and extensive professional engineering experience in manufacturing and the development of specialty machines.

Before earning his bachelors degree he was a professional welder. Accordingly, he strongly supports the traditional manufacturing aspects of the program, and, especially from his long industrial experience, its emphasis on communications and professionalism. Mr. Coullard regularly serves as an adjunct instructor in courses that support the MfgET program.

ECE

The following faculty members from the Electrical & Computer Engineering Department provide teaching and key ancillary support for the MfgET program:

Dr. David Baumann, P.E. (ECE Professor)

Dr. Baumann has BS, MS, and PhD degrees in Electrical Engineering and an MS degree in Statistics from the University Wisconsin. As a graduate student he worked under the direction of Dr. R. A. Greiner in the Electro-Acoustics Laboratory. His research involved acoustic monitoring of machinery condition and active attenuation of noise in air ducts. He has four summers of research experience at the Naval Surface Warfare Center involving active vibration control of submerged propellers. He taught for 5 years at Oral Roberts University and has now taught for 17 years at LSSU. He has expertise and teaches courses in the areas of Electromagnetics, Control Systems, Circuits and Signals, Probability and Statistics, and Power Distribution. He served several years as the coordinator of the Senior Projects Faculty Board and the coordinator of the Department of Electrical and Computer Engineering and now serves as the chair of the School of Engineering and Technology.

Dr. Andrew Jones (ECE Professor)

Dr. Andrew Jones joined LSSU during the 2005-2006 academic year. He has degrees in Electrical Engineering (BS/MS) and in Computer Engineering (PhD). He previously taught at Purdue University for three years. Dr. Jones has research experience in digital and micro-controller systems as applicable to mobile robotics systems. He primarily teaches courses in robotics, software development, digital electronic and micro-controller areas and was awarded with the LSSU Distinguished Teacher Award in 2010. Dr. Jones has also engaged in applied research activities with entrepreneurs interested in developing electronic products as well as consultations for industrial companies. He is also involved with FIRST with coordinating local FLL (FIRST Lego League) tournaments and mentoring the local FRC (FIRST Robotics Competition) team. He is the advisor for the LSSU chapter of IEEE. Dr. Jones is the coordinator of the Department of Electrical and Computer Engineering.

Prof. David McDonald, P.E. (ECE Professor)

Prof. McDonald has been teaching at LSSU for 43 years in the Electrical and Computer Engineering department. His degrees are in Electrical Engineering, and he has recently taken several 500 & 600 level courses in Electrical Engineering and Systems Engineering. His areas of interest include circuit analysis, electrical machines, instrumentation, signal processing, and hybrid/electric vehicle control and power systems. He also teaches courses in these areas in addition to serving as a senior projects advisor. Prof. McDonald has been very active in grant writing and has secured numerous grants for LSSU. He has served as a TAC of ABET evaluator and also as chair of the ECE department. He has done recent consulting as a systems engineer in the electric vehicle industry in the development of testing systems in the controls, test and simulation area.

Dr. Joseph Moening (ECE Professor)

Dr. Moening has been at LSSU since the start of the 2010-2011 academic year. He has BS, MS, and PhD degrees in Electrical Engineering from the University of Toledo. His areas of interest include power electronics, renewable energies, semiconductor devices, analog electronics and micro/nano-device fabrication. He primarily teaches courses related to these areas. He has research experience in laser-based micro-structuring of thin films as well as power processing systems. His is the co-advisor for the Engineering House.

Dr. Paul Weber (ECE Professor)

Dr. Weber has a BS in Computer Engineering, and MS and PhD degrees in Electrical Engineering from Michigan Technological University. While at Michigan Tech, his primary research was in the area of fault-tolerant distributed control algorithms for safety-critical systems (e.g. fly-by-wire aircraft control). After finishing graduate school, he taught for three years as a Visiting Assistant Professor at University of Minnesota Duluth. During his time there, he also developed research in the areas of energy and engineering education, which he has continued while at LSSU since joining the faculty in the fall of 2009. Dr. Weber's primary teaching expertise is in digital design and embedded systems. He is currently the coordinator for Senior Projects.

Mr. Eric Becks (ECE Consulting Engineer)

Mr. Becks earned his BS and MS in Electrical Engineering/System Science from Michigan State University. Prior to joining the LSSU Product Development Center (PDC), Eric Becks was involved in industrial and entrepreneurial activities. His work experience ranges from Engineering Manager in a multi-national company to President of a diagnostic equipment manufacturing firm. Mr. Becks was involved in the formation of real estate, retail, internet marketing and manufacturing businesses as well as negotiating a leveraged buy out. He has designed numerous products including several that have received industry awards. Besides his duties at the PDC, Mr. Becks also serves as Director of Intellectual Property & Economic Development for LSSU and was recently named President & CEO of SSMart^{SM}, Inc., the Sault Ste. Marie/LSSU SmartZone. He has also served as a school board member for 14years; 12 as president.

Mr. Jeff King (ECE Lab Engineer)

Mr. King is a full-time laboratory engineer for the School of Engineering and Technology. He has a BS degree in Electrical Engineering Technology from LSSU, and is pursuing a BS degree in Mathematics from LSSU on a part-time basis. He has valuable professional engineering experience in industrial electrical controls and PLCs, and is responsible for the School's electronic and computer systems. He occasionally teaches as an adjunct in the areas of electrical circuits, electronics, and PLC's for the engineering technology programs in the School and has instructed sections of the digital fundamentals laboratory. He also assists significantly in the senior design projects on the PLC and electrical design and implementation aspects.

B. Faculty Workload

The faculty member is understood to have duties in instruction (encompassing teaching and course assessment), advising (encompassing academic advising and student mentoring), scholarly activities, and service (to the institution, profession, and the community). The time distribution of the faculty member's workload (implied based on proportionality to the contractually allowable weights given in the supervisory evaluation of the faculty member) is 50-75% instruction (corresponding to the 24 load hours per year), 10-20% advising, 5-20% scholarly work, and 10-20% service.

Instruction

The instructional portion, specifically, is fulfilled by instructing coursework amounting to 24 contract hours per year (or an average of 12 per semester), where "contract hours" are defined below. Although faculty members are considered full time when teaching 24 contract hours per year (average of 12 contract hours per semester), nevertheless advising, scholarly work, and service activities are duties that fall outside the 24 measured contract hours (NB: this is contract hours with an "r", not merely "contact" hours, the raw number of hours in class).

Faculty time commitment is measured contractually in contract hours (also interchangeably called "load hours"), which are *not* identical to credit hours earned by a student. A student earns a *credit* hour for each hour of lecture per week, and an additional credit hour for a 1-3 hour lab. On the other hand, one *contract* or *load* hour is one hour of lecture or 1.5 hours of lab (i.e., actual lab time is multiplied by 2/3 to generate contract hours).

The amount of time and energy that faculty are expected to provide to an engineering program greatly influences the general strength of the program. Typical indicators of workload include contract hours, and student-to-faculty ratios (reflective of typical class and lab enrollments). A broad overview of the instructional workload broken down by group (regular faculty, lab engineers, etc) is shown below in Table 6-2.

Table 6-2. Faculty Workload Summary
Manufacturing Engineering Technology – Fall 2015

Faculty Member (name)	FT or PT[1]	Classes Taught (Course No.-Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to the SET Programs[5,6]
			Teaching	Research or Scholarship	Other[4]	
David Baumann	FT	EGNR340-1.333, EGNR346-1.333, EGNR491-2.0, EGNR460-5.0, EGNR101-0.239	75	0	25	100
Eric Becks	PT	EGNR491-0.306	3	0	97	3
Jon Coullard	PT	EGNR491-2.156	18	0	82	100
Jim Devaprasad	FT	EGNR491-2.016, EGRS381-2.0, EGRS480-3.0, EGRS481-4.0, EGNR101-0.865	67	0	33	100
Robert Hildebrand	FT	EGEM320-3.0, EGNR310-3.0, EGNR340-1.333, EGNR491-2.204, EGME350-5.286, EGNR101-0.451	92	0	8	100
Andrew Jones	FT	EGEE250-5.333, EGNR101-2.002, EGNR265-3.0	92	0	8	100
Jeff King	PT	EGNR491-2.096	18	0	82	100
David Leach	FT	EGME1104.0, EGME141-6.666	100	0	0	100
Zakaria Mahmod	FT	EGNR101-2.059, EGNR140-5.0, EGME431-3.0, EGME432-2.0	100	0	0	100
David McDonald	FT	EGEE280-4.0, EGEE330-5.0, EGNR491-2.312	100	0	0	100
Joseph Mocnine	FT	EGEE210-7.0, EGEE170-5.0, EGNR101-0.627	100	0	0	100
Sanjiv Sinha	FT	EGEM220-3.0, EGMT225-4.0, EGME141-3.333, EGRS380-2.0, EGME350-1.714	100	0	0	100
Paul Weber	FT	EGNR230-0.432, EGNR261-3.0 EGNR361-2.0, EGNR491-0.718, EGRS430-9.0	100	0	0	100

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the Self-Study Report is being prepared
3. Program activity distribution should be in percent of effort in the program and should total 100%
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.
6. Note that no distinction can straightforwardly, or meaningfully, be made between time contributions towards the various programs (EET, MfgET, EE, CE, ME) since they are so intertwined with shared courses.

Manufacturing Engineering Technology – Spring 2016

Faculty Member (name)	PT or FT[1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to the SET Program[5,6]
			Teaching	Research or Scholarship	Other[4]	
David Baumann	FT	EGEE411-3.0, EGNR340-1.333, EGNR495-4.254	75	0	25	100
Eric Bocks	PT	EGET310-5.0, EGRS385-4.0	75	0	25	75
Jon Coullard	PT	EGME110-6.0, EGNR495-4.054	88	0	12	100
Jim Devaprasad	FT	EGNR495-4.081, EGRS385-2.0, EGRS435-6.0	100	0	0	100
Robert Hildebrand	FT	EGNR495-4.373, EGME275-3.0, EGME276-4.0, EGME425-4.333	100	0	0	100
Andrew Jones	FT	EGEE355-7.0, EGNR265-3.0, EGRS385-3.0,	100	0	0	100
Jeff King	PT	EGNR495-4.029	34	0	66	100
David Leach	FT	EGME312-6.0, EGME240-8.0	100	0	0	100
Zakaria Mahmud	FT	EGNR140-7.0, EGME337-4.0, EGME338-3.0	100	0	0	100
David McDonald	FT	EGNR495-4.050, EGEE210-5.0, EGNR245-3.333	100	0	0	100
Joseph Moening	FT	EGEE475-5.0, EGRS365-8.0	100	0	0	100
Sanjiv Sinha	FT	EGEM220-3.0, EGME276-4.0, EGME141-3.333, EGME225-3.0	100	0	0	100
Paul Weber	FT	EGEE125-5.666, EGNR260-3.0, EGNR495-0.162	100	0	0	100

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the Self-Study Report is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.
6. Note that no distinction can straightforwardly, or meaningfully, be made between time contributions towards the various programs (EET, MfgET, EE, CE, ME) since they are so intertwined with shared courses.

For the regular faculty, a full-time teaching load is 12 contract hours (or sometimes "load hours") per semester, with the option to take on up to 6 additional load hours per semester with "overload" compensation at a reduced rate, which is currently $907 per load hour. A faculty member may fall under 12 for a given semester, if compensated in the same academic year by an overload in the other semester, such that 24 contract hours are performed per year. Single semester loads are limited to 18, and annual (excluding summer) loads to 32.

The teaching load limits, and the general goals of keeping faculty near to the nominal load of 12 hours per semester and of maintaining a healthy student-to-faculty ratio, are intended to allow faculty time to participate in non-classroom, professional activities as well as provide for quality student interaction and class preparation. Thus, beyond the expectations for teaching, faculty are also expected to hold regular office hours, and to participate in academic advising, student group advising, service activities, and professional development.

Advising

All regular, full-time faculty keep 5 office hours per week, at which they are available to meet students; those teaching less than full-time (e.g., the lab and PDC engineers) have numbers of office hours that are pro-rated by their respective fractions of a full-time teaching load. These office hours permit students to interact with the faculty member to supplement in-class instruction. The University has reinstated recitation sections in some problem-solving courses, for which faculty provide a one-hour recitation and are accordingly relieved of an hour of office hour burden. Thus, the standard is that the total of recitation hours and office hours add up to 5 per week (note that no faculty currently have so far had more than 1 recitation hour per semester, and exceeding 2 recitation hours per faculty member per semester will be discouraged should that situation ever arise, in order that the number of general office hours will remain adequate).

Academic advising, in its aspect as a service to students, is described above. Concerning, on the other hand, its aspect as a faculty activity and time burden, note that the approximately 220 students enrolled in the School are divided amongst the 10 fulltime faculty members as advisees, so that the average is about 22 advisees per faculty member. The advising duties of the faculty member are to meet with each advisee prior to registration, recommend courses for which to register, and discuss course selection alternatives from the perspectives of progress to degree completion, student interests, and career relevance. As a benchmark, 15 minute advising sessions are used for freshmen students in EGNR-101 *Introduction to Engineering* (for students in that course only, these are scheduled during a specific lab session). Thus, an estimate of 5-6 hours of ordinary advising burden per faculty member per semester is reasonable; there is also some additional burden on the program coordinators and the school chair, specifically, in handling supplemental advising related to course overrides, transfer credit evaluation, and waivers.

Most faculty members also advise senior project teams, which provide a substantial amount of additional interaction with students and their respective industrial sponsor contacts in a realistic professional setting. Certainly, advising of senior projects teams is another time-consuming activity for faculty that resembles some of the out-of-classroom student interaction activities described above, but in principle, since this activity is compensated by teaching load from the EGNR-491 and EGNR-495 courses, it is more properly seen as part of team teaching those courses.

The office hour and academic advising burdens are implied extensions of the instructional component of the faculty members' duties; they do not generate additional contract hours, but are rather understood to be a part of the duties inherent in fulfilling the 24 load hours.

Scholarship and Service

The 24-load hour requirement, described above, may be understood to comprise the *instructional* part of the faculty member's duties, only. Outside of the 24 load hours fall the additional duties of service and scholarship. As noted above, this may be up to 40% of the faculty member's workload (scholarship up to 20%, and service up to 20%).

Professional development activities, by their nature, vary considerably in kind and scope from faculty member to faculty member; the reader is referred to the faculty CVs below, for specific activities.

Regarding *service* activities, while these also vary in kind and scope among faculty members, many are School-coordinated to such an extent that a rough overview can be given. Faculty members within the School regularly serve on University-wide committees (e.g., curriculum, general-education, student retention, *etc.*), serve on School committees (e.g., Engineering scholarship awards committee), support the faculty association, and participate in assessment. There are also initiatives within the School, and LSSU, to increase new student enrollment, by means such as high school visits, meeting with prospective students, and lab tours, each of3333 which represent common service activities of the faculty. Faculty members serve as advisors to student chapters of national professional organizations, including ASME, IEEE, SAE, and SWE; such advisorship generally involves overseeing that the clubs operate within their bylaws, recruit, fundraise, manage their budgets, and participate in regional and national events. Faculty members may also participate in summer orientations for incoming students, although the School chair has undertaken the majority of this particular burden.

C. Faculty Size

A review of instructional assignments over the last two years (an ample cycle to capture all courses, including those on an alternating year basis), breaking down the total instructional burden (measured in load hours as defined in 5.B above) by category of instructional personnel, is provided in table 6-3, below.

Table 6-3. Division of Instructional Load by Category of Instructional Personnel

Semester	Regular Faculty	Internal Adjuncts*	External Adjuncts	Total
Fall 2014	112.66	9.83	0	122.49
Spring 2015	114.68	20.42	0	135.1
Fall 2015	123.9	4.56	0	128.46
Spring 2016	124.92	23.08	4	152
Total	476.16	57.89	4	538.05
Percentage	88	11	1	

* Lab and PDC Engineers

The table shows that 99% of all instruction was carried out by the instructional staff listed in Table 6-2, i.e., the ten regular faculty complemented by the lab engineers and the PDC consulting engineer(s). Accordingly, only 1% of the instruction was carried out by outside adjuncts. In particular, 88% of the instruction was carried out by the 10 regular, full-time faculty, specifically. As these are very high proportions, it is clear that so long as the 10 positions are filled, there is an adequate faculty size.

All faculty maintain at least 5 hours of some combination of office hours and recitations (in practice, the latter has never exceeded 1 of the 5 hours for any faculty member). Senior student exit surveys consistently support the notion that these interactions are not only sufficient in quantity, but also in quality; a consistent theme is that students have excellent and fruitful access to faculty members.

Each student has a faculty member assigned as an academic advisor, and meet with the faculty member at least once per semester. As noted above (Criterion 6 Section B), there is an average of 22 student advisees per faculty member, suggesting a situation in which sufficient attention can be given to each.

The faculty have, finally, opportunities to interact with industrial and professional practitioners in a variety of contexts, including senior projects, cooperative education projects, PDC-sponsored projects, IAB meetings, and summer work.

D. Professional Development

All of the School faculty members have pursued professional development activities over the past five years. These include grant writing, consulting, review of scholarly articles and texts, conference presentations, taking classes, and attending conferences, but the level of these activities is, consistent with the focus of the LSSU mission on teaching, less than is traditional elsewhere in academia.

Many of the faculty also regularly serve on the Senior Projects Faculty Board (SPFB). The SPFB oversees all senior year experiences within the School of Engineering and Technology. As many projects are sponsored by industry, *senior projects provide good opportunities for faculty to work closely with industry.* This interaction has resulted in faculty providing training for industrial based engineers, summer employment opportunities for faculty, and general faculty professional development due to the close industrial ties.

E. Authority and Responsibility of Faculty

Establishing policy

This sub-section addresses the faculty's role, and that of administrators, in defining the program's curriculum, educational objectives, student outcomes, and continuous improvement process. It is the faculty that are the primary authority over all of these areas and who *plan and originate curricular change proposals*, but administrators have approval/veto authority relative to curriculum, specifically.

Curricular matters for the MfgET program, including prerequisite structure and the detailed course requirements comprising the program, are planned at the Departmental level (the ME/MfgET group). The ME/MfgET departmental faculty regularly meet (weekly during the academic year), with the ME coordinator setting the agenda, and it is in this forum that the curriculum (among other business) is addressed in detail, and in which any action to change it originates; i.e., administration does *not* generate its own curricular change proposals. The department ordinarily operates by consensus, although a formal majority vote is, in principle, required to adopt any change; such a vote could be undertaken in the unlikely event there were no clear consensus and a decision could not be forestalled. A change so approved by the ME/MfgET faculty is then proposed to the entire School faculty, and a formal vote taken at that level, usually after discussion in a School faculty meeting (discussion may be foregone in the case of minor changes). Upon School faculty approval, the Dean must approve, after which the proposal proceeds to a University-wide Curriculum Committee, a committee consisting primarily of faculty, but also of some administrators and a student, and in which the School is represented by a single voting faculty member. If approved at that level, it must, finally, receive approval by the Provost, usually after advisory discussion in the Provost Council (a body comprised of the Deans and School Chairs).

The educational objectives, student outcomes, and continuous improvement process for the MfgET and other engineering and engineering technology programs, which are provided in Criterion 2 and Criterion 3 above, and the continuous improvement process outlined in Criterion 4, are defined and revised by the entire faculty of the School of Engineering and Technology (*i.e.*, both ECE faculty and ME/MfgET faculty collectively). The Dean and higher administrative instances (Provost, etc.) have no formal approval, veto or other role in this process, although their input is welcomed.

Thus, all the regular faculty of the entire School has some kind of a role in the oversight of the MfgET program. By virtue of the wide involvement of faculty in the assessment process for all of the School's programs, and the similarity in the assessment process for all of these programs, the entire School faculty is in a well-informed position concerning interpreting assessment results for the MfgET program. The entire faculty, regardless of academic rank or other factor, regularly attends and participates in the deliberations, and ample time is taken in these deliberations such that all perspectives are thoroughly heard and considered, and consensus obtained; accordingly, formal votes are unusual.

In summary, the faculty (and all of the faculty members equally) has complete autonomy with regard to defining and revising educational objectives, student outcomes, and the continuous improvement process, but does not despise the input of other constituents. Regarding curriculum, that autonomy is not complete, insofar as administrative approvals are part of the process. The former (educational objectives, student outcomes, continuous improvement) is addressed by the School faculty collectively, while the latter (curriculum) is primarily planned by the Departmental faculty (with later School faculty discussion and approval).

Leadership Responsibilities

Faculty members having some administrative responsibilities relative to the MfgET program are the ME coordinator, the MfgET coordinator, the SET chair, and the Robotics Lab director. The duties of the coordinators are not officially defined, but the university does maintain a list of general chair duties (refer to Table 6-3 below). For an enumerated list of the duties performed by the ME coordinator, the MfgET coordinator, the SET chair, please refer to Criterion 8 Section A.

Table 6-3: Duties and Responsibilities of Chairs

Program/Curriculum: Provide leadership in planning and coordinating academic programs which includes the development, revision, and evaluation of courses, programs and curricula. Represent the unique interests of the School/Department in College and University meetings.

Faculty: Promote professional development such as scholarship, excellence in teaching, and University service among faculty. Assist the Dean with recruitment of future faculty.

Schedule: Assist the Dean with the scheduling of classes by providing a draft schedule.

Students: Assist the Dean in the recruitment of future students and provide leadership in advising current and past students. Approve degree audits, waivers, substitutions, degree changes, and other documents as allowed (or required) by LSSU policy and procedures.

Budget: Assist the Dean in preparation of recommendations for Departmental/School budgets.
Planning: Provide leadership in the development and implementation of strategic planning within the School/Department.

Institutional: Participate in the development and review of academic and university policies.

CRITERION 7. FACILITIES

The MfgET program is housed within the School of Engineering and Technology, which is located entirely in the Center for Applied Science and Engineering Technology (CASET) Building. Built in 1980, the three-story structure is home to the areas of Engineering, Engineering Technology, Mathematics, Computer Science, and Education. Two additional non-academic facilities associated with Information Technology are also located in the building: Enterprise Application Services and University Support Services.

A. Classrooms, Laboratories, and Other Facilities

The School of Engineering and Technology has approximately 30,000 sq. ft. of usable space, which includes offices, storage areas, labs, and work areas. Details of the classrooms, laboratories, and offices follow.

Classrooms

The CASET building has ten classrooms and one lecture room that are assigned by the Registrar's Office, with engineering, engineering technology, mathematics, and computer science courses receiving the highest priority. Room size and capacity are shown in the Table 7-1 below. The School of Engineering and Technology occasionally uses two laboratories for additional lecture space, but these are not shown below.

Table 7-1. University-Allocated Classrooms in CASET Building

Room	Type	Size (sq.ft.)	Capacity
CAS-107	Classroom	675	28
CAS-108	Classroom	575	28
CAS-119	Classroom	880	48
CAS-123	Classroom	1,010	50
CAS-205	Classroom	1,010	40
CAS-207	Classroom	690	30
CAS-210	Classroom	1,100	56
CAS-211	Classroom	585	27
CAS-212	Lecture Room	1,265	76
CAS-310	Classroom	1,320	30
CAS-311	Classroom	1,320	40

All classrooms are equipped with a whiteboard or chalkboard, a computer, a document camera, a projector, and a screen. The rooms are arranged in a typical fashion with desk and chairs arranged in rows. The lecture room has fixed desks and chairs arranged in a stepped fashion. Since most engineering courses have enrollments with less than 40 students, the classroom facilities within the building are adequate, and nearly all engineering classes take place in the CASET building. Elsewhere in campus, several large classrooms with capacities up to 165 students are available within a five-minute walk of the engineering facilities.

Laboratories

Laboratory experiences are a central component of the MfgET curriculum at LSSU. Most technical courses either contain labs or are two-course groups with one course involving the classroom and the second the laboratory (*e.g.* EGRS-380 Robotics Technology and EGRS-381 Robotics Technology Lab); in fact, there are only two technical courses without associated labs (EGNR-265 "C" Programming and EGNR-310 Quality Engineering) either as part of the main course or as a dedicated accompanying lab course. The chemistry and physics labs are located in Crawford Hall; the remainder of the lab facilities used in the MfgET program are located in the CASET building. Table 7-2 shows a summary of the lab facilities available to all engineering and engineering technology students, with those used within the MfgET program denoted as such.

Table 7-2: Laboratory Facilities in the School of Engineering and Technology

Room	Name	Size (sq. ft.)	Capacity	MfgET
CAS-105	Data Acquisition / Microscopy Lab	370	12	☒
CAS-106A	Materials Testing Lab PLC Lab	470	12	☒
CAS-106B	Engineering Design Center	1,140	6 Teams (30 students)	☒
CAS-106C	Thermal Fluids Lab	780	10	
CAS-120	Machine Shop	5,180	20	☒
CAS-120A-120B	Welding Lab Foundry	1,760	10	☒
CAS-122	Wood Shop	2,240	20	
CAS-124	Surface Mount Assembly Lab Vehicle Testing Lab	1,200	8	(for electives)
CAS-125	Robotics and Automation Center	2,600	16	☒
CAS-209A-209B	Computer Lab	1,100	28	☒
CAS-304	Digital Electronics Lab	1,080	14	☒
CAS-306	Analog Electronics I Lab	1,175	16	☒
CAS-309	Analog Electronics II Lab	1,175	16	
CAS-310A	Rapid Prototype Center	580	4	(for electives)

The School of Engineering and Technology provides the necessary hardware and software tools required in the teaching of engineering and engineering technology students. Unlike more research-oriented institutions, LSSU labs are nearly all intended for use by the undergraduate Engineering and Engineering Technology students for instructional purposes. All laboratory facilities are available to students during regular school hours, when they are not in use for lab instruction. Computer labs and some labs with security cameras are available for extended hours. Special access arrangements through University Security are regularly used to permit student access to labs during evening and late night hours. In general, laboratory section sizes are typically 16 students or less. If student enrollment in a section exceeds the suitable lab size, then multiple lab sections are provided.

Data Acquisition / Microscopy Lab

The Data Acquisition / Microscopy lab (CAS-105) is contiguous to CAS-106A, and the two often serve together as a single large lab oriented towards various kinds of materials testing.

It includes microscopes and photographic equipment to support materials characterization, strain gauge mounting and data acquisition equipment, dynamic data collection systems (for acoustic and vibration measurement), ultrasonic and other NDT test equipment, and plastics properties testing equipment. This lab is used primarily by MfgET students in their Strength of Materials Lab (EGME-276) and is used by others for Vibrations and Noise Control (EGME-425).

Materials Testing Lab

The Materials Testing Lab (CAS-106A) contains equipment for tensile and compression testing, hardness testing, and fatigue testing of materials, as well as for polishing and etching in metallographic specimen preparation. Specifically, this laboratory houses a 400,000 lb. Tinius-Olsen compression/tensile testing machine, specimen mounting presses, belt sanders, microscopy polishers, and microscopes. This lab is used for Strength of Material Lab (EGME-276) and Machine Design (EGME-350).

Programmable Logic Controller (PLC) Laboratory

The Programmable Logic Controller (PLC) course hardware is presently located in CAS-106A. There are ten computer stations, each with an HMI (Allen Bradley PanelView) and a PLC (Allen Bradley ControlLogix) training station. There are also project machines (four "mixing stations" and four "part checkers") designed to provide students with more intense programming experiences similar to what they would encounter in industry. This hardware is used in Programmable Logic Controllers (EGRS-365).

Engineering Design Center

The Engineering Design Center (CAS-106B) is a carpeted office space containing eight cubicles, each equipped with chairs, a computer, a phone, an erasable white marker board, and typical office desk furnishings. The room has a printer common to all cubicles, as well as a large conference table and chairs, and a collection of supplier catalogs. All senior project teams are assigned their own cubicle where they work on their projects, keep their records, organize their information and make vendor communications (via e-mail or phone). The teams typically hold meetings, which may include the company contacts, suppliers and faculty advisors, at the conference table. This laboratory provides the Senior Project students with office space and conveys the look and feel of working in industry. All typical office supplies are provided. This lab is used exclusively for the senior Engineering Design Projects sequence EGNR-491 -495.

The adjacent CAS-106C is primarily a laboratory for Mechanical Engineering courses, but frequently serves as an overflow meeting room for senior project students as well, particularly since it has a large conference table and a telephone set-up for conference calls.

Machine Shop

The Machine Shop (CAS-120) contains a variety of manual manufacturing processing equipment (benches, hand tools, vises, drill presses, numerous lathes, mills, grinders, saws) and computer automated CNC machines (two lathes, two mills, a plasma torch). An adjacent computer lab is mainly used for CAM software (Creo) programming. The Machine Shop is also connected to various labs, a tool room, and other storage space. The freshman year curriculum includes a three-credit Manufacturing Processes course (EGME-110) that makes extensive use of this facility. These shops are also used in the CNC Manufacturing Processes course (EGME-312) and for preparation of material specimens in Strength of Materials Lab (EGME-276). The freshmen Introduction to Engineering course (EGNR-101) has a module where students can better understand mechanical engineering and can use the facilities in the machine shop. On a more informal level, they provide facilities that some student teams use during various design projects, and certainly during their Senior Year Experience. The typical lab size is 10 students, though there is ample room for two different labs to be held in this room at one time.

Welding Lab and Foundry

The Welding Lab (CAS-120A) contains arc welders, MIG welders, a TIG welder, Oxy-Acetylene torches, eight arc welding booths, and ten torch welding booths, all of which are well-ventilated. The Foundry (CAS-120B) includes furnaces for melting and heat treating metals, mold benches, flasks, a metal pouring bench and numerous hand tools. The foundry lab is used predominantly for EGME-110, while the Welding Lab is used for EGME-110 and EGME-276, and is available for use by senior project teams in EGNR-491-495.

Plastics Molding Lab and Wood Shop

The Plastics Lab and Wood Shop (CAS-122) includes three different plastics manufacturing machines, benches, countertops, saws, planers and sanders. This room is also used as a build area for Senior Design Projects (EGNR-491-495).

Surface Mount Assembly / EPIC Lab

The Surface Mount Assembly Lab (CAS-124) was equipped between 2009 - 2010 through a Michigan Economic Development Corporation 21st Century Jobs Fund grant. Additional funding through the Michigan Initiative for Innovation and Entrepreneurship grant in 2013 augmented the facility with the establishment of the Electronic Products Innovation Center (EPIC). The lab is outfitted with two Surface Mount Technology robotic assembly machines. APS CS40 has a component placement rate of 2100 components per hour handling parts down to EIA 0603 (0.060" by 0.030") while the APS L40 handles EIA 0201 (0.020" by 0.010") components at a rate of 4800 per hour. Both accommodate boards up to 13.5" by 22". Supporting equipment includes 2 SPR-25 stencils and GF12HC reflow oven. Other equipment includes manual hot air rework stations and fluid dispenser for adhesives and solder paste. This lab is primarily used by PDC workers and students in the Electronic Manufacturing Processes (EGET-310) course.

Robotics and Automation Center

The Robotics and Automation Center (CAS125) consists of 13 five or six-axis, industrial robots (equipped with multiple end-of-arm tooling options), 3 conveyor lines with pallets, 4 Programmable Logic Controllers (PLC's), numerous manufacturing sensors and pneumatic devices, 10 vision systems, 15 Dell computers, and 2 printers. Essentially there are three types of flow lines with robot systems: 1) a big rotary index table with four FANUC industrial robots with an Allen Bradley PLC and panel view, 2) an oval line that uses a Bosch Rexroth Varioflow conveyor, housing 4 Staubli robots integrated with an Allen Bradley PLC, and 3) an oval line that uses a Bosch pallet transfer conveyor with 4 FANUC robots integrated with an Allen Bradley PLC. The oval line with the Staubli robots and the oval line with the FANUC robots have vision systems integrated in all of the robots and also different tool change stations and end-of-arm tooling for the robots. It is estimated that the worth of the Robotics and Automation center would be about 2 million dollars.

During the 2015-2016 academic year, the robotics lab went through a major upgrade. The FANUC oval line system was fully updated except for the Bosch conveyor. The oval line system now incorporates 4 M10/iA FANUC robots that run on the latest R30iB controller platform, 4 FANUC iRVision 2D Vision systems, a FANUC 3DL Vision system, a FANUC force/torque system, two robot line tracking systems, an Allen Bradley PLC controller with ethernet configuration, 4 SCHUNK robot tool changers, several robot end-of-arm tools (grippers, suction cups, etc.), 4 Dell computers, and several sensors. 10 seats of the Roboguide robotics simulation software was also purchased. The entire system (engineering, hardware, software and installation) is estimated at $750,000. This new system and the rest of the robotics lab will help LSSU maintain the industrial robotics niche in its undergraduate engineering and engineering technology programs.

During the 2009-2010 academic year, the robotics lab also went through a major upgrade. The Staubli oval line system was newly installed. The system incorporates 4 Staubli robots that run on the latest CS8 controller platform, a new Bosch conveyor system (Varioflow system with 8 pallet location stations), 4 Cognex Vision systems, an Allen Bradley PLC5 controller with device net configuration, 4 robot tool changers, several robot end-of-arm tools, and several sensors. The entire system (engineering, hardware, software and installation) was estimated at $500,000.

The Robotics and Automation Center is utilized in numerous courses including EGNR-101 Introduction to Engineering, EGRS-381 Robotics Technology lab, EGRS-430 Systems Integration and Machine Vision, EGRS-

481 Manufacturing Automation Lab, and the EGNR-491-495 Senior Projects I and II sequence. Typically at least one senior project each year is undertaken which involves the use of the equipment in the Robotics and Automation Center. Several of the projects completed in this Center have gained national attention in competitions.

The Robotics and Automation Center is also used extensively for demonstrations for members from business and industry, K-12 students, visiting faculty, and the community. The Robotics and Automation Center is also the key facility that serves as the home for the summer Robotics Camps and Women in Technology programs. These programs that have been offered every summer since 1991 and each year have attracted between 50 to 100 gifted and talented middle school and high school students from Michigan, Ontario, and beyond. The programs have served well to attract bright young individuals to the engineering and technology fields.

Computer Lab

The Engineering Computing Labs (CAS-209B-209C) house 33 current PC-type workstations, two common printers, full network access and all software that is taught in the curriculum. Computers Dell Optiplex 3020 computers with Intel i5 quad-core processors and 8GB of RAM, and network access at 10/100 Mbit/s. CAS-209B-209C is the primary computing lab for engineering and engineering technology students. It is available throughout the workday and evening, except when used for instruction (even then, it is divisible into two halves by an accordion wall, and only one half is ordinarily used for courses, leaving the other half available for open student use). Students from programs outside of the School of Engineering and Technology are not granted access to this room. Specialized software installed on these computers includes Creo (Pro-E), MATLAB, RoboGuide, Ansys Fluent, Arduino, and Witness.

Digital Electronics Lab

The Digital Electronics lab (CAS-304) has a fixed workbench in the center of the room with five computers and space for student circuit development. Additionally, this room has eight smaller workstations located around the perimeter of the room. Available in the room are portable oscilloscopes, digital multi-meters, digital trainers, logic analyzers, and FPGA evaluation boards. This lab can accommodate seven student teams (or 14 students) working at either the central benches or the outer benches. It also serves as an alternate computer lab with 13 stations and the mobile robot programming location. Equipment in this laboratory supports instruction of EGEE-125 Digital Fundamentals, EGEE-250 Microcontroller Fundamentals, EGEE-320 Digital Design, EGEE-355 Microcontroller Systems, and EGNR-260 Engineering Research Methods.

Analog Electronics Labs

The Analog Electronics I Lab (CAS-306) and Analog Electronics II Lab (CAS-309) provide the EET and MfgET students with hands-on experiences in two Electrical Engineering Technology courses, Applied Electricity (EGET-110), and Applied Electronics (EGET-175). Although these labs are predominantly used by engineering students for a number of Electrical Engineering courses, they are also used to support the design projects portion of Introduction to Engineering (EGNR-101) and extensively by some senior projects in Engineering Design Projects (EGNR-491-495), both of which are in the MfgET curriculum.

Each of the 16 lab stations (8 in each lab) is equipped with at least one power supply (Agilent/HP E3620), a signal generator (Agilent/HP 33120A), a multimeter (Fluke 45 or Fluke 8846A), an oscilloscope (BK Precision 2530B or Keysight DSO-X2004A), and a computer with PSpice installed.

Rapid Prototype Center

The Rapid Prototype Center (CAS-310A) is overseen by the Product Development Center (PDC) and serves as a laboratory for both PDC projects and Senior Project teams (EGNR-491 and EGNR-495). The majority of the equipment in the lab, with the notable exception of the Stratasys Dimension RP machine, was purchased by the PDC through a Michigan Economic Development Corporation 21st Century Jobs Fund grant. The equipment purchases occurred between 2008 and 2010.

A Stratasys Dimension 3D printer was purchased in late 2015 with donations largely from the IAB. Using ABS+ plastic, the printer can produce parts up to a size of 10"x 10"x12" using Fused Deposition Modeling. The printer is used in a variety of engineering courses (notably, making sample parts for assembly mock-ups in EGNR-491 and EGNR-495), as well as for projects from industry.

A Roland MDX40, a desktop milling machine, purchased in 2009, is used for many of the same activities as the RP machine. It serves as a virtual printer to the 3D CAD software. This device can mill woods, plastics, and soft metals other than aircraft aluminum and steel. This has a serviceable area of 12x12x4 inches and has a rotary axis as well. Prototype parts requiring materials other than ABS can be made on this machine.

A 2013 Michigan Initiative for Innovation and Entrepreneurship grant provided 10 seats of EAGLE Pro Circuit board development software used for creating schematics and printed circuit board artworks for electronic projects. Two licenses are in use by PDC and 8 are located in the computer LAB 209B.

A Next Engine 3D HD Laser Scanner purchased in October, 2009 is used to scan existing parts into a cloud-of-points and from there to 3D CAD. EGNR-491 and EGNR-495, along with the PDC, make use of this machine to scan parts that have no engineering drawing so that modifications or

documentation can be made.
Two Dell workstations which are set up for CAD and engineering activities are also located in the lab.

These major tools are supplemented by Dremel grinding, drilling and polishing tools and various hand tools.

Other Facilities

The CASET building has 27 dedicated office spaces for use by students, faculty, support staff, and the administration. Some of these offices are used to house student engineering groups or for storage. Additionally, the Engineering House, a living-learning community for approximately 30 students, is located about 100 yards from the CASET building and the SSMart Zone building is located about 1 mile north of campus. These areas are discussed in the following sections.

School Office

The School of Engineering and Technology office suite, has four specialty office spaces that include reception, conference room, photocopy/scan equipment and supplies, and a storage room.

Faculty Offices

Faculty offices are furnished with standard equipment that includes a desk and chair, additional chairs for guests, computer, telephone, bookcase(s), and filing cabinet(s). Many offices being used for storage are available to house additional faculty members should enrollment and/or programmatic growth warrant.

Conference Rooms

The School of Engineering and Technology utilizes several areas for conference rooms. These common areas are used for faculty and student meetings. Four areas, CAS-106B, CAS-106C, CAS-203, and CAS-205, are routinely used for conferences. Room sizes vary and can accommodate 6-15 people at one time.

Student Club Offices

Office space has been made available to the engineering student clubs. IEEE is housed in CAS-316. ASME is housed in CAS-309A. SAE is housed in CAS-117. SWE is housed in CAS-103I. The Engineering and Technology Honor society and other student groups meet in the conference rooms.

Engineering House

The Engineering House is a residence on campus in which a select group of engineering and technology students inhabit. The house is adjacent to a number of other living-learning communities from different academic areas.

The house costs the same as traditional dorms, but offers many advantages including larger bedrooms, a kitchen, a laundry facility, as well as common areas where students are able to congregate. The house is open to all engineering and engineering technology students, both male and female (housed on separate floors with separate bathrooms).

There is a good mix of students at different points in their academic careers (from freshmen to senior). Many of the students will be in classes together, allowing them to easily work and study together. The upperclassmen will also have taken many of the same classes, and had many of the same experiences, making them a great resource for help and advice.

In exchange for these additional amenities, the students are required to participate in a group project above and beyond their normal course work. The subject of the project is decided upon by the students themselves, but must be approved by the house advisors. While this project does require some additional work, it is an excellent opportunity to gain experience working in an engineering team. The current project is constructing a 3D printer.

SSMart

LSSU and SSMart, a Michigan Smartzone, have a collaborative use agreement in place that provides access to students and SSMart entrepreneurial clients of the combined equipment owned by the two entities. Specifically SSMart makes available a CNC Lathe (Haas TL-1), a150W Laser cutter/etcher, a consumer grade CUBEX Trio Fused Deposition Modeling 3D printer and high resolution OBJET 30 Pro UV Polymer technology 3D printer.

B. Computing Resources

Lake Superior State University provides computer, network and internet services to members of the campus community. These services are intended to assist faculty, staff and students in the accomplishment of their University responsibilities and duties. The computing resources offered by the University adequately supplement those offered within the School of Engineering and Technology and meet the needs of the students in the MfgET program.

University-wide Computing Resources

Located in the KJS Library, the Courseware lab has 39 Dell GX380 computers. All computers are running Windows XP and have Microsoft Office 2007 installed. Most of the software titles used on campus for classes are also installed on these computers. A high-speed black and white laserjet printer is also installed in the lab for use.

Courseware Lab Hours

Monday	8am - 12am
Tuesday	8am - 12am
Wednesday	8am - 12am
Thursday	8am - 12am
Friday	8am - 7pm
Saturday	11am - 7pm
Sunday	1pm - 12am

The Rathskeller lab has 4 systems that are part of a virtual client platform using NComputing vSpace L-series thin clients and is located in the Walker Cisler Center. All computers are running Windows XP and have Microsoft Office 2007 installed. Most of the software titles used on campus for classes are also installed on these computers. A high-speed black and white laserjet printer is also installed in the lab for use. This lab is separated in to two sections. At times part of the lab is used for training purposes and may not be available for general use.

Rathskeller Lab Hours

Monday	11am - 12am
Tuesday	11am - 12am
Wednesday	11am - 12am
Thursday	11am - 12am
Friday	11am - 5pm
Saturday	12pm - 5pm
Sunday	12pm - 12am

Additional Computing Resources for Students

In addition to the School of Engineering and Technology Computer Lab and the two general LSSU computer labs, there are various computer resources available to MfgET students located throughout the laboratories in the CASET building.

Engineering Design Center (CAS-106B)

The Engineering Design Center (CAS-106B) is equipped with up to eight computers (one for every senior project team). The computers placed in this room have full network access at 10/100 Mbit/s, have the necessary engineering software installed, typically are at least Intel i5 dual-core with at least 4GB of RAM, and are served by a common printer. Students enrolled in EGNR-491-495 have 24 hour access to these computers.

Robotics and Automation Center (CAS125)

The Robotics and Automation Center (CAS124/125) is equipped with 14 computers. The computers have full network access at 10/100 Mbit/s, are at least Core 2 Duo with at least 2GB of RAM, and are served by a common printer. Numerous software packages and programming languages are used in the Robotics and Automation Center. The Fanuc robots are programmed in the Karel programming language and Teach Pendant language and the Staubli robots are programmed in the VAL3 language. The ladder logic programming for the Allen Bradley PLCs are programmed using the Rockwell software RSlogix. The laboratory also provides access to simulation software packages. The RoboGuide robotics simulation software package is used in EGRS-385 Robotics Engineering, and the WITNESS discrete event manufacturing software package is used in EGRS-381 Robotics Technology Lab. Students enrolled in the aforementioned courses have to these computers from at least 8:00 a.m. to 5:00 p.m., but may receive additional after-hours access as needed.

Digital Electronics Lab (CAS-304)

The Digital Electronics Lab (CAS-304) is equipped with 13 computers. The computers have full network access at 10/100 Mbit/s, are at least Core 2 Duo with at least 2GB of RAM, and are served by a common printer. Specialized software installed on these computers includes Quartus (digital synthesis), GoLogic (logic analyzer), and Code Warrior. All engineering and engineering technology students have access to these computers from at least 8 a.m. to 5 p.m.

Analog Electronics Labs (CAS-306 and CAS-309)

The Analog Electronics Labs (CAS-306 and CAS-309) are each equipped with 8 computers and a printer. The computers have full network access at 10/100 Mbit/s, and are at least Core 2 Duo with at least 2GB of RAM. Specialized software installed on these computers includes ORCAD PSpice. All Engineering and Technology students have access to these computers from at least 8 a.m. to 5 p.m.

Computing Resources for Faculty

All faculty members have computers and network connections in their offices, and all faculty computers are at least at least Intel i5 dual-core with at least 4GB of RAM. The minimum software package on these computers includes Windows 7 or Windows 10, Office2010 or later and Internet Explorer, Google Chrome, or Fire Fox. Other software installed on the faculty computers is based on the courses that they teach.

Network connections are 10/100 Mbits/s. All faculty members have full Internet access as well as Microsoft networking. There is at least one networked laser printer on each floor of the engineering building for faculty to use for printing. There are also several shared network drives for faculty to exchange information amongst themselves and with students.

Several web based packages are available for both faculty and student use:

a. Blackboard Learn 9.1is a course management system that allows faculty to supplement, or deliver wholly, the courses they are teaching. Students enrolled in courses with a Blackboard component have access to support materials posted by the instructor (using syllabi and assignments), links to Web-based materials, discussion boards and chat rooms, and online quizzing. Each instructor customizes Blackboard for his or her course, using a variety of "tools" as mentioned above. Campus-wide, over 40 faculty members at LSSU use Blackboard for more than 100 blended or online courses. LSSU has recently transitioned from Blackboard Learn 9.1 to self-hosted Moodle 3.0 and will shortly transition to Moodle 3.0 hosted by Moonami.

b. The 'my.lssu' campus portal is beneficial to staff, students and faculty. It allows for single sign-on access to email, calendar, Blackboard (and soon Moodle), Anchor Access (see item c. below) and FASS (student course scheduling systems). It also offers improved e-mail, groups, chat/message boards, course studio, file sharing, targeted announcements and customizable pages. The portal is role-based, hence users have access to tools and announcements related to their role as a student or faculty member.

c. Faculty and students regularly use Anchor Access, a self-serve computer system, accessible through the 'my.lssu' portal. Anchor Access is just one part of Banner, which also handles finance, advancement, financial aid and more. Through it, students are able to view and pay bills online, print copies of their schedules and view and print transcripts. Automated Graduation Verification has been implemented to assist students and staff in confirming the courses needed to complete a program of study. This component is used in tandem with paper-based verification. Notably, it allows students and their advisors to perform a "what if" analysis to see which courses would be required to complete an alternate degree program.

C. Guidance

LSSU takes great pride in the hands-on learning opportunities provided to its students. To ensure the safe operation of tools, equipment, computing resources, and laboratories, it is standard practice for faculty members to first discuss general safety procedures for a given laboratory in a classroom setting. These procedures are reinforced by demonstrations in the appropriate laboratory. For a particular laboratory exercise, the basics and theory surrounding a specific device or experiment are presented. Best practices for the operation of a particular device are subsequently discussed and demonstrated. Students then work under the tutelage of a faculty member or technician when operating the device for the first time, during which time they may ask questions or request a review of the procedure. A faculty member or technician remains proximate in any laboratory settings where the possibility of bodily harm exists. Once rudimentary mastery of a device has been learned, students are then able to use the equipment with faculty/adjunct guidance present throughout the rest of their courses. More detailed accounts of guidance for two specific settings are provided below.

Preparation for correctly and safely operating equipment in the *Manufacturing Lab* utilizes the following steps:

1) The safety procedures are covered in class, and again in lab
2) The assignment is explained and given in lab
3) The basics and theory of the experiment or assignment is covered in class (i.e. the cutting speed and rpm calculation for 1010 mild steel being cut with a high speed cutter), and then it is shown in lab as well
4) The operation of the equipment and the actual assignment is then demonstrated
5) The student is then instructed to do the assignment. If the student has any questions, they are to ask the instructor for further explanation, and if needed the procedure is covered again

The students are encouraged to work together, but are expected to do their own work on their assignments.

Similarly, preparation to properly and safely utilize equipment in the *Electrical and Computer Engineering Laboratories* is summarized as follows:

Equipment

Use of lab equipment is described and demonstrated in the laboratory setting. The students are then required to use the equipment with faculty guidance throughout the rest of their courses.

Software

Cadence circuit simulation and Quartus digital design software are both demonstrated in the lab setting. The students are then required to use the software packages to solve and design different circuits using the software packages. Cadence software is used in the analog circuits courses. Quartus is used throughout the digital course offerings.

Laboratories

The safety procedures are covered in class, and again in lab.

D. Maintenance and Upgrading of Facilities

The University is committed to continually maintaining and improving the educational environment and facilities used to deliver education. Funding for facilities maintenance and improvement are contained in the University General Fund. Grants from NSF, MEDC, Perkins, and industry, along with donations have been instrumental in acquiring new and replacement equipment.

While there is no annual equipment budget, *per se*, for the School of Engineering and Technology, the laboratories are well equipped and receive adequate funding. The two main sources of revenue that support laboratory facilities via the University General Fund are the course fees and program fees that come from students taking engineering and engineering technology courses. Between the two, approximately $209,000 is generated per year. Equipment, software and hardware are upgraded on an "as needed" basis, which has been sufficient.

Most courses have a course fee that depends on the cost of maintaining the equipment and software to support the course. In general, courses that have a lab component have higher course fees than those that do not. Approximately $57,000 was raised in course fees last year. All courses having the "EG" prefix have a differential tuition of $70 per credit hour.
Approximately $152,000 was raised in program fees (differential tuition) last year.

Recent Upgrades

Major acquisitions made within the last six years that directly impact the MfgET program are noted below.

Data Acquisition / Microscopy Lab (CAS-105)

Year	Item	Quantity	Status
2015	Optiplex 3010 – DELL PC	5	used

Programmable Logic Controller (PLC) Laboratory (CAS-106A)

Year	Item	Quantity	Status
2013	Core 2 duo computers	8	new
2013	PLC Trainers, Desktop	10	new
2013	Panelview Trainers, Desktop	6	new
2013	Part Checkers	3	upgrade
2013	Mixing Stations	3	upgrade
2016	Additional PLC Trainers, Desktop	2	new
2016	Additional Panelview Trainers, Desktop	2	new
2016	Additional Part Checker	1	new
2016	Additional Part Checker	1	new
2016	Additional Computer	2	used

Engineering Design Center (CAS-106B)

Year	Item	Quantity	Status
2014	i7 Desktop Computer	7	new

Machine Shop (CAS-120)

Year	Item	Quantity	Status
2015	Hass TL1 CNC Turning Center and Tooling *(Actually belongs to The Smart Zone but housed here and we use*	1	new

it)

2014	Hass VF2 CNC Machining Center and tooling	1	new

Welding Lab and Foundry (CAS-120A-120B)

Year	*Item*	*Quantity*	*Status*
2010	Miller Dynasty Tig Welder	1	new

Plastics Molding Lab and Wood Shop (CAS-122)

Year	Item	Quantity	Status
2015	Robotics Cell	1	used

Surface Mount Assembly / EPIC Lab (CAS-124)}.

Year	Item	Quantity	Status
2010	APS CS40 Surface Mount Robotic Assembly	1	new
2010	SPR-25 stencils	2	new
2010	GF12HC reflow oven	1	new
2011	APS L40 Surface Mount Robotic Assembly	1	new

Robotics and Automation Center (CAS-125)

Year	Item	Quantity	Status
2011	Staubli RX90 Robot	3	new
2011	Staubli TX90	1	new
2011	VAL3 Studio (Software Package)	4	new
2011	Bosch Rexroth Conveyor System	1	new
2011	SCHUNK Robotics End-of-Arm Tooling	4	new
2011	ATI Robotics Tool Change System	4	new
2011	Piab Vacuum End-of-Arm Tooling	4	new
2011	RS Logix PLC Software	1	new
2011	Dell Computers	4	2 yrs old
2012	Staubli RX60 Robot	1	new
2013	Fanuc LR Mate Robot	2	new
2013	Fanuc M1iA Robot	1	new
2013	Dell Computers	4	1 yr old
2013	Allen Bradley Panel View	1	new
2014	Roboguide Robotics Simulation software	10	new
2015	Fanuc M10iA Robot	4	new
2015	Allen Bradley PLC	1	new
2015	Fanuc 2d iRVision Systems	4	new
2016	Roboguide Robotics Simulation Software	5	new
2016	SCHUNK Robotics End-of-Arm Tooling	4	new
2016	SCHUNK Robotics Tool Change System	4	new
2016	Piab Vacuum End-of-Arm Tooling	4	new
2016	Dell Computers	5	new
2016	Fanuc 3DL iRVision System	1	new

2016	Fanuc Line Tracking System	2	new
2016	Fanuc Force/Torque Sensing System	1	new
2016	Allen Bradley Panel View	1	new

Computer Lab (CAS-209A-209B)

Year	Item	Quantity	Status
2015	i5 computers	30	new
2016	Core 2 duo computers	3	used

Digital Electronics Lab (CAS-304)

Year	Item	Quantity	Status
2010	Altera DE1 – EVB FPGA boards	10	new
2013	Corobot – mobile robot	1	new
2013	Optiplex 745 – DELL PC	5	used
2013	Optiplex 780 – DELL PC	8	used
2014	Altera DE1-SoC boards	10	new
2014	Altera Cyclone V GX Starter Kit	1	new
2014	Acute TL2118E – Logic Analyzers	10	new
2015	Optiplex 3010 – DELL PC	5	used

Analog Electronics Labs

Year	Item	Quantity	Status
2011	Agilent/HP E3620A power supply	20	new
2011	Agilent/HP 33120A signal generator	20	new
2011	Fluke 8846A multimeter	10	new
2011	BK Precision 2530B oscilloscope	20	new
2015	Keysight DSO-X2004A oscilloscope	10	new

Rapid Prototype Center (CAS-310A)

Year	Item	Quantity	Status
2009	Roland MDX40 Desktop Milling Machine	1	new
2009	Next Engine 3D HD Laser Scanner	1	new
2013	EAGLE Pro Circuit Board Development Software	10	new
2015	Stratasys Dimension 3D Printer	1	new

E. Library Services

Kenneth J. Shouldice Library

The Kenneth J. Shouldice Library and Learning Commons provide the core research materials needed to support the academic curricula offered by the University. The Library is headed by Marc Boucher, Director of Library Services.

In the fall of 1997, a 35,000 square-foot expansion and remodeling of the existing structure to the University Library was formally opened and full resources made available for faculty and student use. The facility includes ample space for study; over 32 personal computer stations with access to specialized library resource databases and the Internet; small and large study and conference rooms; an IT help desk; a small art gallery; the campus's center for testing, tutoring, mentoring and the Faculty Center for Teaching.

Collections

The collection consists of over 140,000 volumes and 850 periodical subscriptions (including both electronic and print), as well as 75,000 microforms. The library uses Ex Libris' Voyager integrated library system and OCLC's WorldShare as a discovery layer to provide access to both print and electronic materials through a single user interface off of the library's Website.

Reference and Instructional Services

Reference service provided by professional librarians, is available every day and evening the Library is open, other than weekends. The Ask Us desk, formerly known as the reference desk, now also serves students looking for IT, tutoring, mentoring or any other academic need. Information literacy and research instructional sessions are not only provided to University students, but local K-12 students, students from Sault Ste. Marie, Ontario, and the surrounding intermediate school district areas such as Paradise, St. Ignace, and Pickford. All research databases are accessible to the general public while on campus, and off campus access restricted databases is provided to all campus students, faculty and staff.

Resource Sharing

Resource sharing has always been a prominent aspect of Library operations at Lake Superior State University. A unique feature of this Library is that it is open to the public (on both sides of the international border) and also offers users a joint library card that serves as both their checkout card for LSSU's library as well as all public libraries in the Eastern Upper Peninsula. Our library catalog is shared with Northern Michigan University. Users can locate materials by specific library or collectively. If patrons find materials that are not available at the campus library, library staff will locate it through Interlibrary Loan. Students at Regional Center sites have direct access to a priority interlibrary loan arrangement and materials are shipped directly to the students.

Resources, Special Facilities, and Services

Resources available to students include access to the Internet from any of the computers located in the Library; but more importantly, over 50 research databases which index thousands of resources, many of which provide full text access to scholarly journals. All of these research databases are available off campus through the library's proxy server. The library's home page also provides links to many sites plus additional resource information. There are many group study rooms located throughout the library and the main floor also serves as a space for group interaction through the intentional layout of comfortable furniture and accessible technology to enable group engagement. Throughout the year the Library hosts several lectures that are open to the entire campus community.

Reserve

The Library maintains library reserve materials for faculty to place materials for specific classes. This allows all students to access materials that are of limited availability. Faculty determine the loan period (one hour, in library use only, overnight, etc.). In most cases, materials are removed from reserve at the end of each semester.

Government Publications

The Library is a selective federal government depository library which means it does not receive all publications from the Government Printing Office (GPO), but select publications that are chosen in addition to those required by the GPO. After evaluating the depository program a few years ago, it was decided to reduce the number of titles selected to those that most directly serve our clientele. Currently, the items selected represent about 16 percent of the total items available to us as a selective government depository.

Special Collections

The Library maintains a small special collections area in secured rooms on the third floor of the library. Access is supervised. The collection includes works about the Upper Peninsula, the Soo Locks, regional history, Great Lakes shipping, and Governor Chase S. Osborn. A special room is dedicated to Senator Philip Hart and contains memorabilia of the late senator. While not extensive, the uniqueness of these collections has attracted researchers from Ontario, Canada, within the state, and occasionally from bordering states.

Information Literacy Instruction

Library instruction is conducted in a state-of-the-art computerized room located on the third floor of the Library. Students are taught how to access and search the many electronic resources available through the KJS Library. While general instructional sessions are offered, most often instruction targets access and databases that directly relate to the faculty members' special class needs. When not being used for information literacy instruction, this room is a general access lab for all students.

F. Overall Comments on Facilities

As noted above, the School has the facilities and resources necessary to meet its program educational objectives and student outcomes.

As noted in Section C, detailed instruction on proper and safe equipment use and operation is provided to students prior to their utilization of any laboratory equipment. Once rudimentary mastery of a device has been learned, students are then able to use the equipment with faculty/adjunct guidance present throughout the rest of their courses.

CRITERION 8. INSTITUTIONAL SUPPORT

A. Leadership

As described in section 6.E, decisions on the overall direction of the program are indeed the province of the entire faculty of the School of Engineering & Technology, but the primary responsibility for detailed oversight of the program rests with the up-to-5 faculty (1 presently vacant) belonging to either the Mechanical Engineering or the Engineering Technology Departments, the two of which, while separate in organizational charts, in practice regularly meet and function as a single combined Department. In the following, this will be referred to as the ME/MfgET group (the neutral term "group" is selected in order to avoid implying any formal status, as a "department" would have, in the organizational structure).

Implementation of the decisions of the ME/MfgET group is coordinated by the ME Coordinator, Dr. Robert Hildebrand, and the MfgET Coordinator, Prof. James Devaprasad. The division of labor is roughly as described in the following, although these are presently to be understood as *de facto*, rather than any formally defined sets of duties with respect to the MfgET program (see below in item 8.C.2.3 concerning the reasons for this).

The ME Coordinator typically undertakes the following tasks related to the MfgET program:

- to coordinate course assessment for all EGME and EGMT listed courses which are either specific to the MfgET program or common only to the ME and MfgET programs (i.e., without students from the EE, CE, EET, or other programs);
- to coordinate assessment of the MfgET student outcomes;
- to pursue curriculum and course change proposals related to the MfgET program at the University level;
- to participate in weekly Chair meetings;
- to assist the School chair in course scheduling, and instructor assignments, for MfgET course offerings;
- to set the agenda for meetings of ME/MfgET group in overseeing the MfgET program; and,
- to organize and coordinate hiring committees for faculty vacancies in the ME/MfgET area.

The MfgET Coordinator typically undertakes the following tasks related to the MfgET program:

- to provide academic advising to most students in the MfgET program;
- to maintain the currency of MfgET advising documents;

- to interview all graduating MfgET seniors, for assessment purposes;
- to participate in weekly Chair meetings;

- to serve as an approval authority for course substitutions, course waivers, and transfer credit evaluations for students in the MfgET program; and,
- to advise the ME/MfgET group concerning MfgET curricular matters.

Note, furthermore, that in contrast to what may be typical of departmental leadership positions at other institutions, duties related to faculty supervision are *not* part of either of these coordinatorships.

Above the Coordinators, the School of Engineering & Technology (SET) is, in its day-to-day business, administered by a release-time Chair (see below in item 8.C.2.2 for details on the release time and compensation available). It has been practice for the SET chair to assume the following responsibilities that impact the MfgET program:

- lead discussion relevant to the entire School of Engineering and Technology at the Industrial Advisory Board meetings;
- coordinate course assessment (in School faculty meetings) for courses common to other programs besides MfgET and ME, i.e., to EE, CE, and/or EET;
- coordinate common aspects of student outcome assessment (aspects not unique to ME/MfgET);
- serve as a pre-approval authority for course substitutions and waivers for MfgET students;
- set the agenda and run the meetings of the School of Engineering and Technology;
- set the agenda and run weekly "Chair" meetings (dean, School chair, program coordinators);
- represent the School of Engineering and Technology at weekly "provost Council" meetings;
- conduct scheduling of course offerings, and updates to the schedule, room assignments, and instructor assignments;
- assign instructors to courses;
- advise all SET freshman and transfer students upon arrival;
- write "program review" reports for all SET programs on a five-year cycle;
- establish and maintain transfer equivalency ("articulation") agreements with community colleges; and,
- determine equivalencies for all engineering and engineering technology related transfer courses;
- various other duties, not clearly defined.

There is also a Dean position (shared with other Schools, as described in item 8.C.2.1, below). With respect to the program, this position serves as a final approval authority on course scheduling (and changes to instructor, time, or room), course substitions/waivers, and, of course, budget matters and purchases. The Dean also serves as an approval stage for curricular proposals (new courses, course changes, program changes, etc.) prior to submission to the University-wide Curriculum committee and thence the Provost's office for final approval. The Dean is also the formal supervisor for all faculty and staff within the SET, carrying out performance evaluations, and serving as an approval stage for hiring decisions recommended by Search committees.

B. Program Budget and Financial Support

8.B.1. Budget. LSSU has a Strategic Planning and Budget Committee (SPBC), which is an advisory committee charged with assessing, developing, and monitoring the University's strategic plan, as well as prioritizing resource needs throughout the University. It is a shared governance committee, i.e., has membership representing students, faculty, staff, and administration. The activities of this committee can be reviewed at www.lssu.edu/sharedgovernance/planningbudget/ .

The Vice President of Finance receives department/school budget requests (one of which is for the SET) and prepares the overall General Fund Budget and Auxiliary Budget Summaries for submission to the SPBC. The SPBC members, including the Vice President of Finance, review individual detailed departmental budgets, the General Fund and Auxiliary Budgets. Recommendations are taken to the President's Cabinet (in June each year) for review and finalization prior to presentation to the Board of Trustees for approval in July.

Recurring LSSU funding is shown in Table 8-1, broken down by source

Table 8-1: Summary of SET Funding, Recent Years

Allocations	2012-13	2013-14	2014-15	2015-16
Base Operation	33,984	33,984	33,984	33,984
Carry Over	10,675	1,822	27,332	89,017
Course Fees	42,040	48,310	47,970	57,180
Program Fees	68,700	126,788	134,191	152,216
Total Allocation	155,399	210,904	243,477	332,396

The program receives funding from three University sources (Base operation allocations, course fees, and program fees), represented by rows in the table. When bona-fide plans for expenditure are articulated to the CFO, funds not utilized in the previous academic year are carried over to the next year, that amount also shown as a row.

Base operation funds are LSSU allocated funds for the basic operation of the unit. These basic operations would include paper, phones, office supplies, copying, travel, small office related equipment, and other similar items.

Students enrolled in Engineering or Engineering Technology courses also pay course fees and program fees, which the SET receives. The course fees vary from course to course but range from $10-$100, with a median of $60 (not counting the zeros); these are set for each course considering the extent of that course's usage of laboratory equipment and expendables, large-volume printing (handouts), and/or renewable license software. The program fee is $70 per credit hour for courses beginning with EGxx. The School can adjust course fees yearly. Program fees and course fees are adjusted in consultation with the Provost, and require Board of Trustee approval.

As is evident from Table 8-1, the Base Operation component has been stable from year-to-year. On the other hand, course and program fees received have been increasing each year.

As noted earlier, all degree programs are closely-related, sharing all resources. We do not break out funding by program, but the School Chair and Program Coordinators work closely with the Dean to review the needs for each program and make appropriate allocations and purchases.

In addition, not shown in Table 8-1, but consistent enough to regard as "recurring", LSSU is annually eligible to receive a Perkins Voc-Ed Grant. Most years, SET receives $10K; every fourth year, however, we receive $30K.

Regarding non-recurring, or irregularly recurring, sources of income, there have been equipment sell-offs and donations.

Over the last several years, a few thousand dollars have been raised by selling retired equipment on e-bay. Several pieces of donated equipment have been utilized in our labs, including robots for instance.

Occasional targeted donations have been received. For instance, a $10k donation in 2013 donation paid for new PLC trainers. As another example, a fundraising campaign by the IAB in 2015 paid for a 3D printer.

8.B.2. Teaching Support. Teaching is supported by the occasional use of student assistants, and by the availability of teaching workshops, both on-campus and nationally.

Student class assistants are used, occasionally, in some workshop and computer lab courses. Their roles have included assisting students during the labs with accomplishing the lab work (EGNR101, EGME141, EGME240, EGNR140, EGRS381, EGRS481), or in recitation/additional help hours (EGNR265). These would be students who had previously taken the course, and done well enough to satisfy the current instructor.

More exceptionally, two student "graders" were provided in the Spring 2016 offering of the lecture course EGME275 Engineering Materials, which had a large enrollment (38 initially), to check/"pre-grade" homework (give comments and tentative scores to worked problems for the instructor's review). This may serve as a precedent henceforth, and the Dean had verbally-stated that it would be dependent upon enrollment numbers in courses. To some extent, the student workers in EGNR140 have also reviewed and commented homework.

Teaching workshops exist on campus, via the title-III grant supported "Faculty Center for Teaching"; the extent of participation by faculty connected with the MfgET program is uncertain. There are also usually teaching-related workshops during the development week preceding the Fall semester; as classes are not yet underway at that time, attendance is relatively straightforward for most faculty members.

External workshops are also supported. Jaskirat Sodhi (2014) (no longer with LSSU) and Zakaria Mahmud (2015) each attended the NETI (National Effective Teaching Institute) workshop sponsored by ASEE. David Leach (2016) attended an ABET IDEAL (Institute for the Development of Excellence in Assessment Leadership) workshop. David Baumann and Robert Hildebrand (2013) attended an ABET PAW (one-day Program Assessment Workshop).

Finally, in indirect support of teaching, the University maintains a variety of student services, including counseling, library, placement, admissions, registrar, a learning center (instructing academic success strategies), and tutoring.

8.B.3. Infrastructure Support

Both course and program fees are used for major equipment purchases, computers, lab supplies, equipment maintenance, software, and other related items. Table 8-2 provides a summary of the expenses categories denoting how funds have been spent for the last few years.

Table 8-2. Expense categories and spending

AccountNumber	AccountDescription	Actual 2013	Actual 2014	Actual 2015	YTD 2016
7001	Supplies-Office	4,074.16	4,198.41	3,622.33	1,134.21
7002	Reference Books	914.55	238.99	905.31	624.81
7003	Central Stores	2,043.75	1,958.00	1,700.00	1,840.00
7004	Supplies-Lab	11,558.03	22,427.06	21,372.44	25,202.24
7005	Supplies-Aud Visual	534.80	1,190.25	428.46	14.95
7006	Supplies-Photo-Print	-	-	-	-
7010	Awards-Plaques	95.95	395.61	493.09	99.45
7015	Supplies-LSSU Name-Logo Items	4,067.93	334.56	1,290.79	558.00
7020	Supplies-Other	23,054.14	5,295.99	16,490.33	18,564.99
7030	Copies	12,595.20	13,448.32	10,913.56	14,785.64
7031	Printing	1,227.63	1,399.99	1,134.52	2,558.41
7040	Postage	373.46	180.79	1,355.92	1,099.59
7050	Telephone	5,604.12	4,291.85	5,204.89	4,491.54
7055	Fax	2.05	-	-	-
7060	Software	-	-	57.90	5,000.00
7061	Software Licenses and Maintenance	12,729.20	19,217.45	15,076.84	12,923.00
7065	Computer Hardware	93.80	3,953.03	3,392.87	13,237.42
7070	Equipment <2500	17,360.90	21,040.30	12,034.77	18,392.14
7101	Travel In State	4,117.76	6,356.25	3,883.37	4,363.70
7102	Travel out of State	6,399.61	5,833.01	10,891.48	5,947.30
7103	Travel Students	-	53.00	-	-
7110	Meetings-Luncheons	4,348.33	5,128.36	4,864.81	10,776.89
7111	Guest Lodging-Meals	146.50	14.73	-	100.70
7112	Conferences	585.00	2,710.00	5,168.87	2,945.00
7131	Recruitment--Student	958.36	302.88	244.15	1,267.15
7211	Rental-Equipment	-	-	-	1,300.00
7225	Rental-Other	-	-	-	2,536.50
7230	Product Development Center Services	4,000.00	-	-	-
7253	Contracted Services	-	-	200.00	45,000.00
7261	Equipment Mtnce and Repair	2,994.90	4,078.26	550.00	-
7272	Accreditation	67.99	-	-	-
7290	Linen Service	76.00	-	292.50	292.50
7320	License-Permits-Fees	6,364.00	-	-	539.50
7340	Memberships	2,420.00	2,923.00	2,671.00	7,387.04
7341	Subscriptions-Magazines	-	-	-	-
7345	Advertising	-	-	77.55	-
7365	Professional Development	300.00	619.47	1,928.50	5,447.00
7395	Miscellaneous	-	92.08	-	-
7399A	Academic Base, Carryover and Fees	-	-	-	-
7520	Haz Material Dispose	504.00	-	-	1,406.58
7960	Capitalized Equipment Purch	4,982.50	55,900.00	22,470.90	23,199.45
Grand Total		134,594.62	183,581.64	148,717.18	233,035.70

8.B.4. Equipment / Teaching Support Resource Adequacy

The budget has allowed the College and the MfgET program to meet current *equipment and teaching support* needs. It does not provide for a comprehensive 5 or 10 year equipment replacement plan, but has been adequate for critical and necessary upgrades as well as needed maintenance activities.

C. Staffing

The staffing of the School of Engineering & Technology is described in the following, in terms of compensated positions (full or part time; salaried, release-time, or stipend assignments); evidently, as is typical in academia, much additional work is also available in the form of service activities by faculty members. All of the positions described have some responsibility, to varying degrees, for the MfgET program (as well as other programs).

8.C. 1. Clerical Staff. Throughout the vast majority of the last 6-year cycle, support staff (for the School of Engineering Technology) has included 1-1/2 full-time positions, i.e., a full-time secretary, and a half-time administrative assistant. Only very recently (indeed June 2016) was the half-time position discontinued.

The Secretary provides clerical support to the faculty and Dean, manages day-to-day activities in the School's office, processes purchase requisitions and manages faculty cardholder accounts, organizes special events (e.g., annual School banquet), provides coordination support for Summer programs (camps for high-school-age and younger), and pursues various other duties as well. The administrative assistant position had provided assistance for marketing and recruitment, implementation of Engineering admissions policies, and maintenance of assessment and accreditation records. Given the very recent discontinuance of this position, it's unclear to whom these duties will devolve, but undoubtedly, some will be expected to shift to the full-time Secretary, some to the Chair, some to others, and some may be discontinued.

Furthermore, there has continuously been a part-time student assistant in place to help the Secretary, including Summertime.

8.C.2 Administrative Staff. This includes the Dean and any part-time assignments.

8.C.2.1 Dean. (See above in section 8.A for the Dean's role) The School was administered, at the onset of the 6-year cycle, by its own full-time Dean, but during most of the cycle the Dean has been divided with the Lukenda School of Business under the auspices of a combined college. Beginning July 1 (the date of this report), a reorganization will place the SET together with both Business and Criminal Justice within a Division of Professional Studies & Outreach under a Dean (position vacant, but led by the Interim Provost Dr. Finley, the former Dean of Business & Engineering, assisted by the Associate Provost, Dr. Myton, in the interim); that academic unit will belong to a larger College of Professional Studies.

8.C.2.2 Chair. The Chair (see above in section 8.A for his/her role) is a 3-release hour (1/4-time) appointment, plus $2721 stipend per semester, and $2000 Summer stipend ; that has been consistent during the entire 6-year cycle, except for the Summer stipend, which has varied from 0 to $2000.

8.C.2.3 Coordinators. During some early portions of the 6-year cycle, both Coordinators (see above in section 8.A for their respective roles) received 2 release hours (out of 12 for full time) per semester, i.e., these were 1/6 time assignments, but during the majority of the cycle they received 1 release hour (1/12-time).

As of January 2016, the MfgET Coordinatorship is henceforth uncompensated, and the ME Coordinatorship had the 1-hour release replaced with a $907 stipend (equivalent monetary value for 1-hour at the overload rate, but now strictly as pay, rather than an instrument useable to reduce the full-time instructional load, which had a greater monetary value as 1/12 of full salary; i.e., the duties are now purely on an "over-time" basis); furthermore, it is understood that the ME Coordinator stipend is for duties relative to the ME, not MfgET, program. Accordingly, there is not presently any compensation for administrative work specific to the MfgET program, and the tasks/roles described in 8.A above could not therefore accurately be described as required "duties"; nevertheless, they accurately represent who is doing what work for the program, at least on a voluntary basis.

8.C.2.3 Robotics Director. There is a 3-release hour (1/4-time) assignment for running the Robotics laboratory of the SET. Note that courses such as EGRS381 and 481 make extensive use of this laboratory. The director develops the robotics laboratory through industrial donations and grants, and plays key leadership roles nationally in the Society of Manufacturing Engineers and the Robotics Industry Association.

8.C.3 Instructional Staff. The 10 full-time faculty positions (all tenured or tenure-track) have already been detailed in Chapter 5.

In addition, some usage is made of adjunct faculty. In particular, the two Laboratory Engineers frequently act in this capacity, and the courses they typically instruct (or co-instruct) all belong to the MfgET program, including the lab component of EGME110 Manufacturing Processes, project advising in the capstone EGNR491-495 sequence, the Electrical Technology courses EGET110 and 175, and occasionally the PLC course EGRS365.

The PDC (Product Development Center) of the larger College also employs a full-time Engineer, and has employed 2 during most of the 6-year cycle; these have sometimes served as adjuncts (notably for EGNR245, EGME141, and EGME110, with some lecturing in the capstone courses as well).

An external adjunct is also sometimes used, especially for the lecture component of EGME110 Manufacturing Processes, and for EGME141 Solid Modelling.

8.C.4 Technical Staff. Two-full time Laboratory Engineers are assigned to the School of Engineering and Technology. An Electrical/Computer Laboratory Engineer is responsible for the maintenance and operation of all electrical and computer equipment in the laboratories. A Mechanical Laboratory Engineer is similarly responsible for the maintenance and operation of all mechanical equipment in the laboratories. Both Laboratory Engineers design and manufacture equipment for use by faculty in the laboratory, or the classroom. These positions are full-time, twelve month appointments.

8C.4. Staffing Resource Adequacy

The School of Engineering and Technology has had sufficient *clerical* staffing to meet the needs of the MfgET program. However, the recent loss of the half-time administrative assistant may jeopardize that, or may result in diverting teaching and administrative resources away from the day-to-day needs of the academic programs.

Budgetary allocations may not be sufficient to meet the *administrative* staffing needs of the MfgET program. Although the School chair receives 25% release time supplemented by a $2721 per semester stipend, that position encompasses administrative leadership for all six programs in the School; furthermore the ME departmental coordinator receives a $907 semesterly stipend, but, in principle, earmarked for ME (and only undertaking MfgET-related duties on an informal basis) and the MfgET program coordinator receives neither release time nor a stipend.

The School of Engineering and Technology currently has sufficient *instructional and technical* staffing to meet the needs of the MfgET program, provided the ten positions remain filled. The ten regular faculty members, supplemented by the aforementioned adjunct instructors, are able to deliver the instruction required to support the MfgET program. Furthermore, the two full-time laboratory engineers have the resources to maintain all equipment and facilities used by the MfgET program.

D. Faculty Hiring and Retention

8.D.1 Faculty Hiring Process. The reader is referred to appendix K, "the Agreement", i.e., the contract between the faculty and the University, wherein its appendix B (i.e., appendix B of the Agreement, but appendix K of this document) provides a detailed description of the procedure for formation and conduct of a faculty hiring committee. This is a University-wide procedure to which we adhere (in-fact, this procedure for the whole University was modelled after our longer-standing practices in the School of Engineering & Technology), but it does not address some of the specific additional practices that have developed for, and the philosophy for the conduct of, searches in the ME/MfgET group.

There have been 7 searches (one on-going) conducted for ME/MfgET faculty openings in the last 6-year cycle, to keep the 5 positions filled, all but one of which made a new hire; thus, there is a very ample basis to speak about well-established "practices" in our departmental searches, even if not part of the formalized procedures to which reference is made above. These committees have almost always (6 times of the 7 in the last 6-year cycle) been chaired by the ME Coordinator, Dr. Robert Hildebrand. The balance of the committee has been the other 4 faculty of the ME/MfgET group, together with one faculty member from Electrical/Computer Engineering (ECE); in practice, that has (7 times out of 7) been Dr. David Baumann, the Chair.

Consistent with the institution's primary mission of teaching, and the School's philosophy of maintaining an applied emphasis in its engineering and technology programs, the evaluation process employed in the hiring of new faculty accordingly places a greater emphasis on a candidate's promise as an instructor and on industrial experience than it does on academic research credentials (although the latter *is* also a factor of lesser weight). A faculty candidate is generally expected to have some teaching experience (either as faculty member or a teaching assistant) and to possess excellent communication skills.

After initial screening of CVs, we typically extend invitations for phone interviews to up to a dozen candidates. These are contacted by a committee member, by phone, at which time, as a matter of transparency, the salary (usu. about $65,000 for these openings, which is considered low on the market) is related, as well as something of the geographical and climatological features of the region (rural and wintery), and the nature of the position (heavy teaching loads with little research emphasis). One or more of these factors may cause some of the candidates to withdraw at this point, saving them and the committee needless time expenditure. The remaining phone interview candidates then speak with the entire committee on the telephone for about 20 minutes to half-an-hour, at which time we question them on teaching interests, inclinations to teach laboratories, capstone projects, etc. Up to 3 of those candidates, whichever are most promising (if enough are), are then selected for campus visits.

During the campus visit, candidates give a sample lecture (on a topic specified by the hiring committee chair and generally kept the same for all visiting candidates); this lecture is ordinarily given to both students and faculty (including those not participating in the search committee). Feedback is thereafter solicited from the students and faculty in attendance, and is given much weight in the subsequent hiring decision. Besides the guest lecture, consideration is also given to the candidate's performance in an informal research (or professional) presentation, to collegiality as observed at interactions throughout the day, including meals and one-on-one interviews (including with HR, the Provost, and sometimes the President, who convey their respective feedback), and to feedback from the candidates' references. However, it remains the guest lecture that most often proves decisive.

Historically (and into the early phases of the 6-year cycle), the search committee would select the best candidate, and also rank the other candidates in case of an offer being declined (as happens fairly frequently). The Dean and Provost then had formal authority to negotiate and hire, but tended to support the committee decisions. More recently, the search committees have been discouraged from selecting and ranking, in favor of merely indicating "qualified" or "not qualified".

8.D.2 Faculty Retention. Retention of qualified faculty is partially a matter of correct selection in the search and hiring process, i.e., by identifying a "good fit" faculty hire for the SET. The optimal faculty hire, given the relatively high instructional load, should be committed to instruction, rather than exclusively to research, as well as adaptable to the geographical and climatological particulars of Michigan's Eastern Upper Peninsula (i.e., relative remoteness in a wintery setting). Moreover, while such a person may well be a subject matter expert, the willingness to function as a generalist, and with bonafide laboratory and project skills, is ideal. Given these attributes, a faculty member is likely to find a degree of satisfaction in the work that is conducive to retention.

A School-specific PD fund (beyond that of the University), to bolster faculty retention, has also been available during the 6-year cycle, and still continues in more restricted form. In 2012, subsequent to the EAC of ABET visit which had cited the various Engineering programs for issues of faculty retention (these being the same faculty who cover the Engineering Technology programs), the SET committed to provide a fund for workshops/conferences, summer stipends for scholarly endeavors, and other PD activities. Accordingly, for a portion of the cycle, these funds have been available for the purposes described, and may be allocated to Engineering Technology-related PD just as well as to Engineering-related. In the last year, however, stipends have been discontinued, so that the fund is now limited to travel reimbursement and materials/equipment.

E. Support of Faculty Professional Development

The "Agreement" (ref. appendix K) between Lake Superior State University and the Faculty Association provides each faculty member with $1000 per academic year for professional development; earlier in the 6-year cycle (through 2013), this level was at $800, so it has undergone a $200 annual increase during the cycle. A faculty member's professional development fund can carry over from academic year to academic year, but not to exceed $4,000 (unchanged). Expenditures from professional development funds must be related to the faculty member's professional development or teaching objectives. In addition, faculty members, who are officers of professional organizations or presenters at national conferences, have received additional support to travel to workshops and conferences from departmental and/or Dean's budgets.

Note also the additional SET PD fund described in 8.D. For a couple of years during the 6-year cycle, these provided stipends for scholarly work, as well as travel and materials reimbursement. Although the stipends have been discontinued, the funding continues to exist for travel and materials.

The "Agreement" between Lake Superior State University and the Faculty Association also provides a total of up to three semesters of sabbatical leave at full pay per academic year (it had been four, through 2013). A tenured faculty member is eligible for a Sabbatical Leave after five (5) academic years of employment as a faculty member at the University, so long as s/he has not had a Sabbatical Leave within the previous five (5) years. A Sabbatical Leave Committee comprised of two Deans, appointed by the Provost, and six faculty members elected by the faculty shall consider the applications for sabbatical leave and make recommendations to the Provost. One engineering faculty member, Professor David McDonald of the Electrical and Computer Engineering department, has been awarded a sabbatical during the last 6-year cycle; he received a full-time sabbatical for the 2011-2012 academic year.

PROGRAM CRITERIA

Adherence to the program criteria is discussed in section 5.A.5.2.

Signature Attesting to Compliance

By signing below, I attest to the following:

That Manufacturing Engineering Technology has conducted an honest assessment of compliance and has provided a complete and accurate disclosure of timely information regarding compliance with ABET's *Criteria for Accrediting Engineering Technology Programs* to include the General Criteria and any applicable Program Criteria, and the ABET *Accreditation Policy and Procedure Manual.*

David R. Finley, Ph.D., P.E.
Interim Provost, Lake Superior State University
Dean, School of Engineering and Technology
Dean, Lukenda School of Business

David R. Finley

Signature

July 1, 2016

Date

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**Sample Syllabus – EGMT216 CAM with CNC Applications**
This documentation is relevant to Question number:	**Question #15**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Sample syllabus for EGMT216 CAM with CNC Applications showing course requirements and learning objectives**

LAKE SUPERIOR
STATE UNIVERSITY

College of Engineering and Technology **Fall 2018**
EGMT 216 CAM with CNC Applications **3 Credits**

COURSE OUTLINE

Prerequisites: EGME110, EGME141 and MATH131

Instructor: Mr. David Leach

Office: CASET 129
Phone: 635-2635 desk, 231-881-9953 cell
E-mail: dleach@lssu.edu

Office Hours: *Tentative hours listed below, or by appointment*

Monday	Tuesday	Wednesday	Thursday	Friday
10-11AM, 3-4PM	9-10AM	9-10AM	9-10AM	

Required Texts: Course Handouts

Course Description: Writing CNC programs in machine codes, and the setup and trial runs to produce parts from these programs. Computer software interfacing between programming languages and various industrial machines will be stressed. Computer aided manufacturing (CAM) topics and applications of CAM software will be covered.

Course Objectives:

At the completion of this course

1. Students will be able to describe the sequence of operations for a part program.
2. Students will be able to determine tools required for machining, calculate speeds and feeds, and set-up tools on a CNC machine.
3. Students will be able to manually develop CNC programs using standardized formats to produce a part.
4. Students will be able to use CAM software to produce three dimensional parts.

College of Engineering and Technology **Fall 2018**
EGMT 216 CAM with CNC Applications (2,3)

Grading Scale and Policies:

Exams 30%, Quizzes 10%, Homework 10%, Lab Exercises 30%, Lab Projects 20%

Point Values:

Exams/Quizzes/Homework **500 points (50%)**
Exam 1 100 points (10%)
Exam 2 100 points (10%)
Final Exam 100 points (10%)
Quizzes 100 points (10%)
Homework/Handouts 100 points (10%)

CAM/CNC Lab **500 points (50%)**
Lab Exercises 300 points (30%)
Lab Project 1 100 points (10%)
Lab Project 2 100 points (10%)

Total: 1000 points (100%)

Grading:

98-100	A+	70-77	C
92-97	A	68-69	C-
90-91	A-	66-67	D+
88-89	B+	62-65	D
82-87	B	60-61	D-
80-81	B-	0-59	F
78-79	C+		

Course Policies:

1. Any form of cheating on exams and quizzes will not be tolerated and will result in an F for the course. It is recommended, however, that students help each other on lab assignments and projects to promote a learning environment. All submitted work must be your own.
2. A lab project grade of at least 60% for Projects 1 and 2 must be achieved to pass the course.
3. Lab attendance is required and you must have the instructor's prior permission for excused absences. It is very difficult, if not impossible to make up lab sessions. An unexcused lab absence will result in receiving a zero for the specific lab assignment.
4. Homework will be assigned and will be mixture of textbook questions, handouts, and worksheets.
5. This course requires attendance, a good attitude, patience and hard work.
6. The honor code will be used for all situations that involve cheating, copying, misrepresentation of student work, and misrepresentation of student information.
7. Alternative testing/exam accommodations, if required, must be made with the instructor in advance.
8. Instructor has the right to change or modify grading percentages, lecture topics, and lab topics. Students will be informed of required changes.

College of Engineering and Technology **Fall 2018**
EGMT 216 CAM with CNC Applications (2,3)
University Policies and Statements:

The Americans with Disabilities Act & Accommodations

In compliance with Lake Superior State University policies and equal access laws, disability-related accommodations or services are available to students with documented disabilities.

If you are a student with a disability and you think you may require accommodations you must register with Disability Services (DS), which is located in the KJS Library, Room 103, (906) 635-2355 or x2355 on campus. DS will provide you with a letter of confirmation of your verified disability and authorize recommended accommodations. This authorization must be presented to your instructor before any accommodations can be made.

Students who desire such services should meet with instructors in a timely manner, preferably during the first week of class, to discuss individual disability related needs. Any student who feels that an accommodation is needed – based on the impact of a disability – should meet with instructors privately to discuss specific needs.

IPASS (Individual Plan for Academic Student Success)

If at mid-term your grades reflect that you are at risk for failing some or all of your classes, you will be contacted by a representative of IPASS. The IPASS program is designed to help you gain control over your learning through pro-active communication and goal-setting, the development of intentional learning skills and study habits, and personal accountability. You may contact 635-2887 or email ipass@lssu.edu if you would like to sign up early in the semester or if you have any questions or concerns.

HONOR PLEDGE

As a student of Lake Superior State University, you have pledged to support the Student Honor Code of the College of Engineering & Technology. You will refrain from any form of academic dishonesty or deception such as cheating, stealing, plagiarism or lying on takehome assignments, homework, computer programs, lab reports, quizzes, tests or exams which are Honor Code violations. Furthermore, you understand and accept the potential consequences of punishable behavior.

College of Engineering and Technology **Fall 2018**
EGMT 216 CAM with CNC Applications (2,3)
EGMT216 SPRING 2018 LECTURE SCHEDULE

Week	Date	Lecture	Topics
1	8/28	1	Course intro, syllabus, coordinate systems
	8/30	2	Coordinate systems
2	9/4	3	**No Class – Video Lecture via Moodle**
	9/6	4	**MACHINING CENTERS**
3	9/11	5	Process set-up
	9/13	6	Tools and inserts
4	9/18	7	Speeds and feeds
	9/20	8	Carbide inserts / Canned cycles
5	9/25	9	Manufacturing systems
	9/27	10	HAAS programming
6	10/2	11	HAAS programming – review for Exam 1
	10/4	12	**EXAM 1**
7	10/9		No Class – Attend Monday Classes
	10/11	13	**TURNING CENTERS**
8	10/16	14	Set-up and components
	10/18	15	Speeds and Feeds
9	10/23	16	Speeds and Feeds
	10/25	17	Tooling
10	10/30	18	Cycles
	11/1	19	HAAS programming
11	11/6	20	HAAS programming
	11/8	21	HAAS programming
12	11/13	22	HAAS programming
	11/15	23	HAAS programming – review for Exam 2
13	11/20	24	**EXAM 2**
	11/22		**No Class – THANKSGIVING**
14	11/27	26	Sub programs
	11/29	27	EDM
15	12/4	26	Additional Topics, Review for Final
	12/6	27	Course Assessment

EGMT216 FALL 2018 TENTATIVE LAB SCHEDULE

LAB	Date	Topics

College of Engineering and Technology **Fall 2018**

EGMT 216 CAM with CNC Applications (2,3)

1	8/28	CREO Manufacturing NC introduction (Meet in Computer Lab)
2	9/4	CREO Manufacturing (Via self-study, no lab session)
3	9/11	HAAS Mill Set-up and probe system (Meet in Shop)
4	9/18	CREO Manufacturing & HAAS Mill (Meet in Computer Lab)
5	9/25	Project 1
6	10/2	Project 1
7	**10/9**	**No Lab – Go to Monday Classes**
	10/16	HAAS Milling Machine (Meet in Computer Lab)
8	10/23	HAAS Milling Machine (Meet in Computer Lab)
9	11/6	HAAS Lathe (Meet in Shop) lathe set-up
10	11/13	HAAS Lathe (Meet in Shop) on-screen programming
11	11/20	HAAS Lathe (Meet in Shop) on-screen programming
12	11/27	Project 2
13	12/4	Project 2 / Clean-Up
	12/11	Final Exam Week

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**Sample Course Assessment – EGMT216 CAM with CNC Applications**
This documentation is relevant to Question number:	**Question #15**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Sample course assessment summary from EGMT CAM with CNC Applications, Spring 2018. Shows student self-assessment and faculty assessment of learning objectives, as well as action plans for improvement.**

LAKE SUPERIOR
STATE UNIVERSITY

Department of Engineering & Technology

EGMT 216 CAM with CNC Applications (2,3) 3 Credits

Spring 2018

COURSE ASSESSMENT SUMMARY

Offering Details

Lecture Times: TR 10:00am to 10:50am	Lecturer: David Leach
Lab Times: R 5:30pm to 8:20pm	Lab Instructor: David Leach
Number of Students: 8	Evaluator: David Leach

Context within Curriculum

Student Population: ME and MET(required)
Previous Courses Required: EGME110, EGME141
Subsequent Courses: None

Relationship to ABET Student Outcomes

ETAC of ABET Student Outcomes			EAC of ABET Student Outcomes
a	✓✓✓	•••	
b	✓✓✓	••	
c			
d	✓✓	••	
e			
f	✓	•	
g	✓	•	
h	✓	•	
i			
j			
k	✓	•	

✓ = exposure (e.g., one graded assignment)
✓✓ = stress (e.g., one course objective)
✓✓✓ = focus (e.g., multiple objectives, course title)

• = foundational – ready for further development
•• = developed – prepared for practical application
••• = high – approaching that of a practicing engineer

Student Grades

F	D-	D	D+	C-	C	C+	B-	B	B+	A-	A	A+	GPA
								ME MET	ME MET ME		ME ME	ME	**S18 3.50** *S17 3.17* *S16 3.73* *S15 3.54* *S14 3.29*

General Comments

Faculty Comments

This was our second offering with the new course number EGMT 216 (previously EGMT 312). This semester we had 8 students enrolled, with one lab section of 8 students. There were 2 MET (required) and 6 ME (tech elective) students enrolled in the course. Students learned how to set up CNC milling and turning processes using both on-screen machine controller-generated code (turning) and G&M code computed by CREO 3.0 CAM software and post-processed for specific vertical milling machines. A significant effort was made to increase the amount of hand-programming for G&M code in the lecture content.

Analysis of Objectives

At the completion of this course:

(1) ***Students will be able to describe the sequence of operations for a part program,***

Student Self Assessment	91.4%
Faculty Grades of Student Work	88.1%

Student Comments

- We focused more on hand coding and the types of code. {written}
- Need practice. {written}
- Less so for the lathe codes, but in depth for mills. {written}

Faculty Comments

Sequence of operations was reviewed many times in lecture (hand programming) and in every lab session (CAM). Students were also required to list operations on exams and as part of their paperwork submissions for projects.

(2) ***Students will be able to determine tools needed, calculate speeds and feeds, and set up tools on a CNC machine.***

Student Self Assessment	82.8 %
Faculty Grades of Student Work	85.0%

Student Comments

- Going a little into the theory of where the feeds and speeds come from would be insightful. {written}

- Need experience. {written}
- Learned equations for speed/feed calculations. {written}
- Students explained they would like to understand theory behind speeds and feeds, have more HW problems assigned like the examples given in class. {oral}

Faculty Comments

Feeds and speeds were discussed in detail in lecture and in lab. Both theoretical and in-practice feeds and speeds were discussed. Theoretical speeds and feeds were emphasized to establish a baseline for actual feeds and speeds. Variation in operator experience, machine, tools, parameters, and materials all play a role in establishing operating ranges for feeds and speeds. For future semesters, I will review the history of speeds and feeds and how they are fundamentally derived using math and tool motion.

(3) Students will be able to manually develop CNC programs using standardized formats to produce a part.

Student Self Assessment: ……………..….	96.7 %
Faculty Grades of Student Work ………	91.2 %

Student Comments

- Learned to write basic programs by hand or CAD/CAM. {written}
- More practice. {written}
- Excellent for mills, but lathes are not at all consistent with standardized G-Codes from one make to another. (HAAS vs Mazak for example). {written}
- Lathes – every manufacturer is different. {oral}

Faculty Comments

A significant amount of time, more than previous semesters, was spent on hand programming. I believe it really paid off – to allow the students to gain full understanding of code for both the HAAS mill and lathe. Yes, formats vary depending on the machine builder, however, the foundation of all programs is similar. In class I presented HAAS and non-HAAS (Fanuc) examples of coding. The differences are subtle, and variation in programming comes with experience.

(4) Students will be able to use CAM software to produce three dimensional parts.

Student Self Assessment: ……………..….	94.3 %
Faculty Grades of Student Work ………	92.0 %

Student Comments

- More practice. {written}
- Software capabilities / usability dependent. {written}
- Look into material removal simulation. {oral}
- Investigate another CAM software. {oral}
- We should learn how to import .stl files. {oral}

Faculty Comments

The CREO CAM software is a repetitive process and students continue to build confidence with each laboratory exercise. Additional CAM tools and concepts will be introduced in future offerings.

Supplementary Questions

1. Do you feel comfortable with CNC processes? Explain your response.

Student Comments:

- Yes, CNC is almost second nature for me at this point. Mostly because of prior knowledge, but this course helped with hand programming.
- Yes, my level of comfort in operating CNC machines has dramatically improved over the length of this course.
- Yes, I feel I have spent enough time operating the machines that I can take a part from the planning and design stage through completion.
- Yes, for the most part.
- There are still some features in CREO such as milling window, or mill volume that we haven't use as much and I struggle with when making my part for the project.
- The lab helps the students get familiar with the machines.
- The professor is very knowedgble about the subject matter.
- Yes, because learning to write programs by hand helps to understand code produced by the CAM software.
- Somewhat comfortable – I know enough to get myself in trouble, not quite enough to get myself out.
- Doing more will help w/confidence, esp. selecting feeds/speeds tables + references are well & good, but pushing for speed optimization really gets questionable.

Faculty Comments:

As in every offering, students who spend a considerable amount of time on the CNC machines maintain a high level of 'comfort', while those who put in a minimal effort may never achieve being comfortable. There are many variables to CNC programming which can never be taught in 15 weeks, that only become apparent through years of experience and understanding customer requirements.

2. Do you have suggestions to improve the accomplishment of course objectives?

Student Comments:

- More CAM processes covered.
- Upgrade to the latest CREO CAM and get students access to material removal simulation.

- Homework or in-class problems for solving speeds and feeds, as well as programming assignments for the lathe (only exposure was in class, no push to study it outside of class).
- Possibly handouts with full code written out as examples.
- It would be interesting to learn something about other materials too, even if we're not going to machine them.
- Less of a focus on hand writing code, more software instead.
- Keep it how it is.
- More time learning correct speeds/feeds for different types of cuts and metals.
- More.
- More, more, more everything.
- Another identical HAAS mill would help a lot.

Faculty Comments:

Although performing very well overall, and being happy with the increase of knowledge gained by hand-programming, this group of students did not go out of their way to figure things out as I constantly instructed them to do. They keep talking about feeds and speeds, even up to the final course assessment day, while speeds and feeds were clearly explained, along with how and where to find them --- but they keep coming back to the instructor for a solution. In this course I expect the students to do some outside research. If work isn't handed to the students, they don't go out and find it (a disturbing trend of today's student engineers). It would help to have another HAAS mill to double up on the lab work. Students end up waiting most of their lab period to be able to run their programs.

Evaluation of ABET-ETAC Student Outcome a (EGMT216 Spring 2018)

ABET Statement

an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities

Extent of Coverage in Course

✓✓✓ = focus

Expected Level of Achievement in Course

**** = developed – prepared for practical application*

Performance Indicator

the ability to describe how to set up G&M code using CAM software to CNC machine a given part {MET}

Student Work to Evaluate

Final Exam question 13

Evaluation of Student Work Relative to Student Outcome

- The student work evaluated was a final exam question which required the students to describe how they would set up a CAM file in CREO Manufacturing to machine a given part in a vertical machining center. (Final Exam question 13)
- For the assignment, the students were given information about the material type, overall part dimensions, and a visual representation of the final part.
- The student work was evaluated by David Leach (DL).

Final Exam Question 13

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
DL		1 MET	1 MET 4 ME	2 ME,	**3.13** *2.50 S17* *2.33 S16*

- There were 2 MET students enrolled in this offering. 1 performed at a below standard level for the given performance indicator example, while 1 met the standard. Out of the 6 ME students, 4 performed at the standard and 2 performed above the standard. The overall score increased from 2.50 (S17) to 3.13 (S18).
- The description/steps needed to meet the standard were reviewed during <u>every</u> lab lecture and in the course lecture. All CAM assignments involved the same steps in generating CAM files. This is a very repetitive exercise, but remains a key indicator for understanding the structure of CAM programs.
- The 'below standard' rating was given to the student who scored a 6/10 for the exam problem, while missing a few steps and not providing much detail in his response to the question.

Recommendations for Future Relative to Outcome

- Continue to develop a laboratory manual that will document the steps for this performance indicator and can be reviewed during each laboratory CAM activity.

Action Plans

From Previous Offering

- Move the course to Fall semester, to reduce the CNC machine bottleneck between senior projects, manufacturing processes, and CNC machining. The Spring semester is project-heavy and students tend to perform at a minimum level (what is required, but not above and beyond) for their CNC projects. Moving the course to the Fall semester will remove the bottleneck and give students more time to spend on their CNC projects, thus improving the overall student experience. [Course has been scheduled for F18 and will stay in the fall.] Issue Closed. (DL).
- Introduce Intuitive Programming on the HAAS milling machine. [There was not sufficient time to add intuitive programming to the milling machine lab for S18.] Forward to F18.
- Create a lab manual that covers shop safety, lab schedule, standardized workpiece and tooling libraries, HAAS-specific handouts, and grade sheets. [Components for the lab manual are starting to be assembled for introduction during F18.] Forward to F18.
- Purchase and install BobCad V30 CAM software, to be used for the mill, lathe, and plasma. Create a new hand-out for the CNC Plasma which can be used for EGME110. [Bobcad has not yet been purchased but is a suggested engineering budget item for 18/19 school year.] Forward to F18.
- Consider adding the CNC Plasma as an option for the final CNC project. A student ran a CNC plasma project, with great success, during Spring 17 after she could not find time on the CNC mill, due to capacity issues. BobCad V30 could be used here. [CNC Plasma has been added as an option project to Project 2.] Issue Closed. (DL)
- Purchase more HAAS tool holders and insert tooling for both the mill and the lathe. [This is being addressed in yearly budgeting.] Issue ongoing, but will close from course assessment. (DL).
- Search for additional HAAS milling machines from companies who are selling. [We are slated to acquire a HAAS mill from Precision Edge, date TBD.] Issue remains open.
- Improve the machine shop lab environment so students can create CAM programs next to the milling machines and labs could potentially be run in the machine shop (and not in the computer labs on the 2nd floor). [This issue is still open.]
- Increase the number of homework assignments.
  [The use of HAAS handouts and worksheets increased the number of homework assignments and in-class activities.] Issue Closed. (DL)
- Continue to standardize tooling, materials and assignments.
  [Lab tooling and workpiece materials were standardized for S18 and we will continue standardizing tooling and workpiece materials (and sizes) for future offerings. Our goal is to build-ahead workpieces so more time can be spent on machine set-up, programming, and milling/turning.] Forward to F18 for additional improvement. (DL)
- Create a time-efficient lab assignment for the 4th axis on the HAAS mill.
  [This is scheduled to be accomplished through a special topic project for F18.] Still open.
- Include additional hand-outs for key items such as the performance indicator for item a.
  [Students were given more HAAS-specific handouts and worksheets regarding machine programming for both lathes and mills. We will continue using the HAAS method and curriculum, as available. Development of a lab manual is in-process.] Forward Lab Manual to F18.

For Future Offering:

- Review the history of speeds and feeds and how they are fundamentally derived using math and tool motion.
- Place more emphasis on the differences in programming between CNC machine manufacturers: what to look for, why there are differences, what the similarities are, and what you can expect as a programmer. Experience is key here.
- Add material removal simulation to CAM labs.
- Add 'importing of .stl files' (common 3D printing files) to CAM labs
- Consider alternative materials for machining: steel, plastic, brass, copper, etc.

Appendix Cover Sheet

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	Engineering and Technology
Document Title (if attached) or Filename (if emailed):	Senior Project Posters
This documentation is relevant to Question number:	16
Briefly summarize the content of the file and its value as evidence supporting program review:	Provides example(s) of projects involving students in this major.

Project Statement

The purpose of this project was to update one of the two thermal trainer units currently used in EGME 432 (Thermal and Fluids Lab), and housed in CAS-106C. More specifically, Team STS integrated both software and hardware upgrades, particularly to do with the Programmable Logic Controller's control of the system. In addition, the team converted the system with National Instruments data acquisition systems for all data collection and recording. Major stakeholders were the engineering students, both current and future, enrolled in Thermal and Fluids Lab as well as the involved faculty.

Two of the five laboratory exercises supported by the thermal trainer unit explore the efficiency of what is known as a Pelton turbine (pictured on the left) at variable loads. The system enables a user to select the number of nozzles they would like to use to expel water toward the turbine's cupped fins and, in addition, supports several different nozzle sizes. As this pressurized water strikes the turbine's fins, it causes the turbine to rotate, generating harnessable electricity. The turbine's efficiency can then be calculated using either angular velocity and torque or voltage and current output to a load.

Project Benefits

The thermal trainer's increased functionality now supports a total of five independent laboratory exercises. Each of these exercises fosters the study of unique principles in areas such as the characteristics of centrifugal pumps, turbine efficiency, cooling effects of forced convection, multi-stage energy conversion, and pump performance in single, series, and parallel configurations. The product enables students to quickly and easily configure the system to extract the data necessary to perform these studies at the push of a button.

STS

LAKE SUPERIOR
STATE UNIVERSITY

2017-2018

The Team

[redacted]

EE
ME
EE
MfgET
ME

Mr. Jeff King	Faculty Advisor
Dr. Zakaria Mahmud	Industrial Customer

3D Model:

Video at:

YouTube

Project Challenges

As with most projects, the biggest obstacle was completing all tasks and objectives within the confines of the timeframe. All team members had to maintain a balance between this project and other time commitments. Additionally, learning and successfully implementing the LabVIEW software used for data acquisition proved to be a unique challenge in that it is not widely used within LSSU's engineering and technology department. This lack of a local knowledge and resource bank pushed key team members to learn the software via experimentation and alternate means.

NATIONAL INSTRUMENTS LabVIEW

PTC Creo

Allen-Bradley

The Product

This new and improved training unit features a current generation Allen Bradley PLC used in conjunction with a full-sized color Human Machine Interface. Multiple National Instruments data acquisition cards provide the platform needed for a dedicated computer to employ a software known as LabVIEW. This is done in order to capture and timestamp a plethora of incoming data streams generated by an army of sensors and transducers that monitor dozens of pressures, flow rates, velocities, torques, and temperatures, each contributing to the data required to complete lab exercises in key areas of thermal and fluid studies.

Front Suspension Components

Several suspension components were replaced such as A-Arms, hubs, and spindles. Finite Element Analysis showed that the A-arm thickness could be reduced to reduce weight while maintaining adequate strength. The original spindles were machined from 1040 Carbon Steel and were proven to be too weak and yielded over time. These were replaced with lighter and stronger Yahama Raptor 700 spindles. Lonestar hubs were also implemented to reduce weight.

Find us on YouTube

CarSim

Carsim is a vehicle simulation software that was used to create a virtual model of the kart. With the finished product, future teams can use this to analyze design choices and personalize the kart for individual drivers. The simulation was validated by comparing procedure results with real world testing.

Clutch

Originally the kart was equipped with a belt driven CVTech clutch. The gear ratio for this clutch had a range from 3:1 to 0.43:1. This was replaced with a Comet industries clutch, which has a gear ratio range of 3.3:1 to 0.5:1. The new clutch has a larger operating range and allows for better power and acceleration. The slight loss in top speed being traded for more low-end power is ideal as SAE event tracks are design such that karts do not operate at top speed for long periods of time during race events.

SUPERIOR BAJA RACING

LSSU Engineering Senior Project

2017-2018

LAKE SUPERIOR STATE UNIVERSITY

Team Members

[redacted]

Dr. Robert Hildebrand

Industrial Customer

Dr. Zakaria Mahmud, LSSU SAE Faculty Advisor

Mr. Jordan Huff, LSSU Mechanical Lab Engineer

Project Statement

Team Superior Baja Racing (SBR) set out to improve components and sub-systems of the Society of Automotive Engineers (SAE) Club's mini-baja kart created by a previous senior project team. The three major systems improved on the kart were: suspension, brakes, and drive train. Testing with the use of a new data acquisition system was done to validate these changes.

Sponsors

Chippewa Motors, Inc.

We can do it all!

Suspension

The shocks were changed from a Fox Podium 2.0 coilover with a fixed spring rate, to the Fox Evol Float 3's. The Evol Float 3's have an adjustable air chamber which allows for a variety of spring and damping rates. Being able to adjust the pressure within the chamber allows for optimal settings for different events and maneuvers. At lower pressures the kart is able to withstand a much larger lateral acceleration, allowing for higher maximum speeds through curves. The shocks have a secondary chamber with a different pressure setting to protect the kart against bottoming out from large impacts.

Original Shocks: Fox Podium 2.0

New Shocks: Fox Evol Float 3.0

Evol Float Dual Stage Compression Chart

Data Acquisition System

The Data Acquisition System (DAQ) was replaced with an AIM Evos 4s racing system. It features a built-in 3-axis accelerometer, 3-axis gyroscope, and a GPS receiver. It also has 5 other available channels to add any sensors that may be needed to perform a test. The data collected was used to compare previous design performance to new design performance and justify the changes that were made. This data can also be used to validate the accuracy of CARSIM simulation.

Project Summary

Team KUKA Roboline Upgrade (KRU) has implemented a third KUKA robot to the pre-existing two-robot KUKA workcell in LSSU's Robotics Lab. In addition to updating the workcell's controls, vision, and safety systems, Team KRU installed a rotary index table used to transport work pieces between two robots, a worktable, and end-of-arm tooling for the third robot. Team KRU also updated all documentation for the workcell and created two new lab exercises. Finally, a synchronized robotics motion project and a robotic deburring project were completed to demonstrate the capabilities of this workcell.

The KUKA Robotics Workcell

The fully completed robotics workcell now contains:

- 3 KUKA KRS R1400 robots
- A rotary index table and a linear conveyor system
- Multiple end-of-arm tooling for the each robot
- Automatic tool-change capability
- Ethernet/IP communications
- 3 Cognex vision systems
- Allen Bradley PLC (Programmable Logic Controller) with HMI (Human Machine Interface)
- 3 new computer stations
- Safety system with a SICK area scanner and 2 Keyence light curtains (shown below)

K.R.U.

KUKA ROBOLINE UPGRADE

Senior Projects 2017-2018

Faculty Advisor
Jim Devaprasad

Team KUKA Roboline Upgrade
[redacted]

Industrial Contacts
Eric Becks
Ron Bergamin

Vision System

Team KRU installed a Cognex 7802 vision system for each of the three robots. The vision system includes several advanced capabilities such as autofocus, integrated lighting and on-board processing. An image of the camera can be seen below.

Project Benefits

The main project benefits are:

1) Addition of a new robotics platform to LSSU's Robotics Lab
2) Future LSSU engineering students can get lab experience on KUKA robots and Cognex vision software
3) New project demonstrations created to highlight LSSU Robotics capabilities to visitors
4) New platform for future senior and research projects
5) Experience for Team KRU members on robotics system integration.

Synchronized Robotic Motion

Team KRU developed a piano demonstration using Autodesk's Maya software in conjunction with the Mimic software plugin and KUKA's EntertainTech software. Maya is a 3D computer animation software that uses time-based programming and has been used extensively in the production of films and video games. The Mimic plugin allows for time-based animation of KUKA Robots. Mimic then exports data as a program file which can be executed using KUKA's EntertainTech software package. These technologies allowed the three robots to play two pianos in sync. An image of the robots playing the pianos is shown below.

Robotic Deburring

Team KRU developed a demonstration that simulates the deburring process of marine boat propellers. The process utilizes a deburring tool manufactured by ATI. The RoboTeam software package was used to traverse the complicated geometry of the propeller blades. RoboTeam has many features including program and motion synchronization, collision avoidance, and operation of multiple robots from a single SmartPAD. An image of the robots performing the deburring sequence can be seen below.

Project Made Possible By:

KUKA
SCHUNK
LAKE SUPERIOR STATE UNIVERSITY
COGNEX
TEXTRON AVIATION

CORNING

AUTOMATION OF A PARTICULATE FILTER REPAIR STATION

2017-2018 Senior Projects

LAKE SUPERIOR STATE UNIVERSITY

Project Contributors

SMC

FASTENAL

Industrial Customer

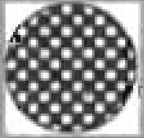
The industrial customer (IC) for this project is Corning Incorporated. Headquartered in Corning, New York and founded in 1851 they are responsible for some of the most advanced glass technologies. Boasting 107 locations in 24 countries they are truly a global company. Special thanks to Gail Dyer (LSSU Alumna) for her guidance on this project.

Project Benefits

- Tested feasibility of automating the current manual process
- A small but safe work cell near high traffic areas
- More precise, consistent process achieved through use of automation
- Improved cycle times
- Learning experience for students

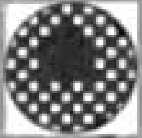
Project Statement

Team Automated Repair Cell (ARC) was charged by Corning to create an automated robotic cell which integrates machine vision with a collaborative robot. The project automated a previously manual process at Corning of repairing ceramic diesel particulate filters. The vision system identified the imperfections in the filters and a custom built end of arm tool (EOAT) performed repairs on the filters. The EOAT punched out unwanted caps and filled in unwanted holes repairing the filter matrix which restored the perfect checkerboard pattern of holes and caps in the filter.



Perfect filter

Filter missing caps



Filter missing holes

What is a Collaborative Robot?

Standard industrial robots require additional safety equipment such as light curtains, fencing, and area scanners in order to follow industry standard guidelines. Corning has provided the team with a FANUC Collaborative Robot that features contact stop capabilities. The FANUC CR 7iA/L robot automatically stops when unexpected contact is made. This allows the robot to be used without additional safety equipment while still following industry safety standards.

Team Members

[redacted]

ARC

Automated Repair Cell

Faculty Advisor:
Eric Becks

Industrial Customer:
Gail Dyer

Project Outcomes

Custom end of arm tooling was developed for the robot to complete both types of repair operations on the filter. The work cell utilizes an extremely high resolution camera to detect errors in the filter and validate proper repair of the filter. An Allen Bradley Programmable Logic Controller (PLC) was used to manage communications within the work cell.

Light Inspection System

(2017-2018)

AUTOMOTIVE LIGHTING AND VISION SYSTEMS

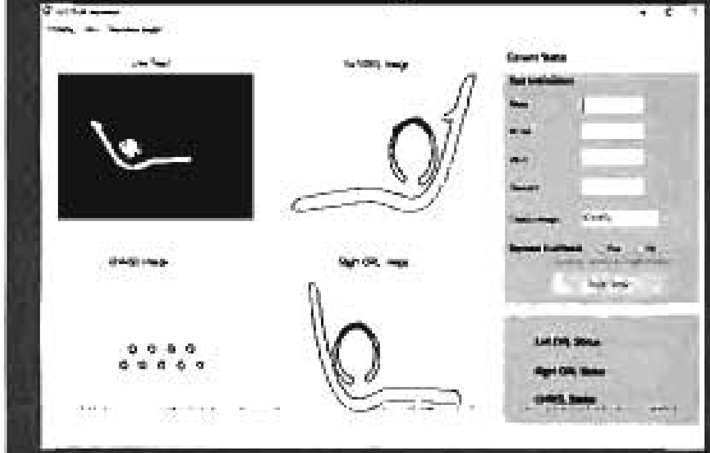
Project Statement

Team Automotive Lighting and Vision Systems (ALVS) was responsible for researching and developing a machine vision system to automate the inspection of light elements during automotive assembly. The project includes a high resolution machine vision camera, mobile test cart, light assembly stands, and a graphical user interface.

Graphical User Interface

The main focus in developing the user interface was to create a simple, user-friendly environment to interact with the hardware and vision software. The team designed a graphical user interface (GUI), and implemented the vision system software functionality directly into the code. With this interface, plant operators can set up configurations for new vehicle models and conduct tests on both the front headlight assemblies, and the rear center high-mount stop light while viewing all of them on the same basic screen. The program stores all of the information from each test and exports it into an external data file. Failed test results can be viewed easily within the interface via the error log tab in the toolbar. This feature will help manufacturers swiftly locate vehicles with faulty components in the assembly line.

GUI Layout



Team Members

[redacted]

Industrial Contact
Mark Compton

Faculty Advisor
David Leach

LAKE SUPERIOR
STATE UNIVERSITY

Check us out on YouTube!

Esys Automation is an engineering and manufacturing systems integration firm located in Auburn Hills, Michigan. The company specializes in turnkey solutions that serve the automotive and manufacturing industries.

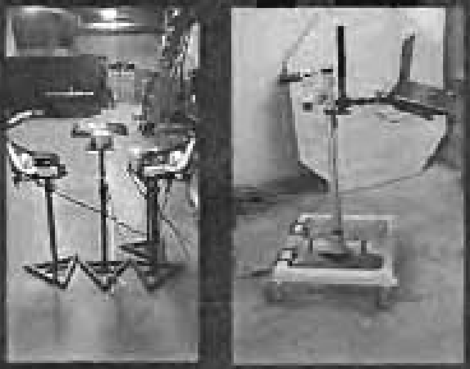
Project Result

The Team researched and tested several potential vision techniques and methods prior to creating the algorithm that determines whether the lights are functioning properly. The end product is a fully adjustable vision system that can be easily adapted for use in different environments with different car models.

Setup and System Design

Fixtures were designed to be fully adjustable to accommodate a diverse range of testing scenarios. The team created fixtures to hold the light assemblies as well as the camera and laptop. The camera fixture was made to be mobile so it can move relative to the three light positions.

Test Equipment



Automation Controls

Senior Projects: 2016-2017

Project Statement

Along with team Conveying Automation Solutions (CAS), team Automation Controls Engineering (ACE) created an educational KUKA robotic platform for students at Lake Superior State University. The new robotic platform allows students to familiarize themselves with KUKA systems and also train students how to correctly follow safety standards used in industry today.

This project features two KUKA KR5 R1400 robots. These robots offer new capabilities such as synchronous robot movement. The cell includes a linear slide that allows the robots to avoid interference with each other. The cell also features safety equipment including light curtains and an area scanner. These features are new to LSSU's robotics lab and offer a unique learning experience for students. This project helps keep LSSU's robotics lab current with technology used in industry today.

The Cell

PLC (Programmable Logic Controller)
Team ACE is using an Allen-Bradley CompactLogix PLC and also a Banner safety controller. The PLC is responsible for all inputs and outputs while the safety controller is responsible for the safety aspects of the cell.

HMI
For the HMI, an Allen-Bradley *PanelView* Plus 1250 with 12.1 inch touch screen capabilities is utilized.

Servo Drive/Motor
The cell features an Allen-Bradley Kinetix 350 servo controller. This controls the movement of the conveyor.

Sensors
Primary sensors in the cell are for end-of-arm tooling identification and gripper sensors. A limit switch at each end of the conveyor will limit the distance the conveyor can travel.

I/O Switch Boxes
The switch boxes utilize eight basic toggle switches and eight LED lights for educational purposes.

Faculty Advisor
Jeff King
Electrical/ Computer
Laboratory Engineer

Automation Controls Engineering Team
[redacted]

Industrial Customer
Eric Sicks
Engineering Projects Manager/Director

Please scan the QR code to learn more about this project.

Project Made Possible By:

SCHUNK

LAKE SUPERIOR STATE UNIVERSITY

Parker

COGNEX

KUKA

TECHNOLOGY GROUP

JR AUTOMATION TECHNOLOGIES LLC

KUKA Robot Features

The KUKA robots have a reach of about 1.4 meters. The robots are placed in such a way that their work envelopes slightly overlap. This allows the robots to interact with each other when utilizing RoboTeam. The KR5 R1400 have a maximum payload of 5kg. The three largest joints on the robot, axis 1-3, have a maximum speed of 218°/s while the three smaller joints at the end of the arm, axis 4-6, have a maximum speed of over 492°/s. The robot is very precise, with a pose repeatability of ±0.04mm.

Key Robot Features:

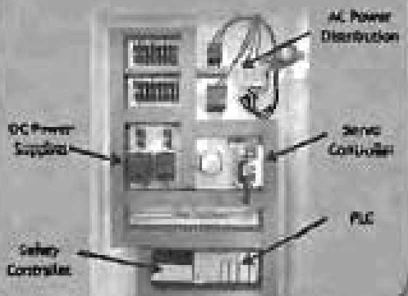
- KUKA SmartPAD
- KR C4 small-size controller
- Robot collaboration software – RoboTeam
- Cognex VisionTech

Electrical

The cell needs various hardware that requires both power and communication wiring. Team ACE developed the power distribution and communication required for the cell.

Junction Boxes
Junction boxes are used for cleanly routing signals to the PLC. This allows the PLC to monitor and control actions within the cell.

PLC Cabinet
The PLC is installed in the main cabinet. The cabinet houses all main power distribution, network communications, and control systems.



Controls and Vision Systems

LAKE SUPERIOR
STATE UNIVERSITY

Controls and Vision Systems
Engineering Senior Project 2016-2017

SYS

Project Description: *Pharm-Assist*

The *Pharm-Assist* project is an automated prescription dispensing machine designed to assist pharmacy employees and increase the time they are available for customer service. Team CVS was tasked with Phase 2 of the *Pharm-Assist* project, where the main goal was to reduce the cost of the workcell. Building off the previous team's proof of concept workcell, team CVS designed and built a 3D gantry system which replaced the FANUC delta robot that was used in the previous iteration. Along with replacing the robot, team CVS converted a majority of the control of the system from PLC (Programmable Logic Controller) to Raspberry Pi (mini-computer). The main focus of Phase 2 was to build and test a rigid gantry design that would be reliable and fast (30 pills per minute). Other areas of focus for the project included reducing noise and vibration from the previous year's design, improving the security of the cell, and converting the power of the cell from 240 Volts to 110 Volts.

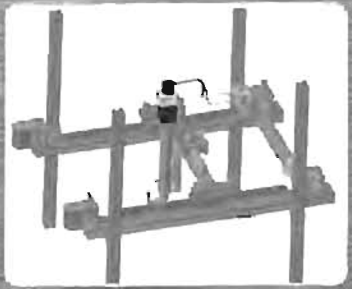
Team Controls and Vision Systems:

[redacted]

Dr. Joseph Moening (Faculty Advisor)

Gantry Design:

The team chose a "Core XY" design for the gantry system, as seen pictured below. This design allows the motors that drive the X & Y movement of the gantry to be stationary and mounted on the frame rather than having to move with the carriage. This reduces the weight that the motors need to move and therefore increases the maximum speed at which the XY plane of the gantry can move.



Company Background:

4D Systems, LLC. sponsored Phase 1 and Phase 2 of this senior project. 4D Systems is an automation integration company that automates production processes for their clients, as well as providing software and software services to the engineering community. This company is located in Flint Township, Michigan and has been open since 2011. Mr. Jean Pierre Rasaiah is the president and founder of the company. Mr. Rasaiah and Mr. Brett Newill, both alumni of Lake Superior State University, were the industrial contact for the project.

Project Benefits:

With the completion of Phase 2 of this project, many people will benefit. The team members of team CVS will benefit from working with 4D Systems and completing their senior project. This will allow them to gain valuable real world engineering experiences. 4D Systems will benefit by having a prototype which they can expand upon and eventually market to pharmacies and nursing homes. The users of the workcell will benefit by being able to spend more time with the customers, increasing customer service.

Project Outcomes:

- Designed, built, and tested rugged 3D gantry system
- Speed of pill dispensing: 30 pills per minute
- System delivers correct prescriptions 95% of the time
    - Accomplished by detecting if a pill is dropped from the End of arm tooling (suction cup)
- Total cost of project was under $10,000
- Improved security from previous iteration
    - Accomplished by the use of electronic locks and a fingerprint scanner
- The cell produces less than 65dB of noise (slightly louder than office conversation)
- Vibrations were reduced 25% from the previous iteration

Conveying Automation Solutions

KUKA Robotic Training Cell

Engineering Senior Design Project 2016-2017

LSSU

[redacted]

- Faculty Advisor: Prof. Jim Devaprasad
- Industrial Contact: Prof. Eric Becks

Project Statement

Team Conveying Automation Solutions (CAS), along with Team Automation Controls Engineering (ACE), created a new training work cell using 2 KUKA KR 5 R1400 robots.

The new work cell is used as a platform for student learning, future senior projects, and research. The work cell features safety equipment, End-of-Arm Tooling, and robotic interaction that are unique to the LSSU robotics lab. Team CAS was responsible for designing, manufacturing, and implementing several mechanical components of the work cell.

Sponsors and Industrial Support

LAKE SUPERIOR STATE UNIVERSITY

KUKA

SCHUNK

JR AUTOMATION TECHNOLOGIES LLC

Parker

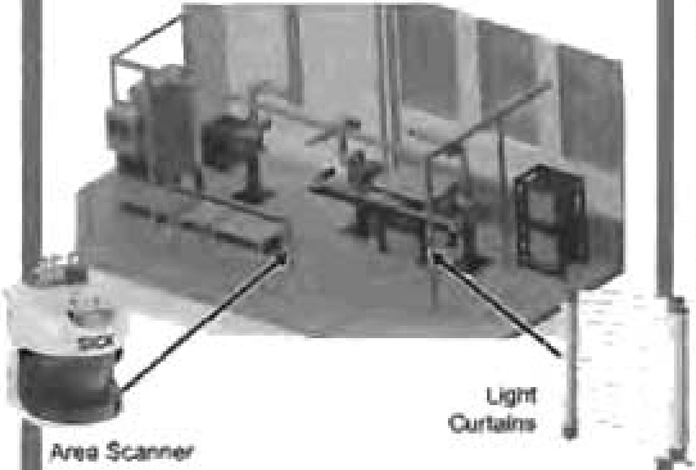
AMT

Baumer

COGNEX

Safety Features

The safety features include emergency stop buttons, 3 light curtains, and an area scanner. All of these features are used in conjunction with the physical enclosure to ensure the safety of both users and observers of the work cell.



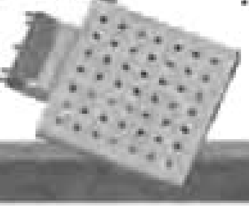
End-of-Arm Tooling

End-of-Arm Tooling allows the robots to manipulate and interact with their surroundings. The KUKA robots have a tool library that includes a centric 3-finger gripper, a single suction cup gripper, and a 3-finger expansion gripper. In addition to these End-of-Arm Tools, there is a pallet gripper that will be utilized for special projects, labs, and demonstrations.

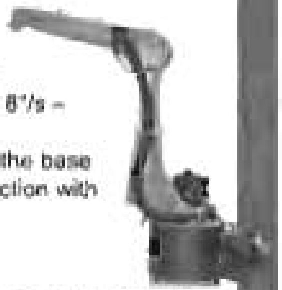

Expansion Gripper


Centric Gripper


Suction Cup Gripper


Pallet Gripper

Robot Specifications



- 6 axes creating a 4 foot reach
- 5 kg (~11 lb) payload
- Rotational speed of 218°/s – 492°/s
- 170° of rotation about the base
- Capable of safe interaction with other KUKA robots

Special Cell Features

The work cell features a spring-loaded top plate mounted to a work table that protects both the table and the robots from being damaged. Attached to the table is a linear conveyor and specialty tool cribs. The tool cribs were designed to allow the quick exchange of End-of Arm Tools without damaging the work cell components.

Special Thanks

Team CAS would like to extend special thanks to the following individuals for their support, technical expertise, and guidance in the completion of this project.

- Ron Bergamin – KUKA
- Jason Markesino – AMT
- Josh Bodell – AMT
- Eric Becks – IC & LSSU PDC
- Gibson Kramer – LSSU PDC
- Nick MacArthur – LSSU PDC

Please scan the QR code to learn more about this project.

WHEEL
INSPECTION
SYSTEMS

Rim Quality Inspection via Vision
Senior Project 2016-17

LAKE SUPERIOR
STATE UNIVERSITY

Sponsored By:

ESYS AUTOMATION

Industrial Contact:
Mark Compton

Wheel Inspection Systems:

Team Members:

[redacted]

CE
ME
MET
ME
ME
EE

Faculty Advisor:
David McDonald

Project Statement:

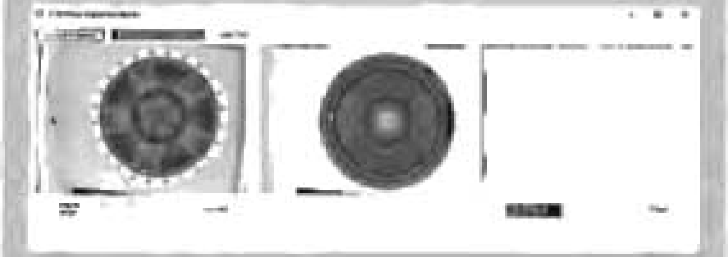
Team Wheel Inspection Systems (WIS) was tasked with researching and developing a system to automate the inspection of automotive rims using an industrial grade camera and machine vision software.

Company Background:

Esys Automation is a robotics integration company located in Auburn Hills, Michigan. The company was established in 1999, and it specializes in turnkey automation for the automotive industry.

GUI Interface:

The picture below shows the user interface of the vision system. Here, users can set up and run tests on automotive rims. The user can acquire an image of the rim via a camera, run a live feed from the camera, load a previous test image, reference an ideal image, and run the vision algorithm. The GUI will display the results of the test.

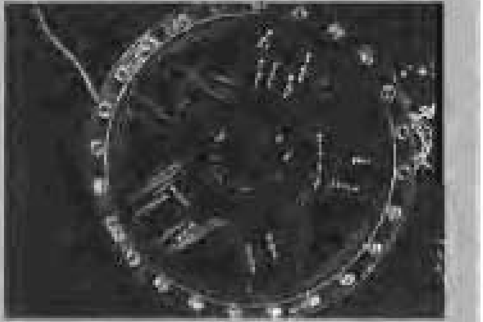


System Design:

The pictures to the right show Team WIS's shroud. The shroud is a chamber designed to block outside light and to scatter light inside the shroud. High-intensity bar lights, a high resolution camera , and a rim are mounted in the shroud. This system allows for a controlled testing area of vision algorithms on automotive rims.

Project Result:

The team researched the effect of different lighting positions and intensities on the surface of the rims. Based on the research, the team was able to create an algorithm using a visions system that could inspect automotive rims.



Lake State Automation

2016 – 2017 CNC Gantry Mill

Project Description

Team Lake State Automation has been sponsored by Mactech On-site Machining Solutions to design, build, and automate a prototype CNC milling machine. The project came about due to the desire for increased flexibility and functionality of the current machine. The project entails an upgrade on an existing gantry mill which was originally manually operated. This machine is designed to work in a wide range of applications from ship maintenance to bridge building. It may be mounted and operated while in any orientation, and is completely mobile

The prototype machine features increased speed, accuracy and repeatability. New Fanuc hardware has allowed the machine to be operated by software which may be created off-site. Automation of the machine has greatly increased its capabilities and reduced human labor. The prototype design of the CNC milling machine is intended to be replicated by Mactech On-site Machining Solutions in the future. Team Lake State Automation has undertaken this project facing a fixed budget and a need to collaborate with multiple vendors.

Fanuc Controls

Team Members:

[redacted]

Faculty Advisors:

Professor David Leach
Professor Jon Coullard

Industrial Contacts (Mactech):

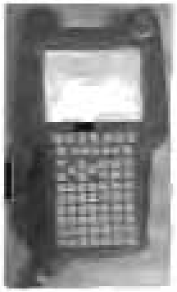
Mr. Joel Wittenbraker
Mr. Chad Peterson

Mactech On-Site Machining Solutions

Mactech was founded in 1974 in order to provide portable stress relieving solutions. The company expanded in 1985 in order to provide portable machine tools and on-site services. Mactech is a world leader in the production of portable machining and heat treating equipment.

iPendant User Interface

- User friendly operation
- Touch screen interface
- Operate machine from more than 30 feet away
- Easily load G&M code programs via USB
- Manual and automatic operation



CNC Gantry Mill

LAKE SUPERIOR
STATE UNIVERSITY

MACTECH
ON-SITE MACHINING SOLUTIONS

FANUC

PART 2: Degree-Level Review

Degree Program: BS. Electrical Engineering Technology (ABET Accredited 2016)

Explain how the program works to address each of the following questions. For each question, respond with a narrative and supporting evidence.

Assessment (CC 4.B and CC 4.C)

13. Provide evidence that the degree-level program outcomes are clearly stated and are effectively assessed, including the "use of results." Attach the 4-Column Program Assessment Report.

14. Explain how results from degree assessments were used to improve the degree program. Include specific examples.

Program review and feedback from students indicated that they thought ethics (student outcome I) should be removed from senior projects. The recommended action was to create a new General Education course that would cover ethics, economics, and sustainability as it applies to the design and use of technology. This course would then allow for the removal of that material from senior projects giving student more time to focus on their project. For a number of reasons, the creation of this class was not possible. However, based on faculty discussions and student feedback it was decided to bring in an expert in ethics. Thus, Dr. Jason Swedene a Professor in Department of Humanities & Philosophy who specializes in ethics began teaching the ethics portion of senior projects in the spring of 2017. From the latest student outcome evaluation, there is no concern for outcome I. Student feedback regarding the ethics portion has overall been very positive. Some students indicated that they would prefer that ethics be moved to the fall semester of senior projects. The possibility of moving this topic is currently being explored and may occur in the future. Overall, it seems that bringing in Dr. Swedene was beneficial to the program.

As a follow up of the 2016 ABET report, based on discussions with students and faculty it was found that students were spending the vast majority of their time completing project #2 in EGRS365 to the detriment of their other courses (not completing other assignments, etc.). Project #2 contained two operating modes "Production" and "Quality". After review, the "Quality" mode was removed as it was determined that there was not much additional learning taking place but it required a significant amount of time to implement. In addition, to better prepare students for realistic systems an emergency stop button was added to the machine and project requirements. Implementing this in the project requires very little extra work for the student but gives them experience with practical safety requirements. In discussions with students and faculty there seemed to be agreement that the time required for students to complete the project was reduced. Overall, the change was beneficial and we will continue with it. The students are meeting the needed learning outcome without it adversely affecting their other courses. We still plan on looking for additional ways of optimizing student learning and reducing the workload.

Quality, Resources and Support (CC 3.A)

15. Explain how the program ensures that degree program-level and course-level learning outcomes are at an appropriate level. Attach evidence, including a degree audit for the program.

As copied from the 2016, ABET Self-study report, "The initial student outcomes for the EET program were determined by the School of Engineering and Technology faculty based on advice given by the ABET-EAC site visitation team in Fall 2012 and with the approval of the School of Engineering and Technology Industrial Advisory Board (IAB). The student outcomes may be revised by the School of Engineering and Technology faculty with advice from the IAB. The IAB meets twice every year, once in April and once in November, and provides advice to the School of Engineering and Technology faculty at both meetings. The student outcomes, just as the program educational objectives, will be reviewed by the IAB every three years."

For more information regarding the Student Learning Outcome alignment see the ABET report.

For course-level alignment, faculty maintain course reports that track success in the outcomes, student self-assessment, faculty assessment, student assessment of the prerequisites, and if applicable assessment of program indicators. Faculty in the school meet regularly to discuss the results and make changes as needed. An example of one such report for EGET 310 is attached. More examples are available upon request in CAS 203.

The Lumina Foundation's Degree Qualification Profile (DQP) is suggested as a resource for answering the questions about what students should know and be able to do at each degree level: http://degreeprofile.org/wp-content/uploads/2017/03/DQP-grid-download-reference-points-FINAL.pdf

Intellectual Inquiry (CC 3.B).

16. Explain what the program does to engage students in collecting, analyzing, and communicating information; mastering modes of inquiry or creative work; developing skills integral to the degree program. Attach examples of undergraduate research, projects, and creative work.

The excerpt below was taken from page 49-50 of the 2016 ABET Self-Study Report. Attached to this program review are examples of posters from Senior Projects.

Senior Project Capstone Experience

EET students usually take the senior design course sequence, EGNR-491-495, as indicated in table 5-4 above; detailed syllabi for these courses are found in Appendix F. However, there are actually three possible paths for graduates to follow for their senior year capstone experience: Industrial-based, Co-op, or Research-based. All of these paths provide a realistic design experience in an academic environment. All students participate in the same initial course

(EGNR-491), with a strong emphasis on team and communication skills during the definition and proposal phase, and initial design phase, of a multi-disciplinary project. The majority of students then continue to work on multidisciplinary teams to implement and engineer, i.e., realize, a final design for an industrial customer (EGNR-495). Alternatively, Cooperative Education students may substitute an equivalent design experience during their Co-op for the EGNR-495 course (realization phase). Finally, a research-based project may also be substituted for the industrial-based project. Research-path students again participate in the team/communication skills area of the Senior Year Experience (EGNR-491), but define and execute an academically-oriented research project under the direction of a faculty member. The Senior Year Experience for all of these paths requires the application of student knowledge and skills acquired in earlier course work to enhance their ability to accomplish required objectives.

In recent years, most students have chosen the EGNR491-495 sequence, with very few opting for the Coop - EGNR491 alternative. The research option, while remaining available in principle, has been completely inactive for many years.

Thus, for most students, the senior design experience at LSSU involves participating in an intensive design project that spans two semesters. Students work on multidisciplinary teams (i.e., typically a mix of students from the disciplines EET, MfgET, CE, EE, and ME), often 4-7 students depending on the scope. They normally design and build a product for an industrial customer; some projects, however, are supported directly by LSSU. Typical project budgets are $5,000 - $30,000, but have occasionally fallen out of that range on both ends. Examples of projects from the past few years which have involved EET students are:

- Design and build of an automated hydraulics control cart for offshore machining operations, and development/implementation of a method for hydraulic leak detection.
- Design and development of a robotics assembly line, incorporating four FANUC robotics, and end-of-arm tooling, and including a robotics-playing-tetris demo, for use in LSSU laboratory courses in robotics.
- Design and development of a stand-alone robotics work cell to be used by pharmacists to fill prescriptions.
- Design and build of a system which utilizes laser measurements to achieve alignment between a robot arm and a steering column. The system replaced a manual method of robot alignment and thereby increased the repeatability and accuracy of the steering column testing procedure.
- Design of a multipurpose robot hand and tutorial guides for the application of advanced program features in an industry-standard robotics simulation software called ROBOGUIDE. The features and applications explored in ROBOGUIDE included machine vision, calibration, robotic path generation, and 3D bin picking.

- Design and construction of two robotic workcells using delta type robots suitable for use in an educational environment and design of a curriculum for a high school students using the workcell.

- Design and implementation of a robotics workcell to simulate the dispensing of a wood filler product into railroad ties. A robot, using custom end of arm tooling and a machine vision system, locates the positions of spike holes on railroad ties as they move by on a continuous conveyor, serving as a proof-of-concept for future development of a wood product dispensing system in the railroad industry.

More information regarding senior design projects, including more extensive descriptions of specific projects, can be found on the School's web site at the URL http://www.lssu.edu/eng/seniors/. The senior design courses are managed by a multidisciplinary team of faculty called the senior projects faculty board (SPFB). Figure 5-4 below depicts the major activities associated with the senior design courses. The display materials available at the time of the visit will also contain portfolios of the design projects.

Additionally, we have included as attachments posters from senior projects involving students in this program for the last two years.

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	Engineering and Technology
Document Title (if attached) or Filename (if emailed):	Four-Column Report
This documentation is relevant to Question number:	13
Briefly summarize the content of the file and its value as evidence supporting program review:	Evidence that Four-Column Report was completed.

Assessment: Program Four Column

Program (CoIS) - Electrical Engineering Technology BS

Program Notes: The student outcomes for the LSSU Electrical Engineering Technology program are the same as those in ABET Criterion 3 (a) through (k).
Assessment Contact: Dr. Paul Weber, Chair
Mission Statement: To produce sought-after engineers and technologists by providing a rigorous undergraduate learning experience characterized by close student-faculty interaction.

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
Criterion 3.a - Students will be able to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Mid-Level (Analyzing/Applying) (Bloom) **Institutional Learning:** ILO2 - Use of Evidence - Students will identify the need for, gather, and accurately process the appropriate type, quality, and quantity of evidence to answer a complex question or solve a complex problem.	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There are three performance indicators for Criterion 3.a. Performance Indicator #a1-the ability to use an industrial robot to automate a manufacturing process in EGRS-381(Robotics Technology Lab) using a project report and robot code on setting-up a Staubli robot for automating an advanced palletization task or a machine tending task using VAL3 programming and I/O communications. Performance Indicator #a2-the ability to use surface mount technology equipment to automate placement of electronic components on a printed circuit board in EGET-	**Finding Reporting Year:** 2016-2017 **Goal met:** No Performance Indicator #a1- no data Performance Indicator #a2- Spring 1.0 (08/10/2017)	**Use of Result:** For EGRS 381, no data was collected this term. Our action item is to assess in Fall 2018. For EGET 310, low sample size was an issue as there was only one EET student in this particular offering. There is some cause for concern since the EET student performed "Unacceptable" on a key understanding of panelization, which is widely used in industry. It is recommended that more panelization example problems be added to future lectures. (08/10/2017)

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
	310 [Electronic Manufacturing Processes] on the final exam question on identifying column and row information for the starting point fiducial mark of each board in a multi-board panel. **Criteria Target**: 3.0 out of 4 on at least one performance indicator, with no performance indicator below 2.0. **Schedule/Notes:** EGET 310 is an alternate year course. 1- Unacceptable, 2-Below Standard, 3-Meets Standard, 4-Exemplary		
Criterion 3.b - Students will be able to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies. **Goal Status**: Active **Goal Category**: Student Learning **Goal Level (Bloom/Webb)**: High-Level (Creating/Evaluating) [Bloom] **Institutional Learning**: ILO3 - Analysis and Synthesis - Students will organize and synthesize evidence, ideas, or works of imagination to answer an open-ended question, draw a conclusion, achieve a goal, or create a substantial work of art.	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There are two performance indicators for Criterion 3.b. Performance indicator #b1-the ability to apply calculus of several variables in EGNR-245 [Calculus Applications for Technology] on the project on derivation of the formula for the least-squares line. Performance indicator #b2-apply knowledge of energy levels to determine whether materials are insulator, semiconductor or conductor in EGET-310 [Electronic Manufacturing Processes] on an exam question on material identification based on energy level diagram and placement of Fermi level.	**Finding Reporting Year**: 2016-2017 **Goal met**: Yes Performance Indicator #b1-No data Performance Indicator #b2-Spring, 4.0 (08/10/2017)	**Use of Result**: For EGNR 245, no data was collected in this offering. Our action item is to collect data in Fall 2018. For EGET 310, there was only one EET student in this offering. No cause for concern at this time. (08/10/2017)

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
	Criteria Target: 3.0 out of 4 on at least one performance indicator, with no performance indicator below 2.0. **Schedule/Notes:** EGET 310 is an alternate year course. 1- Unacceptable, 2-Below Standard, 3-Meets Standard, 4-Exemplary		
Criterion 3.c - Students will have the ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** High-Level (Creating/Evaluating) (Bloom) **Institutional Learning:** ILO3 - Analysis and Synthesis - Students will organize and synthesize evidence, ideas, or works of imagination to answer an open-ended question, draw a conclusion, achieve a goal, or create a substantial work of art.	**Indirect - Report/Audit - Internal -** Assessment of this criterion is documented in Appendix G of the ABET report. There are two performance indicators for Criterion 3.c. Performance Indicator #c1-the ability to develop a valid and reliable experimental procedure that will validate a product in EGNR-495 (Engineering Design Project II) on the design review on final product testing. Performance Indicator #c2-the ability to use statistical methods to plan an efficient, yet effective, program of experimentation, when the output variable studied is expected to depend on multiple input variables in EGNR-310 (Quality Engineering) on the term project technical report. **Criteria Target:** 3.0 out of 4 on at least one performance indicator, with no performance indicator below 2.0.	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Performance Indicator #c1- Spring 3.0 Performance Indicator #c2- Fall 2.5 (08/10/2018)	**Use of Result:** In EGNR 310 there was a low sample size, but some concern. Emphasize the necessity to document and explain methodology for construction of the test programm as part of the assignment. In EGNR 495, given that all teams met standard and that there were no common weaknesses noted, there is no cause for concern. The present setup should be continued. (08/10/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** Yes Performance Indicator #c1- Spring 3.3 Performance Indicator #c2- not offered (08/10/2017)	**Use of Result:** All teams whose evaluations were recorded met the standard or were exemplary. No modifications needed; the current setup should continue to be used. (08/10/2017)

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
	Schedule/Notes: EGNR 310 is an alternate year course. 1- Unacceptable, 2-Below Standard, 3-Meets Standard, 4-Exemplary **High Impact Program Practices 1:** Capstone Course(s), Projects		
Criterion 3.d - Students will have the ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** High-Level (Creating/Evaluating) (Bloom) **Institutional Learning:** ILO3 - Analysis and Synthesis - Students will organize and synthesize evidence, ideas, or works of imagination to answer an open-ended question, draw a conclusion, achieve a goal, or create a substantial work of art.	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There is one performance indicator for Criterion 3.d. Performance Indicator #d1-the ability to reformulate implied customer needs as specifications and produce an acceptable design solution in EGNR-491 (Engineering Design Project I) on the product design review. **Criteria Target:** 3.0 out of 4 on at least one performance indicator, with no performance indicator below 2.0. **Schedule/Notes:** 1- Unacceptable, 2-Below Standard, 3-Meets Standard, 4-Exemplary **High Impact Program Practices 1:** Capstone Course(s), Projects	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Performance Indicator #d1-Fall, 3.0 (08/10/2018)	**Use of Result:** There is no cause for concern; the present setup should be continued. (08/10/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** Yes Performance Indicator #d1-Fall, 3.0 (08/10/2017)	**Use of Result:** There is no cause for concern. (08/10/2017)
Criterion 3.e - Students have the ability to function effectively as a member or leader on a technical team	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There is one	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Performance Indicator #e1- There were no EET students in this course offering. (08/10/2018)	**Use of Result:** In the course overall, which includes students from many different engineering majors, while there are a few

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
Goal Status: Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Level 4 (Extended Thinking) (Webb) **Institutional Learning:** ILO4 - Professional Responsibility - Students will demonstrate the ability to apply professional ethics and intercultural competence when answering a question, solving a problem, or achieving a goal.	performance indicator for Criterion 3.e. Performance Indicator #e1-the ability to provide constructive criticism of team members in EGNR-495 (Engineering Design Project II) on peer evaluations **Criteria Target:** 3.0 out of 4 on at least one performance indicator, with no performance indicator below 2.0. **Schedule/Notes:** 1- Unacceptable, 2- Below Standard, 3-Meets Standard, 4-Exemplary **High Impact Program Practices 1:** Capstone Course(s), Projects		outliers that were below standard or unacceptable, 87.5% of the students met standard or were deemed exemplary. There is no cause for concern. The current setup should be continued. (08/25/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** No Performance Indicator #e1-Spring, 2.9 (08/10/2017)	**Use of Result:** Continue to monitor. While the average was slightly below standard, 35 out 39 assessments were at 'Meets Standard' or 'Exemplary'. (08/10/2017)
Criterion 3.f - Students have the ability to identify, analyze, and solve broadly-defined engineering technology problems. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** High-Level (Creating/Evaluating) (Bloom) **Institutional Learning:** ILO3 - Analysis and Synthesis - Students will organize and synthesize evidence, ideas, or works of imagination to answer an open-ended question, draw a conclusion, achieve a goal, or create a substantial work of art.	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There are two performance indicators for Criterion 3.f. Performance Indicator #f1-the ability to identify possible reasons that a product or process may fail to function well, and categorize these in EGNR-310 (Quality Engineering) on homework on fishbone chart exercise. Performance Indicator #f2-the ability to design an analog amplifier that maximizes the resolution of a sensor output for an embedded system in EGEE-355 (Microcontroller Systems) on exam 1 on the hardware design	**Finding Reporting Year:** 2017-2018 **Goal met:** No Performance Indicator #f1- Fall 2.75, Performance Indicator #f2- No EET students. (08/10/2018)	**Use of Result:** In EGNR 310, 3 out of 4 of the students were at "Meets Standard". No immediate concern. Continue to monitor. (08/10/2018)

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
	problem. **Criteria Target:** 3.0 out of 4 on at least one performance indicator, with no performance indicator below 2.0. **Schedule/Notes:** EGNR-310 and EGEE-355 are alternate year courses. 1- Unacceptable, 2-Below Standard, 3-Meets Standard, 4-Exemplary		
Criterion 3.g - Students are able to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Mid-Level (Analyzing/Applying) (Bloom) **Institutional Learning:** ILO2 - Use of Evidence - Students will identify the need for, gather, and accurately process the appropriate type, quality, and quantity of evidence to answer a complex question or solve a complex problem.	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There are two performance indicators for Criterion 3.g. Performance Indicator #g1-the ability to make formal engineering presentations in EGNR-495 (Engineering Design Project II) on the final project presentations. Performance Indicator #g2-ability to research and use technical specification sheets to implement a useful design element in EGET-310 (Electronic Manufacturing Processes) on the final project. **Criteria Target:** 3.0 out of 4 on at least one performance indicator, with no performance indicator below 2.0. **Schedule/Notes:** EGET-310 is an alternate year course. **High Impact Program Practices 1:** Capstone Course(s), Projects	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Performance Indicator #g1, 3.0 Performance Indicator #g2, not offered. (08/10/2018)	**Use of Result:** • The teams get a lot of practice between the scope presentation, update presentations, and these final presentations and it shows. This is also externally validated to some degree by the ratings of the external reviewers (e.g. IAB members). • There is no cause for concern. This setup should be continued. (08/25/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** Yes Performance Indicator #g1, Spring 3.0 Performance Indicator #g2, Spring 3.0 (08/10/2017)	**Use of Result:** No concerns. In EGEE 310, move design portion earlier in the semester and have a greater emphasis on aesthetics. (08/10/2017)

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
Criterion 3.h - Students demonstrate an understanding of the need for and an ability to engage in self-directed continuing professional development. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Level 4 (Extended Thinking) (Webb) **Institutional Learning:** ILO4 - Professional Responsibility - Students will demonstrate the ability to apply professional ethics and intercultural competence when answering a question, solving a problem, or achieving a goal.	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There is one performance indicator for Criterion 3.h. Performance Indicator #h1-the ability to define and clarify customer needs through technical investigation in EGNR-495 (Engineering Design Project II) on the FA evaluation of each team member at end of semester. **Criteria Target:** 3.0 out of 4 on at least one performance indicator, with no performance indicator below 2.0. **Schedule/Notes:** 1- Unacceptable, 2 Below Standard, 3-Meets Standard, 4-Exemplary **High Impact Program Practices 1:** Capstone Course(s), Projects	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Performance Indicator #h1. no EET majors in this offering of EGNR 495. (08/10/2018)	**Use of Result:** • Although there were no EET majors in this offering, the overall average has been slightly over 3.0 (meeting standard) for the last two years and self-evaluation of this outcome has been relatively high on the Senior Exit Surveys, so no individual assignment is deemed necessary at present. • There is no cause for concern. (08/25/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** Yes Performance Indicator #h1-Spring, 3.1 (08/10/2017)	**Use of Result:** There is no concern. (08/10/2017)
Criterion 3.i - Students have an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Level 4 (Extended Thinking) (Webb) **Institutional Learning:** ILO4 - Professional Responsibility - Students will demonstrate the ability to apply professional ethics and intercultural competence when	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There is one performance indicator for Criterion 3.i. Performance Indicator #i1-the ability to apply perspectives from established ethical philosophies in the analysis of a case study in EGNR-495 (Engineering Design Project II) on the ethics essay.	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Performance Indicator #i1-no EET students in this offering (08/10/2018)	**Use of Result:** This outcome was reviewed by Dr. Jason Swedene from Humanities. The overall average from the course was 3.2 All teams met standard or were deemed exemplary. There is no cause for concern. Students continued to report higher levels of engagement in the material with Dr. Swedene teaching it. The present setup with Dr. Swedene should be continued. See the course report for minor adjustments. (08/25/2018)

Student Learning Outcomes	Assessment Criteria & Procedures	Assessment Results	Use of Results
answering a question, solving a problem, or achieving a goal.	**Criteria Target:** 3.0 out of 4 on at least one performance indicator, with no performance indicator below 2.0. **Schedule/Notes:** 1- Unacceptable, 2- Below Standard, 3-Meets Standard, 4-Exemplary **High Impact Program Practices 1:** Capstone Course(s), Projects	**Finding Reporting Year:** 2016-2017 **Goal met:** Yes Performance indicator #I1-Spring, 3.1 (08/10/2017)	**Use of Result:** There is no concern. (08/10/2017)
Criterion 3.j - Students have a knowledge of the impact of engineering technology solutions in a societal and global context. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Level 4 (Extended Thinking) (Webb) **Institutional Learning:** ILO4 - Professional Responsibility - Students will demonstrate the ability to apply professional ethics and intercultural competence when answering a question, solving a problem, or achieving a goal	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There is one performance Indicator for Criterion 3.j. Performance Indicator #J1-the ability to recognize the impact of engineering technology solutions in a societal and global context in EGET-310 (Electronic Manufacturing Processes) on the final exam question on environmental impact of engineering practices. **Criteria Target:** 3.0 out of 4 on at least one performance indicator, with no performance indicator below 2.0. **Schedule/Notes:** 1- Unacceptable, 2- Below Standard, 3-Meets Standard, 4-Exemplary	**Finding Reporting Year:** 2016-2017 **Goal met:** Yes Performance Indicator #J1-Spring, 4.0 (08/10/2017)	**Use of Result:** No concerns at this time. (08/10/2017)
Criterion 3.k - Students have a commitment to quality, timeliness, and continuous improvement. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Level 2	**Indirect - Report/Audit - Internal** - Assessment of this criterion is documented in Appendix G of the ABET report. There is one performance indicators for Criterion 3.k.	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Performance indicator #k1- Fall, 3.3 (08/10/2018)	**Use of Result:** Already a subject of great emphasis, and no extensive problems in performance, so no changes recommended. (08/10/2018)

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
(Skills and Concepts) [Webb] **Institutional Learning:** ILO4 - Professional Responsibility - Students will demonstrate the ability to apply professional ethics and Intercultural competence when answering a question, solving a problem, or achieving a goal.	Performance Indicator #k1-the ability to analyze, by methods of statistical process control, data representing output of a continuously monitored manufacturing process, in order to make early detection of any drift away from the target values of the output in EGNR-310 [Quality Engineering] on homework 5, control charts (statistical process control). **Criteria Target:** 3.0 out of 4 on at least one performance indicator, with no performance indicator below 2.0. **Schedule/Notes:** EGNR-310 is an alternate year course. 1- Unacceptable, 2-Below Standard, 3-Meets Standard, 4-Exemplary		

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering and Technology**
Document Title (If attached) or Filename (If emailed):	**ABET Report**
This documentation is relevant to Question number:	**15**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Main body of abet report. All appendices and supporting documents are available in CAS 203.**

ABET
Self-Study Report

for the

Bachelor of Science
Electrical Engineering Technology

at

Lake Superior State University
Sault Sainte Marie, Michigan, USA

July 1, 2016

CONFIDENTIAL

Table of Contents

List of Appendices

B.S. Electrical Engineering Technology
Self-Study Report
for
ETAC of ABET
Accreditation

BACKGROUND INFORMATION

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B. Program History

Lake Superior State University (LSSU) was originally founded in 1944 as a branch of what is known today as Michigan Technological University, based in Houghton, Michigan. In 1969, the Sault Sainte Marie campus gained autonomy from Michigan Technological University. Over time, three bachelor of science programs in engineering technology were introduced and accredited -- Mechanical Engineering Technology (1977), Electrical Engineering Technology (1981), and Manufacturing Engineering Technology (1987). The EET and MET programs received continuous TAC of ABET accreditation until 1999, but were discontinued several years prior to that as noted below. The MfgET program is still in place and is currently accredited by ETAC of ABET through 2017.

In 1994 the Engineering Technology faculty and constituents (alumni, employers of graduates, Industrial Advisory Board, and area educators) underwent a review process and reached the decision to discontinue the EET and MET programs in favor of electrical engineering (EE) and mechanical engineering (ME). The decision was based upon input from alumni and designed to better serve a larger audience of Michigan's industry and public. Subsequently a computer engineering (CE) program was added. All three of these engineering programs are now accredited by the EAC of ABET through 2019.

In 2009 electrical engineering technology (EET) was re-introduced and began accepting new students into the program beginning Fall 2010. The decision to re-introduce the EET program was based on offering an electrical-based option for students who otherwise enter the MfgET program and providing an opportunity for our EE students who desired a less mathematically intensive program. The first graduate of the EET program was in May 2014, and there have been 4 additional graduates since then. In Fall 2015, 17 students were enrolled in the EET program. We are now seeking initial accreditation for the EET program on the same cycle as our already accredited MfgET program.

C. Options

There are no options in the EET program at this time; however, students can, and often do, earn a minor in Robotics Technology while pursuing this degree. The program does offer a significant number of technical elective courses.

D. Program Delivery Modes

The EET program is delivered predominately as an on-campus program with face-to-face lectures and labs. Lecture and lab times have been weekdays from 8am through 10pm, but beginning in the 2016-2017 academic year, the 8am classes will be eliminated. Co-operative education is encouraged and one of the School faculty members (Paul Weber) serves a co-op coordinator to assist students who wish to pursue this option. Students may use up to three semesters of co-op and one senior project course (EGNR-491) to satisfy their capstone experience requirements.

A few courses had, as recently as 2013, been occasionally offered via distance education as well as traditional face-to-face instruction; these were:

EGNR-310: *Advanced Quality Engineering*
EGRS-380: *Robotics Technology*
EGMT-225: *Strength of Materials*

However, with the discontinuance of an unaccredited Engineering Management program, this mode of delivery has fallen into disuse, and there is no expectation that it will be revived.

E. Program Locations

The EET program is offered exclusively on the main campus in Sault Sainte Marie, Michigan.

F. Public Disclosure

The Mission, Goals, Program Educational Objectives, and Student Outcomes for the EET program are made accessible to the public on the LSSU web site at the following URL:

< http://www.lssu.edu/eng/mission.php>

The annual enrollment and graduation data, along with the above information, for the EET program are made accessible to the public on the LSSU web site at the following URL:

< http://www.lssu.edu/eng/SETtransparency.php>

G. Deficiencies, Weaknesses or Concerns Documented from the Previous Evaluation

This is the initial accreditation for the EET program.

CRITERION 1. STUDENTS

A. Student Admissions

Admission of First-Time-In College Freshmen into LSSU

LSSU is an "access institution" and has a relatively low standard for admission to the university. Admission is guaranteed with a 2.4 high school GPA and a composite ACT score of 19 or a total revised SAT score of 990. However, other factors such as higher grades, positive recommendations from counselors or other professionals, or time since high school graduation are taken into consideration if the student does not meet these standards.

From the university web site:

> ***Admissions Criteria***
> *The primary factors used to determine admission are cumulative grade point average (GPA), high school course curriculum, and ACT or SAT results. LSSU recommends that students follow a college preparatory curriculum mirroring the Michigan Merit Curriculum. The middle fifty percent of our entering freshman class have high school GPA's ranging from 2.9 to 3.6 and ACT scores ranging from 22-25. Students should feel free to submit any additional materials which may aid the Admissions Office in reviewing unusual circumstances which may have impacted high school performance. ACT or SAT scores will not be used in the admissions process if you graduated from high school two or more years ago.*

The average ACT score of all students enrolled in the EET program is shown below in Table 1-1. The average ACT score of all students enrolled in any degree program at LSSU is also shown for comparison.

Table 1-1: ACT Scores of EET Students by Academic Year

Year	ACT Scores of EET Students	ACT Scores of LSSU Students
2010-2011	24.0	21.6
2011-2012	22.0	21.7
2012-2013	21.2	21.8
2013-2014	22.2	22.0
2014-2015	20.8	22.1
2015-2016	21.3	22.1

Admission into the EET Program (Before Fall 2016)

Until Fall 2016, there was no standard for admission into the EET program beyond admission into the university. This resulted in students being admitted into the program needing remediation in reading (READ-091), English (ENGL-091), and mathematics (MATH-087-088). Such students stood little chance of completing the EET program.

Admission into the EET Program (Fall 2016 and Thereafter)

Beginning with Fall 2016, the standard for admission into the EET program will be raised. The new admission standard for entry into the EET program will be:

> *To be admitted into the B.S. Electrical Engineering Technology degree program, a student must have all of the following:*
>
> *1. Acceptance into LSSU.*
>
> *2. Placement into MATH102 or higher (Currently an ACT Math minimum score of 21 or an ACT minimum score of 18 and a COMPASS Algebra A minimum score of 46).*
>
> *3. High school GPA of 2.5 or higher or 19 or more earned credits of university coursework.*

This will result in no students needing mathematics remediation being admitted into the program and far fewer needing reading or English remediation. These students should all have a decent chance of completing the EET program.

B. Evaluating Student Performance

Course Grades

Student performance in a course is evaluated by the course instructor, who assigns, at the completion of the course, a grade on an A-F scale, where F is a failing grade; i.e., no courses in the EET program are graded on a pass-fail basis, except possibly, at the student's discretion, the free elective 3 credits.

Pursuant to concepts of academic freedom, which are affirmed by the faculty-LSSU collective bargaining agreement, the School of Engineering and Technology does not mandate any methodology by which instructors are to arrive at grades, nor any distribution of grades, etc. Instead, grading policies are left to the judgment of the individual faculty member; the assurance of quality and consistency in grading is therefore *not directly* by virtue of common policies, but rather *indirectly* by virtue of the care taken in the process of making faculty appointments to ensure that the faculty candidate has a mastery of his/her field and is a person of judgment (refer to Criterion 8 Section D for discussion of this process). Moreover, the Dean prepares performance evaluations of faculty members, as discussed in Criterion 6, and issues of fairness and accuracy of grades could be addressed, and feedback given, if necessary. The student can appeal to the instructor of a course for a grade change, after which there is a well-defined due process procedure involving first the Chair, then the Dean, and finally an ad hoc Grade Review Board of upper-class students, faculty members, and a dean (each from another area on campus), which recommends to the Provost after hearing all perspectives.

With the exceptions noted below in Table 1-2, for a course to satisfy any course requirement in the EET program, a student must obtain a passing grade in that course. The exceptional courses are considered to be foundational for further course work in the EET program.

Table 1-2: Exceptions to General Grade Rule

EET Core Course	Degree Requirement
EGEE-125 Digital Fundamentals	C or better
EGET-110 Applied Electricity	C or better
EGET-175 Applied Electronics	C or better
MATH-111 College Algebra	C or better
PHYS-222 Principals of Physics II	C or better

All efforts are made to monitor student performance *during*, and not merely after, a course in order to be in a position to take corrective action, *i.e.*, to encourage better study habits and learning approaches, when appropriate. Thus, instructors are encouraged to submit midterm grades, which not only apprise a student of his/her performance midway through a course, but also alerts the academic advisor and academic support units of the University when that student is not performing well. The *IPASS* program (see Criterion 1 Section D), in particular, can provide an academic intervention in such a scenario.

Course Prerequisites

The EET curriculum has a fairly rigid prerequisite structure. Thus academic advising, as outlined in Criterion 1 Section D, is especially important. There are, however, instances in which it is in the student's best interest to be allowed to take a course for which the prerequisite requirement has not been met. These are handled on a case by case basis in conjunction with the student, his or her advisor, and the course instructor. If it is decided to allow the student to take the course, the instructor, or in his absence the School of Engineering and technology chair, will override the prerequisite requirement for that student for that course on the LSSU registration system. Furthermore, during the first session of each School of Engineering and Technology course, all students are required to complete a "Prerequisite Compliance" form, and any exceptions are noted on the form.

With the exceptions noted below in Table 1-3, for a course to serve as a prerequisite for another course in the EET curriculum, the student must obtain a passing grade in that course. The exceptional courses are notably taught by departments outside of School of Engineering and Technology, and the prerequisite requirements are established by them.

Table 1-3. Exceptions to General Prerequisite Rule

EET Core Course	Prerequisite Requirement
MATH-111 College Algebra	C or better in MATH-102
MATH-112 Calculus for Business & Life Science	C or better in MATH-111
MATH-131 College Trigonometry	C or better in MATH-111
PHYS-222 Principals of Physics II	C or better in PHYS-221

C. Transfer Students and Transfer Courses

Acceptance of Transfer Students

The admissions criteria outlined in Criterion 1 Section A applies equally to transfer students, except it is the *"or 19 or more earned credits of university coursework"* that applies rather than the *"high school GPA of 2.5 or higher"*.

Acceptance of Transfer Courses

Courses taken elsewhere with grades less than C- are not transferable to LSSU. For courses from accredited institutions with grades of at least C-, the Admissions Office completes transfer credit evaluations to determine whether the course concerned counts is equivalent to any LSSU course. The decision on courses and transfer credit granted may be appealed first to the academic dean and then to the provost.

It is LSSU policy that if a course taken at another institution is not offered at LSSU, elective credit may be granted for that course. Elective credits may be applied toward total credit requirements for a degree (124 credits for the EET program) but may not be used to satisfy any specific course requirement. For purposes of the EET program, there are only 3 credits of free elective to which such credit can be applied.

The engineering and engineering technology courses required in the EET program, or applicable to it as electives, may transfer in if the *content and prerequisites* are similar in the judgment of the coordinator of the department of Electrical and Computer Engineering or the chair of School of Engineering and Technology; in such cases, the student must furnish an official course description from the institution which granted credit.

MACRAO Agreement Between Michigan Colleges and Universities (phasing out)

An agreement regarding the transfer of General Education credit exists between participating Michigan colleges and universities, but is being phased out. This is called the MACRAO transfer agreement. Since LSSU participates fully and without provision in the MACRAO transfer agreement, any transfer student who has completed the General Education requirements at any participating institution automatically meets all General Education requirements at LSSU. The details of this agreement are given below.

A minimum of 30 semester hours of coursework must be taken at one of Michigan's participating community colleges. The courses needed to satisfy the MACRAO requirements are as follows:

English Composition	6 credit hours
Science and Math	8 credit hours Courses must be taken from a minimum of two subject areas. At least one science course must include a laboratory.
Social Science	8 credit hours Courses must be taken from a minimum of two subject areas.
Humanities	8 credit hours Courses must be taken from a minimum of two subject areas.

MTA Agreement Between Michigan Colleges and Universities (now in place)

A new agreement regarding the transfer of General Education credit between participating Michigan colleges and universities has now been initiated. This is called the Michigan Transfer Agreement (MTA)

In order to satisfy the MTA, students must successfully complete at least 30 credits from an approved list of courses at a sending institution with at least a grade of 2.0 in each course. These credits, which will be certified by a sending institution, should be completed according to the following distributions:

One course in English Composition

A second course in English Composition or one course in Communication

One course in Mathematics

Two courses in Social Sciences (from two disciplines)

Two courses in Humanities and Fine Arts (from two disciplines excluding studio and performance classes)

Two courses in Natural Sciences including at least one with laboratory experience (from two disciplines)

Students who complete the MTA and transfer to Lake Superior State University will be considered to have met the general education core requirement (oral and written communication, computational literacy, social science, natural science, and humanities), but not the remainder of the general education requirement (cultural diversity and an oral and written communication elective). Students will still be expected to complete all other general education and degree requirements as required for the completion of their program.

Students who do not complete the entire block of courses required by the MTA will receive credit for the courses they do complete on the basis of individual course evaluation and established transfer equivalencies.

D. Advising and Career Guidance

The purpose of academic advisement is to provide guidance for students to succeed in their academic pursuits. This includes:

a) Advising students on the sequence of courses that should be completed to finish their degree in a timely manner.

b) Providing information on academic support services available on campus such as counseling, preparing résumés and seeking job opportunities.

c) Interpreting LSSU's policies on issues such as dropping courses, taking an "I" grade, transferring courses from other institutions, waiving courses, and substituting courses.

d) Fostering a sense of joint responsibility to lifelong learning.

Academic Advising

All students admitted into the EET program are assigned a faculty advisor who teaches courses in their major. Students are notified of their assigned faculty advisor prior to or during their first semester of residence. The School of Engineering and Technology office maintains an updated advisee list. Students may request a change of academic advisor, but the School of Engineering and Technology chair is responsible for the approval of all advisor changes.

The faculty receives training to allow them to effectively advise their assigned students. Such training includes advising methods, transfer evaluations, degree audits, placement tests, substitution and waiver forms, policies and procedures relevant to student advising, and use of the LSSU academic advising web site, *Anchor Access*, which is based on *Banner*.

A student and his/her faculty advisor meet a minimum of once per semester.

a) The faculty advisor and student review the student's success toward meeting program objectives and review student progress toward the degree. The student's plan-of-study is updated every semester.

b) The faculty advisor and student plan the student's courses for the next semester. The faculty advisor ascertains that the student has completed prerequisites and is in good scholastic standing before scheduling into any new courses.

c) The School of Engineering and Technology chair and dean both approve all course waivers or substitutions.

Career Guidance

LSSU maintains a Career Center that provides extensive support designed to help students decide and meet their career goals. Some of the services provided include:

- periodic "Resume Workshops" and "Career Exploration Workshops" held throughout the academic year.
- yearly job fair held on the LSSU campus
- career testing and counselling
- on-line career tools

University Seminar Courses

LSSU also offers several courses that are designed to help students achieve their academic goals, succeed in pursuing their degrees at the university, and to select appropriate careers. These courses shown in Table 1-4, which do not count toward any academic School of Engineering and Technology degree but may be helpful to certain students, are listed below along with the associated course description that appears in the LSSU catalog. Few, if any, EET students take these courses.

Table 1-4. Seminar Courses for Academic and Career Success

SERV-100 University Success Strategies

Based on assessment of student inventories, students are provided the opportunity to improve their study skills, methods of time management, modes of memorization, note-taking techniques, and university examination preparation. Emphasis is placed on making the transition to university life by focusing on various academic strategies and exposing students to basic information on LSSU programs, policies and procedures. (1,0) 1

SERV-125 Career Planning and Decision Making

Expanding awareness of personal strength and career option, this course will help students make realistic decisions relating to planning and implementation of academic and life. (1,0) 1

USEM-101 Foundations for Success

Seminar I - This course focuses on academic skills and critical thinking, on knowledge of the institution and the role of higher education, and on personal skills for living, which together are requisite for student success and lifelong learning. Seminar I - Foundations for Success places emphasis on incorporation into university culture, time management, use of campus resources, written and oral presentations, development of critical thinking skills, and strengthening study skills for academic success. (1,0) 1

USEM-102 Developing Critical Thinking

Seminar II - Developing Critical Thinking continues the goals of Seminar I while placing emphasis on the application of critical thinking skills to the academic setting. A reading anthology is used as the basis for regular written, and oral communication and a term research paper. While continuing to apply skills and techniques used in Seminar I, students additionally develop cultural literacy and incorporate greater computer usage, and explore campus organizations, community events and community service. (1,0) 1

USEM-103 Thinking about the Discipline

Seminar III - Thinking about the Discipline begins a more focused examination of the applications of critical thinking to the student's discipline. Each school selects a reading anthology suitable for analysis and discussion by its majors in order to examine such as current critical issues, social responsibility, ethics and cultural diversity from the perspective of the student's discipline. Continuing the activities of earlier seminars this course promotes ongoing participation in community events, application of academic success in skills and writing in the discipline. (1,0) 1

USEM-104 Professional Seminar

Seminar IV - Professional Seminar serves as the fourth and final in the series and focuses on introducing the student to their discipline with special emphasis on interviews with professional, examinations of career options, and overviews of the literature and research of their discipline. This course focuses attention on the skills and knowledge base of the profession, features of the work environment, development of resume and career developing activities. (1,0) 1

E. Work in Lieu of Courses

Besides regular course work, three types of experiences, Dual Enrollment, Departmental Examination, Advanced Placement, and College Level Examination Program, may count toward a degree in any LSSU program, including the Electrical Engineering program.

Dual Enrollment

High school juniors and seniors may take classes at Lake Superior State University through our High School Dual Enrollment program. These courses may count toward the EET program either as a core class (typically MATH-111 College Algebra or MATH-131 College Trigonometry) or as a General Education course. Attendance as a High School Dual Enrollee does not constitute admission into any four-year degree program at the University.

Only students who have received endorsements in Mathematics, Science, Reading, and Writing are eligible to take courses in those areas. All students are eligible to take courses in other areas. Grade point average is not a determining factor in eligibility to enroll.

Departmental Examination

A policy exists for students to "test out" of a course by taking a Departmental Examination. The department is free to administer its own examination for any course that it offers. The student must have the written approval of the School of Engineering and Technology chair to take the examination. The student must receive a grade of C or better on the examination in order to receive credit for the course, in which case the credit earned by exam is recorded as transfer credit on the student's transcript.

Although the policy for Departmental Exams exists, there has not been a single instance of its usage for an EET program core or elective course in the past six years.

Advanced Placement (AP)

Course credit is awarded to students who receive a score of 3-5 on any Advanced Placement exam listed in Table 1-5 below. The student will receive credit for the specified courses on the chart after being granted unconditional admission to Lake Superior State University. Note that Table 4 is not a complete list and only includes those courses which may count toward credit in the Electrical Engineering program.

Table 1-5: AP Courses for EET Program

Advanced Placement Exam	LSSU Course Equivalent	Type of Course in EET Curriculum
American Govern & Politics	POLI-110	General Education – Social Science
Art – History of Art	ARTS -250, ARTS-251	General Education – Humanities
Calculus AB	MATH-151	Electrical Engineering Core
Calculus BC	MATH-151, MATH-152	Electrical Engineering Core
Chemistry - Score of 3	CHEM-108-109	EET Core
Computer Science A	CSCI-319	EET Tech Elective
Computer Science AB	CSCI-121, CSCI-201	EET Core and Tech Elective
English – Language & Composition	ENGL-110, ENGL-111	General Education – Communications
English – Literature & Composition	ENGL-110, ENGL-111	General Education – Communications
European History	HIST-102	General Education – Social Science
French Literature	FREN-355, FREN-356	General Education – Humanities
French Language	FREN-351, FREN-352	General Education – Humanities
German Language	GRMN-241, GERM-242	General Education – Humanities
Human Geography	GEOG-201	General Education – Social Science
Macroeconomics	ECON-201	General Education – Social Science
Microeconomics	ECON-202	General Education – Social Science
Music – Listening & Literature	MUSC-220	General Education – Humanities
Physics C: Mechanics	PHYS-221	EET Core
Physics C: Electricity and Magnetism	PHYS-222	EET Core
Physics C	PHYS-221, PHYS-222	EET Core
Psychology	PSYC-101	General Education – Social Science
Spanish Language	SPAN-261, SPAN-262	General Education – Humanities
Spanish Literature	SPAN-380, SPAN-381	General Education – Humanities
United States Govern & Politics	POLI-110	General Education – Social Science
United States History	HIST-131, HIST-132	General Education – Social Science
World History	HIST-101, HIST-102	General Education – Social Science

College Level Examination Program (CLEP)

Course credit is also awarded to students who receive a passing score on any College Level Examination Program (CLEP) subject exam listed in Table 1-6 below. The student will receive credit for the specified courses on the chart after being granted unconditional admission to Lake Superior State University. Note that Table 5 is not a complete list and only includes those courses which may count toward credit in the EET program.

Table 1-6: CLEP Courses for EET Program

CLEP Exam – Passing Score	LSSU Course Equivalent	Type of Course in EET Curriculum
American Government – 50	POLI-110	General Education – Social Science
American Literature – 50	ENGL-110, ENGL-111	General Education – Communications
Calculus – 50	MATH-112	EET Core
College Composition – 50	ENGL-110	General Education – Communications
English Literature – 50	ENGL-110, ENGL-111	General Education – Communications
French Language – 58	FREN-251	General Education – Humanities
French Language – 66	FREN-251, FREN-252	General Education – Humanities
History of the US I – 50	HIST-131	General Education – Social Science
History of the US II – 50	HIST-132	General Education – Social Science
Introductory Psychology – 50	PSYC-101	General Education – Social Science
Introductory Sociology – 50	SOCY-101	General Education – Social Science
Principals of Macroeconomics	ECON-201	General Education – Social Science
Principals of Microeconomics	ECON-202	General Education – Social Science
Spanish Language – 58	SPAN-261	General Education – Humanities
Spanish Language – 66	SPAN-261, SPAN-262	General Education – Humanities
Western Civilization I – 50	HIST-101	General Education – Social Science
Western Civilization II – 50	HIST-102	General Education – Social Science

F. Graduation Requirements

The name of the degree awarded through successful completion of the EET program is Bachelor of Science in Electrical Engineering Technology.

Two semesters before the student plans to complete degree requirements and graduate, he/she submits a *Degree Audit* form and a *Declaration of Candidacy for Degree* form to the registrar's office. The *Degree Audit* denotes all previous coursework and lists the courses to be taken during the final two semesters. The faculty advisor, program coordinator, and school chair must approve the *Degree Audit*. The registrar determines the University requirements remaining for graduation, and the student is informed in writing of the remaining requirements. Any degree requirements not denoted on the *Degree Audit* are immediately brought to the attention of the school chair, program coordinator, and faculty advisor.

The *Degree Audit*, which is shown in the Criterion 5 Section A, contains all the requirements for the B.S. EET degree. Those requirements are summarized in Table 1-7 below.

Table 1-7: Summary of Requirements for the B.S. EET Degree

Course Requirements	
General Education	21 credits
EET Core	82 credits
EET Technical Electives	12 credits
EET Capstone	6 credits
Free Electives	3 credits
	124 credits
Other Requirements	
General Education GPA	2.0
EET GPA	2.0
Overall GPA	2.0
Minimum Credits at LSSU	32 credits
Minimum 300/400 Credits at LSSU	22 credits

Recently, an automated process using the web based Banner system has been initiated to handle the *Degree Audits*. This process ensures that all requirements have been met. The chair and dean of School of Engineering and Technology have the ability to waive requirements and substitute courses.

G. Transcripts of Recent Graduates

There have been 4 graduates of the EET program since its inception five years ago. A list of these students is shown in Table 1-8 below. We are prepared to provide transcripts for all of these students.

Table 1-8: Recent Graduates from the EET Program

Student	LSSU ID	Graduation	Minor
[redacted]	[redacted]	May 2014	Robotics Technology
[redacted]	[redacted]	May 2015	none
[redacted]	[redacted]	May 2015	Robotics Technology
[redacted]	[redacted]	Dec 2015	Robotics Technology

CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

A. Mission Statement

The University-level mission statement reads:

> *University Mission Statement*
>
> *Our mission at Lake Superior State University is to help students develop their full potential. We launch students on paths to rewarding careers and productive, satisfying lives. We serve the regional, state, national and global communities by contributing to the growth, dissemination and application of knowledge.*

This mission statement is published in the LSSU Catalog and on the University's web-site at the URL <www.lssu.edu/president/mission.php>, and the University catalog (now wholly on-line) links to it.

The School of Engineering and Technology has maintained a Mission Statement since 1996, when the School was formed. The School has reviewed and modified the Mission Statement periodically – most recently in February 2014. The Mission of the School of Engineering and Technology is:

> *SET Mission Statement*
>
> *To produce sought-after engineers and technologists by providing a rigorous undergraduate learning experience characterized by close student-faculty interaction*

This mission is published on the Engineering & Technology School web page at <www.lssu.edu/eng/mission.php>.

It is apparent by comparing the two mission statements that the mission of the School is supportive of that of the University as a whole, and does not conflict in any fashion. LSSU's statement calls for us to "help students develop their full potential", and the School of Engineering & Technology indicates *how* we accomplish that, *i.e.*, by "providing a rigorous undergraduate learning experience characterized by close student-faculty interaction".

The School's mission is, moreover, further elaborated by a set of appended School goals (also periodically revised, most recently in February 2014), as follows:

SET Goals

A. Deliver an undergraduate education that is current and provides knowledge and skills to be successful in professional careers or graduate school.

B. Provide programs that focus on the applications of fundamental principles of engineering, technology, mathematics, science, and computing to benefit society.

C. Provide courses which incorporate and develop skills in communication, design, ethics, teamwork, technology, and capstone experiences relevant to the students' degrees.

D. Provide an education and opportunities for students with diverse abilities to enhance their professional growth and capacity for life-long learning.

E. Engage in continuous improvement activities through ongoing external and internal reviews.

F. Enable faculty, staff, and students to apply engineering solutions that support regional economic growth and develop intellectual property.

G. Maintain the School's viability, productivity, and effectiveness by supporting enrollment, retention, and placement initiatives.

H. Provide a supportive environment in which faculty, staff, and students are recognized as essential in the realization of the mission.

These goals elaborate and clarify the mission, providing a more detailed roadmap to accomplishing it, and then serve as a link between the School's Mission Statement and the Program Educational Objectives (PEOs) to be discussed in the following.

B. Program Educational Objectives

The School of Engineering and Technology, in accordance with its mission and goals, has the task to educate and prepare its students for successful professional careers in engineering and engineering technology. To provide statements defining what accomplishment of this task entails, for Engineering Technology in particular, the faculty has developed three Program Educational Objectives (PEOs). These are statements of what we might expect our alumni serving as practicing Engineering Technologists to have typically accomplished, or be active with, after three years of professional experience. The PEOs are applicable either to working graduates or to graduates pursuing advanced degrees. They are common to both the Electrical Engineering Technology (EET) program and the Manufacturing Engineering Technology (MfgET) program.

The PEOs are based on the needs of our graduates, as well as those of employers of our graduates. Ongoing evaluation by the faculty and input from our Industrial Advisory Board (IAB), graduates, and employers guide the continued improvement of these objectives.

They were most recently revised in March 2014, are published at the School website at URL www.lssu.edu/eng/mission.php, and read as follows:

EET Program Educational Objectives

Graduates of the Electrical Engineering Technology and Manufacturing Engineering Technology programs having three or more years of experience:

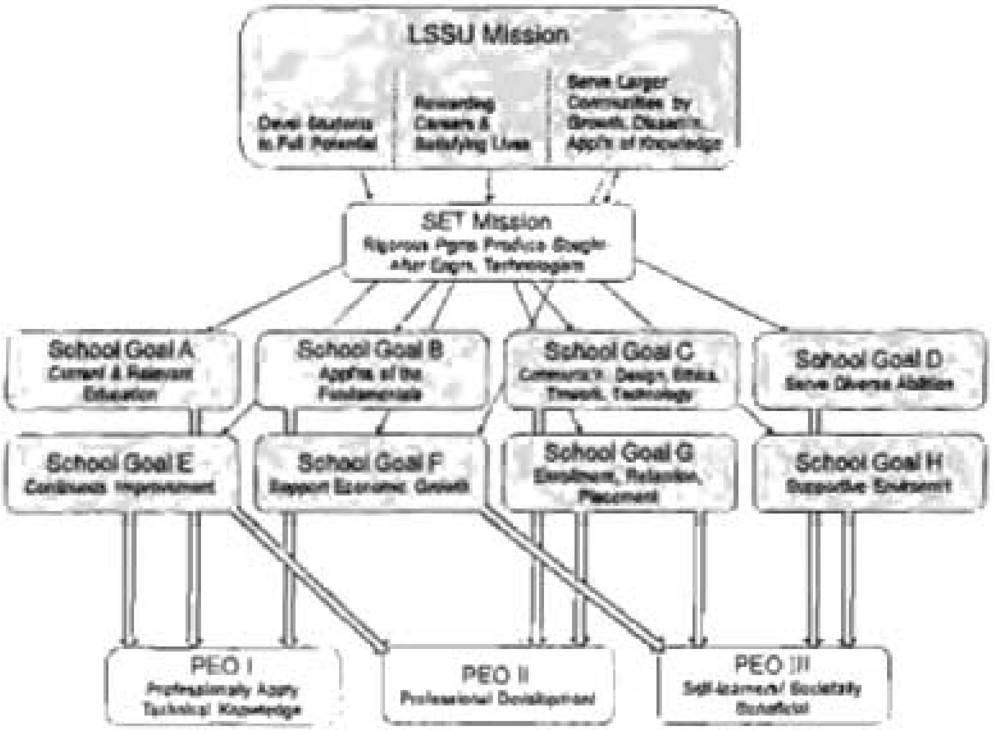
I. will have demonstrated professional application of technical skills and engineering judgment to solve problems in their profession subject to technical, practical and societal constraints.

II. will have set professional goals, experienced professional growth, and be engaged in ongoing professional development and learning activities.

III. will be capable self-learners and make meaningful contributions to society

C. Consistency of Program Educational Objectives with the Mission of the Institution

The critical focus of the EET program is to afford undergraduates of varying backgrounds and abilities every opportunity for achieving success in the EET profession. Specific emphasis in the EET program is given to professional and industrial related engineering technology practice. The relations between the Program Educational Objectives and the School Goals (and thence to the School and University missions) are depicted in Figure 2-1 below.



The School goals link the PEOs to the mission statement for the School, and thereby to that of LSSU. The Program Educational Objectives most directly correspond to the first four School Goals (A through D) which explicitly address knowledge, skills (both "soft skills" and technical skills) and abilities imparted by the academic programs, and the idea that these are imparted to all of our students, whatever their initial abilities. Clearly, the more the program is successful in imparting these attributes to this wide audience, the more propitious for alumni to ultimately accomplish the kinds of things, and possess the kinds of characteristics, called for by the PEOs.

The last four School Goals (E through H) are more indirectly related to the Program Educational Objectives, since they instead focus on faculty and institutional activities, rather than the delivery of the EET or other programs. Nevertheless, although indirect, they are quite relevant. Indeed, goal E relates to the assessment process whereby feedback is obtained that redirects some of the ways in which the program is constructed and delivered. Goal F relates to the School's economic development activities, which contribute to a stimulating environment in which the program is delivered. Goal G, specifically its aspect of support for placement, can be seen as promoting the opportunities alumni need to practice, i.e., a precondition for meeting the PEOs. And Goal H, finally, is explicitly about the quality of the environment in which the program is delivered, the good delivery of which is presumably, again, a precondition for the attainment of the PEOs.

D. Program Constituencies

The School of Engineering & Technology recognizes as its principal constituents, all of the following:

- Current Students
- Alumni
- Faculty
- Employers of graduates
- Industrial Advisory Board (IAB)

This is not an exhaustive list that precludes other, perhaps more situational, interest groups; for instance, the economic development roles of the College, which the School supports through goal F, would suggest including entrepreneurial and industrial customers of the Product Development Center, and even the wider population of the Eastern Upper Peninsula – Northern Lower Peninsula region, which can be regarded as a beneficiary of the economic growth objectives of the School. It would also include, situationally, senior project sponsors. Nevertheless, given the primary mission of the School to focus on offering quality academic programs, the list does identify those listed above as primary constituents.

The Industrial Advisory Board (IAB), in particular, was formed in 1985 and currently consists of approximately 30 members. IAB members possess a variety of professional experiences in the engineering and technology fields. The Board meets twice per year, once at a member company site, and once on campus for program review and critique.

E. Process for Review of the Program Educational Objectives

It is evident that PEOs represent a goal for the product of a slow process, *i.e.*, an engineering technology professional developed first by a 4-year curriculum and then further by the first few years of a professional career. Hence, it is not desirable to make rapid or frequent changes to how the PEOs are defined. The PEOs are best seen as the foundation of a long-term plan for which stability is desirable. Renewing and/or changing them is accordingly fairly deliberative; they are reviewed by the faculty on a 3-year cycle, at which time decisions to renew, update, or establish new PEOs are undertaken. These decisions take account of feedback obtained, by various channels, from the constituencies listed in section D above, as described in the following.

The IAB, in particular, is solicited for PEO-specific feedback on the occasion of one of its biannual meetings, no less frequently than once every three years. This is documented in the minutes of that group and surely represents the most focused, PEO-specific form of external feedback that is obtained.

Alumni and their employers have a voice, partially through the IAB (as many or most of the IAB members are either employers of engineering technology graduates, engineering technology alumni, or both), but otherwise by feedback they may provide on other occasions when not systematically solicited. It should also be noted that the faculty has significant interaction with senior project sponsors, and sometimes with industrial clients of the Prototype Development Center, who again are frequently alumni and employers. These groups include additional alumni/employers who are not IAB members, or not active, so that yet another communication channel for the alumni and employer constituencies is thereby provided. In some instances, their perspectives have shaped our outlook on the PEOs.

Students have a voice through individual course feedback questionnaires and, finally, through graduate exit interviews. In neither case are the questions directed specifically at the PEOs, as recent graduates are not in a good position to accurately predict what kinds of professional attainment they might have reached after a few years, but the information provided on what they value in their programs, and especially anything about their career or professional aspirations, is nevertheless ultimately linked to the relevance of the PEOs.

The faculty of the School, by majority vote, have complete discretion over the PEOs.

Evidence, related to PEOs, to be available for review by the ETAC of ABET team is shown below:

- Industrial Advisory Board Minutes
- School Meeting Agendas and Minutes
- Fundamentals of Engineering Exam Results

CRITERION 3. STUDENT OUTCOMES

A. Process for Establishing and Revising Student Outcomes

The initial student outcomes for the EET program were determined by the School of Engineering and Technology faculty based on advice given by the ABET-EAC site visitation team in Fall 2012 and with the approval of the School of Engineering and Technology Industrial Advisory Board (IAB). The student outcomes may be revised by the School of Engineering and Technology faculty with advice from the IAB. The IAB meets twice every year, once in April and once in November, and provides advice to the School of Engineering and Technology faculty at both meetings. The student outcomes, just as the program educational objectives, will be reviewed by the IAB every three years.

B. Student Outcomes

The EET student outcomes are simply the ABET-ETAC student outcomes (a)-(k).

(a) an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities

(b) an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies

(c) an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes

(d) an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives

(e) an ability to function effectively as a member or leader on a technical team

(f) an ability to identify, analyze, and solve broadly-defined engineering technology problems

(g) an ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature

(h) an understanding of the need for and an ability to engage in self-directed continuing professional development

(i) an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity

(j) a knowledge of the impact of engineering technology solutions in a societal and global context

(k) a commitment to quality, timeliness, and continuous improvement

The EET student outcomes are documented, along with School mission statement, School goals, and EET program educational objectives, on the LSSU web site at the following URL:

< http://www.lssu.edu/eng/mission.php>

C. Mapping of Student Outcomes to Program Criteria Outcomes

The eleven EET student outcomes (a-k) are related to the program criteria outcomes (a-e) as described in Table 3-1.

Table 3-1: Mapping of Program Criteria Outcomes to Student Outcomes

Program Criteria Outcome *Graduates must demonstrate knowledge and hands-on competence appropriate to the objectives of the program in:*	a	b	c	d	e	f	g	h	i	j	k
(a) *the application of circuit analysis and design, computer programming, associated software, analog and digital electronics, and microcomputers, and engineering standards to the building, testing, operation, and maintenance of electrical/electronic(s) systems*	x		x	x		x					
(b) *the application of natural sciences and mathematics at or above the level of algebra and trigonometry to the building, testing, operation, and maintenance of electrical/electronic(s) systems*		x									
(c) *the ability to analyze, design, and implement one or more of the following: control systems, instrumentation systems, communication systems, computer systems, or power systems*	x	x		x							
(d) *the ability to apply project management techniques to electrical/electronic(s)systems*					x						
(e) *the ability to utilize differential and integral calculus, as a minimum, to characterize the performance of electrical/electronic(s) systems*		x									

D. Relationship of Student Outcomes to Program Educational Objectives

The eleven EET student outcomes (a-k) prepare student to attain the three EET program educational objectives (I, II, and III) through the course work as outlined in Criterion 5 Section A. A mapping of the student outcomes to each program educational objective is found in Tables 3-2, 3-3, and 3-4 below.

Program Educational Objective I

Graduates of the Electrical Engineering Technology program having three or more years of experience will have demonstrated professional application of technical skills and engineering judgment to solve problems in their profession subject to technical, practical and societal constraints.

Table 3-2: Mapping of Student Outcomes to Program Educational Objective I

Student Outcome	Level of Support
(a) ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities.	high
(b) ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies.	high
(c) ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.	high
(d) ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives.	high
(e) ability to function effectively as a member or leader on a technical team.	n/a
(f) ability to identify, analyze, and solve broadly-defined engineering technology problems.	high
(g) ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature.	moderate
(h) understanding of the need for and an ability to engage in self-directed continuing professional development.	n/a
(i) understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity.	n/a
(j) knowledge of the impact of engineering technology solutions in a societal and global context.	high
(k) commitment to quality, timeliness, and continuous improvement.	moderate

Program Educational Objective II

Graduates of the Electrical Engineering Technology program having three or more years of experience will have set professional goals, experienced professional growth, and be engaged in ongoing professional development and learning activities.

Table 3-3: Mapping of Student Outcomes to Program Educational Objective II

Student Outcome	Level of Support
(a) ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities.	n/a
(b) ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies.	n/a
(c) ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.	moderate
(d) ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives.	n/a
(e) ability to function effectively as a member or leader on a technical team.	high
(f) ability to identify, analyze, and solve broadly-defined engineering technology problems.	moderate
(g) ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature.	high
(h) understanding of the need for and an ability to engage in self-directed continuing professional development.	high
(i) understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity.	high
(j) knowledge of the impact of engineering technology solutions in a societal and global context.	high
(k) commitment to quality, timeliness, and continuous improvement.	high

Program Educational Objective III

Graduates of the Electrical Engineering Technology program having three or more years of experience will be capable self-learners and make meaningful contributions to society.

Table 3-4: Mapping of Student Outcomes to Program Educational Objective III

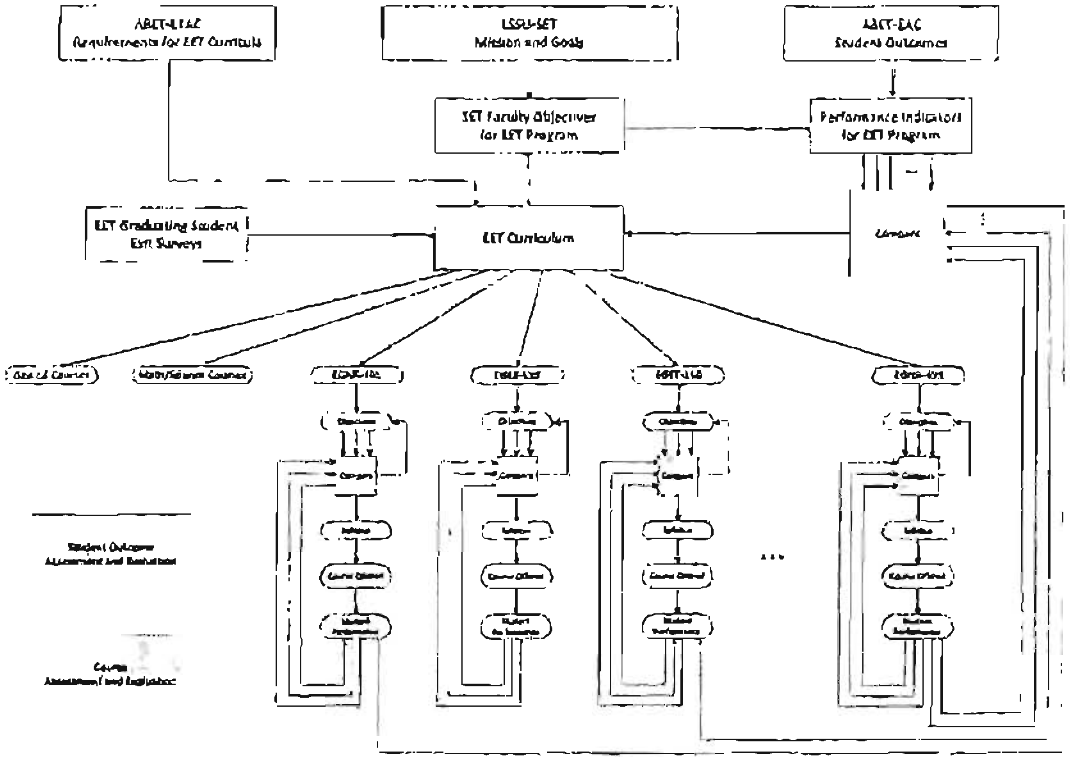
Student Outcome	Level of Support
(a) ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities.	moderate
(b) ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies.	moderate
(c) ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes.	moderate
(d) ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives.	n/a
(e) ability to function effectively as a member or leader on a technical team.	moderate
(f) ability to identify, analyze, and solve broadly-defined engineering technology problems.	moderate
(g) ability to apply written, oral, and graphical communication in both technical and non-technical environments, and an ability to identify and use appropriate technical literature.	high
(h) understanding of the need for and an ability to engage in self-directed continuing professional development.	high
(i) understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity	high
(j) knowledge of the impact of engineering technology solutions in a societal and global context.	moderate
(k) commitment to quality, timeliness, and continuous improvement.	high

CRITERION 4. CONTINUOUS IMPROVEMENT

A. Process for Continuous Improvement

The process for continuous improvement of the EET program is a combination of student outcome assessment and course assessment. This is pictured in the Figure 4-1 below. The inputs are the ABET-ETAC student outcomes (a-k) for all engineering technology programs, the ABET-ETAC requirements for EET curricula, and the mission and goals of the School of Engineering and Technology (SET). The data are student performance and student self-evaluation.

Figure 4-1: EET Program Assessment Process

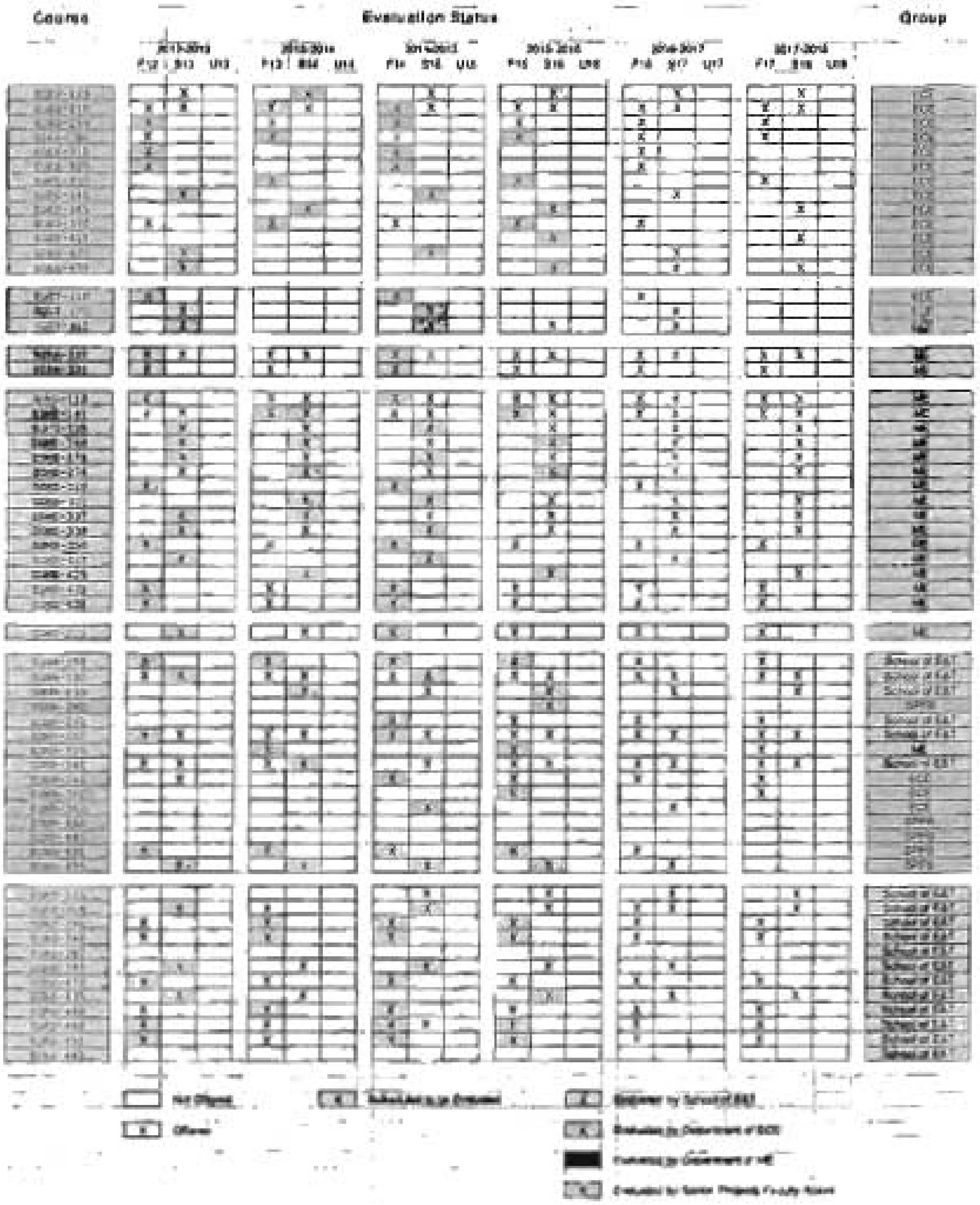


All decisions are made by the School of Engineering and Technology faculty with advice from the Industrial Advisory Board (IAB) on larger issues. Ultimately, the EET program is improved by small changes to courses (course layout, syllabi, grading structure, extent of coverage, *etc.*), changes to content in courses (alteration of objectives, topical content, *etc.*), and large curricular changes (course deletion, course addition, shifting material from one course to another, adding new material to the curriculum, *etc.*). The smaller changes tend to be made at the time of course evaluation while the more significant changes tend to be made at the time of program evaluation.

B. Continuous Improvement of Courses (Course Evaluation)

Each course that is taught within School of Engineering and Technology is assessed every offering and evaluated at least once every two years. The schedule for course evaluation is shown below in Table 4-1. This schedule includes all courses offered by the School of Engineering and Technology, not just those that are in the EET curriculum. It is intended to illustrate the pattern of course offerings and subsequent evaluation.

Table 4-1: Course Evaluation Schedule



At the completion of every offering, the course is assessed by the instructor and results in a course assessment summary report. The reports from the most recent offerings may be found in Appendix F *Course Assessment Summary Reports*. In addition to other items, the reports include an analysis of students attainment of the course objectives, a brief analysis of the efficacy of the most recent course improvements, improvements planned for the next offering, and, if applicable, an analysis of any student outcome performance indicators that are tied to the course.

Each course is evaluated by the appropriate constituency. The Department of Electrical and Computer Engineering evaluates the courses that appear solely in the CE, EE, and/or EET cores. All other "cross-disciplinary" courses that are also contained in the ME and/or MfgET cores are evaluated by the School of Engineering and Technology as a whole.

C. Continuous Improvement of EET Program (Student Outcome Evaluation)

For each student outcome (a-k) of the EET program, one, two, or three performance indicators have been established by the Department of Electrical and Computer Engineering. Each performance indicator is an activity in one of the core courses in the EET curriculum. Student attainment of the performance indicator is evaluated by the instructor and, in some cases, another knowledgeable faculty member. Additionally, graduates of EET program are surveyed regarding their attainment of each student outcome at the end of their final semester. Upon completion of the survey, each graduate receives an exit interview with the General Engineering and Technology coordinator. In order to evaluate attainment of EET student outcomes, and hence the efficacy of the EET program, the performance indicators and the student survey results are to be reviewed on a two-year cycle.

Establishment of Performance Indicators

For each course in the core of the EET curriculum, the faculty of the School of Engineering and Technology has determined the extent of coverage and expected level of attainment of each student outcome. This information, which is shown in Criterion 5 Section A, was essential to selecting the performance indicators used to assess and evaluate the EET program.

Because of the relatively small number of engineering technology (EET and MfgET) students, some of the performance indicators include activities that include students from both programs. The performance indicators for the EET program were established by the Department of Electrical and Computer Engineering if they solely involved EET students and by the School of Engineering and Technology if they involved both EET and MfgET students.

The performance indicators for the EET program are shown below. For the sake of completeness and clarity, each student outcome is stated; then, for each student outcome, the associated performance indicators are listed. First the definition of the performance indicator is given then the sample of student work to be evaluated in light of that definition is given.

Student Outcome (a)

an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities

Performance Indicator (a1)

the ability to use an industrial robot to automate a manufacturing process

EGRS-381 – project report and robot code on setting-up a Staubli robot for automating an advanced palletization task or a machine tending task using VAL3 programming and I/O communications

Performance Indicator (a2)

the ability to use surface mount technology equipment to automate placement of electronic components on a printed circuit board

EGET-310 – final exam question on identifying column and row information for the starting point fiducial mark of each board in a multi-board panel

Student Outcome (b)

an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies

Performance Indicator (b1)

the ability to apply calculus of several variables

EGNR-245 – project on derivation of the formula for the least-squares line

Performance Indicator (b2)

apply knowledge of energy levels to determine whether materials are insulator, semiconductor or conductor

EGET-310 – exam question on material identification based on energy level diagram and placement of Fermi level

Student Outcome (c)

an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes

Performance Indicator (c1)

the ability to develop a valid and reliable experimental procedure that will validate a product

EGNR-495 – design review on final product testing

Performance Indicator (c2)

the ability to use statistical methods to plan an efficient, yet effective, program of experimentation, when the output variable studied is expected to depend on multiple input variables

EGNR-310 – term project technical report

Student Outcome (d)

an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives

Performance Indicator (d1)

the ability to reformulate implied customer needs as specifications and produce an acceptable design solution

EGNR-491 – product design review

Performance Indicator (d2)

the ability to design library objects linking the symbolic schematic representation to physical package and contact locations for creation of circuit board artwork

EGET-310 – lab exercise on obtaining data sheet from web search

Student Outcome (e)

an ability to function effectively as a member or leader on a technical team

Performance Indicator (e1)

the ability to provide constructive criticism of team members

EGNR-495 – peer evaluations

Student Outcome (f)

an ability to identify, analyze, and solve broadly-defined engineering technology problems

Performance Indicator (f1)

the ability to identify possible reasons that a product or process may fail to function well, and categorize these

EGNR-310 – homework on fishbone chart exercise

Performance Indicator (f2)

the ability to design an analog amplifier that maximizes the resolution of a sensor output for an embedded system

EGEE-355 – exam 1, hardware design problem

Student Outcome (g)

an ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature

Performance Indicator (g1)

the ability to make formal engineering presentations

EGNR-495 – final project presentations

Performance Indicator (g2)

ability to research and use technical specification sheets to implement a useful design element

EGET-310 – final project

Student Outcome (h)

an understanding of the need for and an ability to engage in self-directed continuing professional development

Performance Indicator (h1)

the ability to define and clarify customer needs through technical investigation

EGNR-495 – FA evaluation of each team member at end of semester

Student Outcome (i)

an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity

Performance Indicator (i1)

the ability to apply perspectives from established ethical philosophies in the analysis of a case study

EGNR-495 – ethics essay

Student Outcome (j)

a knowledge of the impact of engineering technology solutions in a societal and global context

Performance Indicator (j1)

the ability to recognize the impact of engineering technology solutions in a societal and global context

EGET-310 – final exam question on environmental impact of engineering practices

Student Outcome (k)

a commitment to quality, timeliness, and continuous improvement

Performance Indicator (k1)

the ability to analyze, by methods of statistical process control, data representing output of a continuously monitored manufacturing process, in order to make early detection of any drift away from the target values of the output

EGNR-310 – homework 5, control charts (statistical process control)

Evaluation of Performance Indicators

Each performance indicator tied to a specific assignment in a specific course. Each student's performance on that assignment is evaluated solely for the capability denoted by the performance indicator. Each sample of student work receives a score of 1, 2, 3, or 4 depending on how well the student meets the expected capability defined by the performance indicator. The meaning of the score is listed in Table 4-2 below. The evaluation is performed either by the instructor or instructors responsible for teaching the course or by them and an additional expert in the area.

Table 4-2: Scoring of Student Work for Performance Indicators

Score	Meaning
1	Unacceptable
2	Below Standard
3	Meets Standard
4	Exemplary

The performance indicators will be continually evaluated in that every time a course containing the associated student work is offered, that work will be evaluated. The results of the evaluation are reported in the course assessment summary that is written at the conclusion of each course. These can be found in Appendix G *Course Assessment*

Summary Reports. Additionally, the actual student work that has been evaluated will be made available in binders at the time of the site visit.

The schedule for the courses associated with all EET student outcomes (*i.e.* each performance indicator) is shown below in Table 4-3. Since some of the courses are offered on an alternating year basis, the schedule for the past two years is indicated. Note that since this schedule was only initiated recently, some student work was not evaluated in the first year. However, in the future all student work associated with all performance indicators will be evaluated in the future.

Table 4-3: Student Work Samples for EET Student Outcome Assessment (Two Year Cycle)

Fall 2014

Class	Instructor	Assignment	Student Outcome	Status
~~EGNR-310~~	~~RH~~	~~term project technical report~~	~~c(EET,MfgET)~~	course not offered
~~EGNR-310~~	~~RH~~	~~homework on fishbone chart exercise~~	~~f(EET,MfgET)~~	course not offered
~~EGNR-310~~	~~RH~~	~~homework 5, control charts (statistical process control)~~	~~k(EET,MfgET)~~	course not offered
EGNR-491	SPFB(DB)	product design review	d(EET,MfgET)	not evaluated
EGRS-381	JD	project report and robot code on setting-up a Staubli robot	a(EET,MfgET)	not evaluated

Spring 2015

Class	Instructor	Assignment	Student Outcome	Status
~~EGEE-355~~	~~AJ~~	~~exam 1, hardware design problem~~	~~i(EET)~~	course not offered
EGET-310	EB	final exam question on identifying column and row information	a(EET)	not evaluated
EGET-310	EB	exam question on material identification	b(EET)	not evaluated
EGET-310	EB	lab exercise on obtaining data sheet from web search	d(EET)	not evaluated
EGET-310	EB	final project	g(EET)	not evaluated
EGET-310	EB	final exam question on impact of engineering practices	j(EET)	not evaluated
EGNR-245	DM	project on derivation of the formula for the least-squares line	b(EET,MfgET)	not evaluated
EGNR-495	SPFB(DB)	design review on final product testing	c(EET,MfgET)	not evaluated
EGNR-495	SPFB(DB)	peer evaluations	e(EET,MfgET)	not evaluated
EGNR-495	SPFB(DB)	final project presentations	g(EET,MfgET)	evaluated / in binders
EGNR-495	SPFB(DB)	FA evaluation of each team member	h(EET,MfgET)	not evaluated
EGNR-495	SPFB(DB)	ethics essay	i(EET,MfgET)	not evaluated

Fall 2015

Class	Instructor	Assignment	Student Outcome	Status
EGNR-310	RH	term project technical report	c(EET,MfgET)	evaluated / in binders
EGNR-310	RH	homework on fishbone chart exercise	f(EET,MfgET)	evaluated / in binders
EGNR-310	RH	homework 5, control charts (statistical process control)	k(EET,MfgET)	evaluated / in binders
EGNR-491	SPFB(PW)	product design review	d(EET,MfgET)	evaluated / in binders
EGRS-381	JD	project report & VAL3 robot code for setting-up automation process	a(EET,MfgET)	evaluated / in binders

Spring 2016

Class	Instructor	Assignment	Student Outcome	Status
EGEE-355	AJ	exam 1, hardware design problem	i(EET)	evaluated / in binder
EGET-310	EB	final exam question on identifying column and row information	a(EET)	evaluated / in binder
EGET-310	EB	exam question on material identification	b(EET)	evaluated / in binder
EGET-310	EB	lab exercise on obtaining data sheet from web search	d(EET)	evaluated / in binder
EGET-310	EB	final project	g(EET)	evaluated / in binder
EGET-310	EB	final exam question on impact of engineering practices	j(EET)	evaluated / in binder
EGNR-245	DM	project on derivation of the formula for the least-squares line	b(EET,MfgET)	evaluated / in binders
EGNR-495	SPFB(PW)	design review on final product testing	c(EET,MfgET)	evaluated / in binders
EGNR-495	SPFB(PW)	peer evaluations	e(EET,MfgET)	evaluated / in binders
EGNR-495	SPFB(PW)	final project presentations	g(EET,MfgET)	evaluated / in binders
EGNR-495	SPFB(PW)	FA evaluation of each team member	h(EET,MfgET)	evaluated / in binders
EGNR-495	SPFB(PW)	ethics essay	i(EET,MfgET)	evaluated / in binders

Evaluation of Student Outcomes (Program Evaluation)

Once every two years the Department of Electrical and Computer Engineering will evaluate each EET student outcome by considering the results of all performance indicators tied to that outcome and the results of the senior exit surveys over the previous two years. The first such series of meetings were held in May 2016.

Plans for improvement to the EET program will be made as a result of the student outcome evaluation. Details of the most student outcome evaluation can be found in the EET Student Outcome Evaluation report found in Appendix H *Student Outcome Evaluation Reports*. A summary of the most recent action plans, which were determined in May 2016, are shown below in Table 4.4.

Table 4-4: Summary of EET Student Outcome Evaluation Results

1. We should consider adding a 100-level course in basic wiring, troubleshooting, laboratory safety, wiring schematics, basic components, codes and standards, etc.

2. We should consider adding a 300-level course that extends the concepts learned in EGET-110-175 and reinforces calculus.

3. We may need to beef up the content of EGET-110-175. (This become apparent as a result of evaluating (f))

4. Compared to MTU, Wayne State, and Ferris, our EET curriculum goes deeper into robotics and, perhaps, digital electronics, but lacks the breadth, especially in analog electronics.

5. Perhaps develop a common simple handout that would be distributed in courses across the curriculum, for example on the topic of "troubleshooting" or "problem decomposition"?

6. We hope to reduce the time students spend in open-ended projects (e.g. EGRS-365) so they will have adequate time to spend on their other classes.

7. We may need to bolster instrumentation within the curriculum. EET graduates need to understand how to identify, utilize, and synthesize multiple types of equipment, including automated data acquisition. (This came about as a result of evaluating outcomes (a) and (c).)

8. We may need to add more troubleshooting to the curriculum. EET graduates need the ability to reduce a larger problem into smaller ones and the ability to determine how to demonstrate how a system is functioning properly. They also need to experience more open-ended labs. (This came about as a result of evaluating outcomes (a) and (f).)

9. We may need to increase expectations in presenting and correctly interpreting data in all pertinent courses. For example, the EET students need to thoroughly label and describe results and to communicate the aspect of the results that are needed by the audience. (This came about as a result of evaluating outcome (k).)

10. Seek ABET advice during the Fall 2016 site visit.

CRITERION 5. CURRICULUM

A. Program Curriculum

The EET curriculum at LSSU is designed both, firstly, to cover the subject matters called for in ETAC criterion 5 and the EET program criteria, and, secondly, to provide the necessary technical background, as well as experiences developing engineering judgment and the professional attributes ("soft skills" and self-learning habits), that lay the groundwork for graduating students to attain the student outcomes, and for alumni to be capable of meeting the PEOs by a few years into their careers.

The following will first detail the courses comprising that curriculum, and then address its relation to the aforementioned PEOs, student outcomes, and curricular and program criteria, student outcomes.

Plan-of-Study

Table 5-1, below, depicts the curriculum for students for students in the EET program, current as of the Fall 2016 semester; this would only vary in small details for any other previous. The table constitutes a listing of the courses comprising the curriculum, indicating for each the number of credits, the curricular area (math/science, engineering technology, general education, other) it belongs to, and the recent offering schedule and class sizes.

It will be evident from the table that, while there certainly are some large classes (e.g. Introduction to Engineering, Chemistry or Physics, each over 50 students), they are relatively few. The majority of lecture courses outside the discipline are in the 15 – 30 student range, and within the discipline in the 10 – 20 student range; most lab sections are in the 8 – 16 student range. Over a span of years, the School of Engineering and Technology has had an average class size (regardless of instructional mode) of 14 students.

Recitations are a very marginal phenomenon at LSSU, and exist exclusively within the Engineering courses (some of which are parts of the Engineering Technology curricula); these are usually (with one or two exceptions) identical in enrollment to the associated lecture section.

The EET program, moreover, requires 124 overall *semester* credits, the majority of which are specified (i.e., required, "R"), but allowing for student choice of specified electives ("SE") for most of the general education components, as well as for 1 credits within the discipline (the so-called "technical electives"). There are also 3 credits of free, unrestricted electives ("E").

Table 5-1: EET Curriculum for 2016-2017

Course (Department, Number, Title)	Required (R), Elective (E), or a Selective Elective (SE)**	*Curricular Area (Credit Hours)**				Last Two Semesters the Course was Offered:	Average Section Enrollment for the Last Two Semesters the Course was Offered[1]
		Math & Basic Sciences	Discipline Specific Topics	General Education	Other		
Key to Engineering and Engineering Technology Prefixes (others self-evident): EGEE – Electrical Engineering; EGET – Electrical Engineering Technology; EGME-Mechanical Engineering; EGMT-Manufacturing Engineering Technology; EGNR - General Engineering; EGRS-Robotics and Control Systems							
1st Year, 1st Semester							
EGME141 Solid Modeling	R		3			F'15, S'16	11 (lec, lab)
EGNR101 Introduction to Engineering	R		2			F'14, F'15	54 (lec) 27 (lab)
ENGL110 First-Year Composition I	R			3		F'15, S'16	24
MATH111 College Algebra	R	3				F'15, S'16	29
Social Science Elective	SE			3		F'15, S'16	
1st Year, 2nd Semester							
CHEM108 Applied Chemistry	R	3				F'15, S'16	50
CHEM109 Applied Chemistry Lab	R	1				F'15, S'16	12
EGEE125 Digital Fundamentals	R		4			S'15, S'16	26 (lec) 10 (lab)
ENGL111 First-Year Composition II	R			3		F'15, S'16	36
MATH131 College Trigonometry	R	3				F'15, S'16	17
Cultural Diversity Elective	SE			3		F'15, S'16	

Course (Department, Number, Title)	Required (R), Elective (E), or a Selective Elective (SE)[1]	Math & Basic Sciences	Discipline Specific Topics	General Education	Other	Last Two Semesters the Course was Offered:	Average Section Enrollment for the Last Two Semesters the Course was Offered[1]
2nd Year, 1st Semester							
Communications Elective	SE			3			
EGET110 Applied Electricity	R		4			F'12, F'14	18 (lec) 12 (lab)
EGNR140 Linear Algebra & Numerical Applications for Engineers	R	2				F'15, S'16	30 (lec) 12 (lab)
MATH112 Calculus for Business and Life Science	R	4				F'15, S'16	28
PHYS221 Elements of Physics I	R	4				F'14, F'15	50 (lec) 17 (lab)
2nd Year, 2nd Semester							
EGET175 Applied Electronics	R		4			S'13, S'15	19 (lec) 9 (lab)
EGNR245 Calculus Applications for Technology	R	3				S'15, S'16	11 (lec,lab)
EGNR265 "C" Programming	R		3			F'15, S'16	24 (lec) 16 (rec)
PHYS222 Elements of Physics II	R	4				S'15, S'16	29 (lec) 15 (lab)
Technical Elective	SE		3			F'15, S'16	
3rd Year, 1st Semester							
EGEE 250 Microcontroller Fundamentals	R		4			F'14, F'15	33 (lec) 9 (lab)
EGRS380 Robotics Technology	R		2			F'14, F'15	13
EGRS381 Robotics Technology Lab	R		1			F'14, F'15	7
MATH207 Principles of Statistical Methods	R	3				F'15, S'16	23
Humanities Elective	SE			4		F'15, S'16	
Technical Elective	SE		3			F'15, S'16	

Course (Department, Number, Title)	Required (R), Elective (E), or a Selective Elective (SE)[1]	Math & Basic Sciences	Discipline Specific Topics	General Education	Other	Last Two Semesters the Course was Offered:	Average Section Enrollment for the Last Two Semesters the Course was Offered[2]
3rd Year, 2nd Semester							
EGEE355 Microcontroller Systems	R		4			S'14, S'16	21 (lec) 10 (lab)
EGET310 Electronic Manufacturing Processes	R		4			S'15, S'16	13 (lec) 13 (lab)
EGRS365 Programmable Logic Controllers	R		3			S'15, S'16	23 (lec) 6 (lab)
MGMT371 Business and Operations Analytics	R				3	F'15, S'16	22
Free Elective	E				3	F'15, S'16	
4th Year, 1st Semester							
EGEE320 Digital Design	R		4			F'14, F'16	16 (lec) 10 (lab)
EGNR491 Engineering Design Project I	R		3			F'14, F'15	22 (lec, lab)
EGNR310 Quality Engineering	R		3			F'13, F'15	25
Technical Elective	SE		4			F'15, S'16	
4th Year, 2nd Semester							
ECON302 Managerial Economics	R				4	S'14, S'16	25
EGNR495 Engineering Design Project II	R		3			S'15, S'16	22 (lec, lab)
Humanities Elective	SE			3		F'15, S'16	
Technical Elective	SE		3			F'15, S'16	
OVERALL TOTAL CREDIT HOURS FOR THE DEGREE	124						
PERCENT OF TOTAL		25%	31%	18%	8%		

Curricular Alignment to PEOs

The PEOs of the EET program (refer to Criterion 2, above) call for alumni to have (in shorter paraphrase), after 3 years of practice, professionally applied technical knowledge of electrical engineering technology (I), remain engaged in professional development (II), and be self-learners benefitting society (III). The curriculum contributes to each of these objectives in various ways.

PEO I. The first PEO concerns the professional application of technical knowledge; recall that it states that 3 years into a career, alumni "... will have demonstrated professional application of technical skills and engineering judgement to solve problems in their professions subject to technical, practical, and societal constraints." It is apparent from Table 5-1 that some 50% of the curriculum, *i.e.*, 63 semester credits, constitutes "discipline-specific topics"; these are primarily courses imparting the technical background knowledge that would later undergo "technical application...to solve problems (*etc.*)". This is evidently very ample, representing a total of almost 5 semesters of college at 14-credits per semester, if it were all to be taken as an isolated block.

But there is also the aspect of the *application of* that ample technical knowledge obtained. Indeed, the curriculum practices problem-solving skills which are generalizable to the application of not only that knowledge, but also other knowledge that may be later obtained as a professionally-practicing graduate. Towards this end, the capstone courses (EGNR-491-495), as well as many other courses with more modest term projects, place the students in situations requiring the *application of* the technical knowledge to real (in the capstone case) or hypothetical (mostly otherwise) electrical engineering technology problems, with constraints of the kind described in the PEO language. The reader is referred to the detailed description of the capstone experience, below.

PEO II. The second PEO concerns professional development. Graduates after 3 years "...will have set professional goals, experienced professional growth, and be engaged in ongoing professional development and learning activities."

Again, the capstone course sequence (EGNR-491-495) is a major contributor, in that it provides the kind of large-scale (the projects are such that they span an academic year) experience, a *professional* experience in all respects except that it is unpaid and managed in an academic setting, in which the students have opportunity to discover their own technical and managerial strengths and weaknesses and realize the need to compensate the latter and maximize the former. In other words, in this respect, the program serves as a motivator for professional development. Because the project is, moreover, pursued under the guidance of a faculty advisor and industrial contact, mentoring in project management and "soft skills" (communications, team dynamics, time management, etc.) is an ongoing process, so that an early stage of professional development is undertaken.

One should also not underestimate the smaller contributions here of earlier course term projects, which would also typically involve team dynamics (group work), time management, communications, and so forth.

The EGNR101 *Introduction to Engineering* course also makes a notable contribution here by introducing students to the LSSU student chapters of professional societies, such as IEEE for example. Sustained involvement in these societies is expected to be a factor promoting professional growth, particularly to the extent the association with the corresponding national organizations continues after graduation.

PEO III. Finally, the third PEO concerns self-learning tendencies and societal contribution. Graduates after 3 years "…will be capable self-learners and make meaningful contributions to society." There are two aspects here: (1) self-learning tendencies; and, (2) aptness to make societal contributions.

Concerning the first aspect, self-learning, the curriculum is so constructed as to provide both the *tools* and the *attitude* necessary for sustained self-learning in the long run.

The primary *tool* is the coherence of knowledge, in the sense that advanced and/or applied knowledge (upper-level engineering technology courses, and capstone/design experiences) is rooted in fundamentals and derived from first principles; the development of first principles (*e.g.*, Kirchhoff's laws) into advanced principles (*e.g.*, methods of circuit analysis and design, electronic manufacturing) within the curriculum instills the ability to see the larger picture and interconnectedness within the discipline, and the ability to extrapolate and develop competencies that go beyond the knowledge obtained directly from the curriculum. The depth of prerequisite structure emphasizes the linkages of "first principles" to advanced results, developing this tool.

The *attitude* promoting sustained self-learning is instilled, especially, by exposure to experiences that are interdisciplinary, e.g., the senior (capstone) project and the Introduction to Engineering project. The interdisciplinarity is suggestive to the student of the need to synthesize knowledge beyond that obtained directly in coursework by the student.

Concerning the *second* aspect of the PEO, societal contribution, it is clear that the technical and scientific know-how imparted by the curriculum, through the 66 credits of disciplinary topics and 25 credits of math and science, make one capable of contributing to the betterment of society-as-a-whole, given the predisposition to do so.

Curricular Alignment to Student Outcomes

The courses are mapped to the (a) – (k) student outcomes in Table 5-2. Each outcome is served by at least one, but usually several, of the courses in the curriculum. Indeed, the capstone courses EGNR-491 and EGNR-495, taken together (and even just EGNR-495 on its own), contribute to all of the outcomes. And it's evident that certain other courses, such as EGET-310 *Electronic Manufacturing Processes* and EGNR-310

Quality Engineering, contribute to a majority of the outcomes. Some outcomes, notably (a) and (b), are served by almost all courses in the curriculum. In summary, the student outcomes are well-integrated throughout the curriculum, for the most part.

Table 5-2: Alignment of Curriculum to Student Outcomes

Course	Cores	a	b	c	d	e	f	g	h	i	j	k
EGEE-125	EET, MfgET	✓✓ •	✓✓ •		✓✓ •	✓✓ •		✓ •				
EGEE-250	EET	✓ •	✓ •									
EGEE-320	EET	✓✓ ••	✓✓ ••	✓ ••	✓✓ ••	✓✓ ••		✓ ••				
EGEE-355	EET	✓✓ ••	✓✓ ••	✓ •	✓ •	✓ ••	✓ •	✓ ••				✓ •
EGET-110	EET, MfgET		✓✓ •					✓ •				
EGET-175	EET, MfgET	✓✓ •	✓ •	✓ •								
EGET-310	EET	✓✓✓ •••	✓✓ •		✓ •	✓✓ •		✓✓ •			✓✓ ••	
EGME-110	MfgET	✓ •	✓ •									
EGME-141	EET, MfgET	✓✓✓ •	✓ •		✓ •							✓ •
EGME-340	MfgET	✓✓✓ ••	✓ •		✓✓ ••	✓✓ ••	✓ •	✓✓ ••	✓ •			✓ •
EGME-275	MfgET		✓✓✓ •••		✓ •		✓✓ ••				✓ •	
EGME-276	MfgET	✓✓ ••	✓ •	✓✓✓ •••		✓ •		✓✓✓ ••				
EGME-311	MfgET	✓✓✓ ••	✓✓✓ ••		✓✓ ••		✓ •	✓ •	✓ •			✓ •
EGMT-225	MfgET		✓✓✓ ••				✓✓✓ ••					
EGMR-101	EET, MfgET		✓ •		✓ •	✓ •		✓ •		✓ •		
EGMR-140	EET, MfgET	✓✓ •	✓✓ •				✓✓ •					
EGMR-245	EET, MfgET		✓✓✓ •									
EGMR-265	EET, MfgET	✓✓ •	✓ •									✓ •
EGMR-310	EET, MfgET	✓✓ ••	✓✓ ••	✓✓✓ ••	✓✓ ••		✓✓ ••	✓ •				✓✓ ••
EGMR-491	EET, MfgET	✓✓✓ •••	✓ ••		✓✓✓ •••	✓✓✓ ••	✓✓✓ ••	✓✓✓ •••	✓ ••		✓ •	✓ •
EGMR-495	EET, MfgET	✓✓✓ •••	✓ ••	✓✓ ••	✓✓✓ •••	✓✓✓ •••	✓✓✓ •••	✓✓✓ •••	✓ ••	✓✓ ••	✓✓ ••	✓ ••
EGRS-265	EET, MfgET	✓✓✓ ••	✓ ••		✓✓ ••		✓ •					
EGRS-380	EET, MfgET	✓✓ ••	✓ ••					✓✓ ••	✓ ••			
EGRS-381	EET, MfgET	✓✓ ••						✓✓ ••	✓✓ ••			✓ •
EGRS-460	MfgET	✓✓ ••	✓ ••				✓ ••		✓ ••			
EGRS-461	MfgET	✓✓ ••			✓✓ ••		✓✓ ••					✓✓ ••

▨	evaluated for EET
☐	evaluated for MfgET

☐	evaluated for EET and MfgET

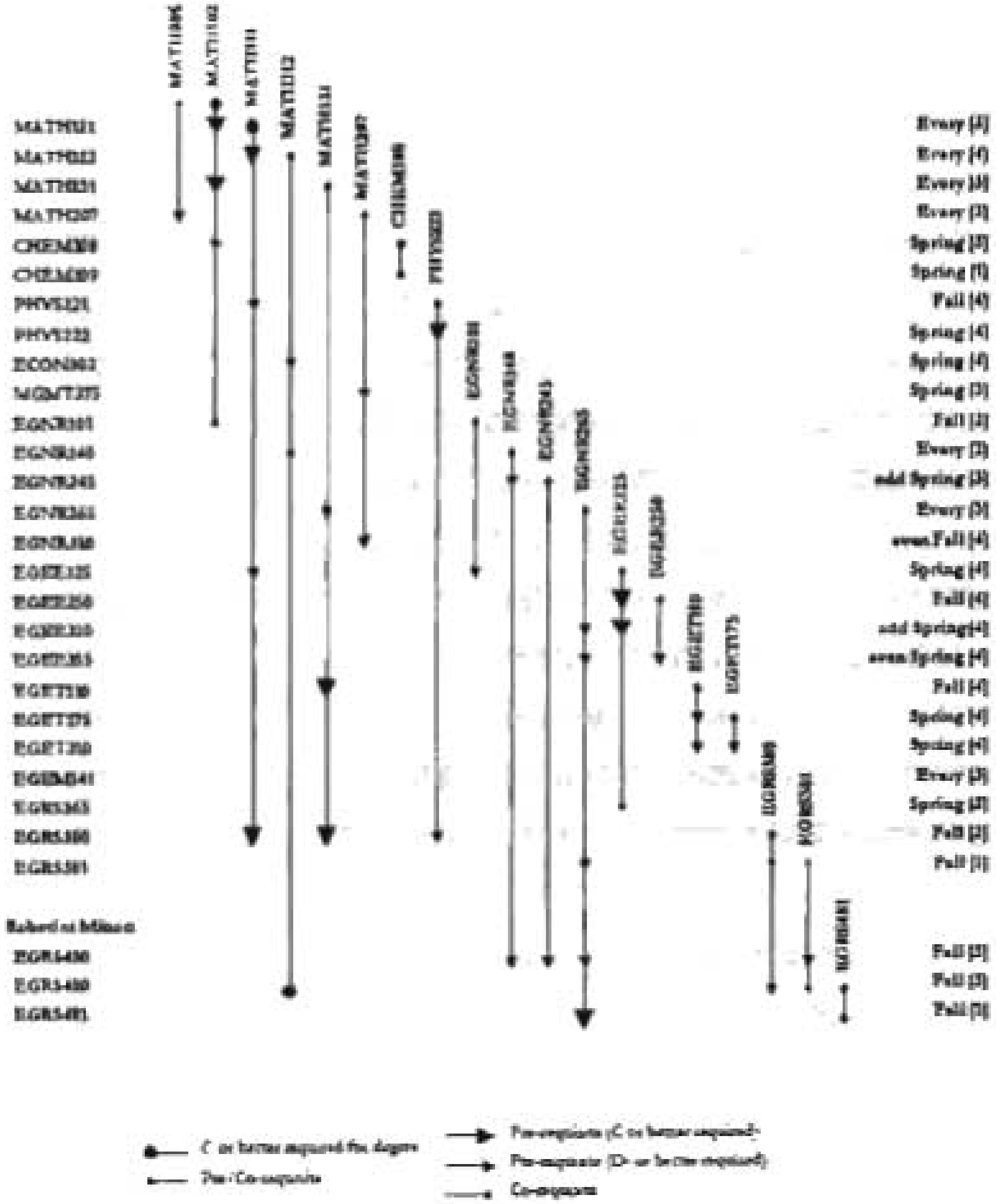
✓	exposure (for instance, one graded assignment)
✓✓	stress (for instance, one course objective)
✓✓✓	focus (for instance, multiple objectives or course title)

•	foundational – ready for further development
••	developed – prepared for practical application
•••	high – approaching that of a practicing engineer

Prerequisite Structure

Figure 5-1 below depicts the prerequisite structure of the EET degree prograro. A line terminated with an arrow depicts a prerequisite, while a line terminated by a dot depicts a corequisite. The courses that comprise the Robotic Technology minor are shown; however EGNR-491 Senior Design Projects I is not shown even though it is in the core of the EET program.

Figure 5-1: Prerequisite Structure of EET Curriculum



In particular, note the following features of the program that this prerequisite diagram makes evident:

- The electronic manufacturing processes grouping has four layers of depth (MATH-131 → EGET-110 → EGET-175 → EGET-310);
- The digital electronics grouping has four layers of depth (MATH-111 → EGEE-125 → EGEE-250 → EGEE-355);
- The Robotics Technology minor has four layers of depth (MATH-111 → PHYS-221 → EGRS-380 → EGRS-430);
- The MATH-207 → EGNR-310 sequence develops a theme of statistical methods and their applications to quality control;
- The MATH-207 → MGMT-371 sequence develops a theme of statistical methods and their management;
- The MATH-131 → EGNR-265 → EGRS-365 sequence develops a theme of programming for machine control of manufacturing processes. Furthermore, beginning with EGNR-365 and extending to EGNR-491 and EGNR-495, a strong chain with a theme of professionalism and project management and communication skills is developed.

To enforce compliance with the prerequisite structure provided, the University's registration system is designed to disallow enrollment in courses for which students lack the prerequisites. In the event of a student failing or dropping a prerequisite course after registration has already taken place, the system automatically removes the student from the follow-up course. But as a second "line of defense" to these automated solutions, we also require students, at the beginning of any course, to complete and sign a statement that testifies to their having completed any prerequisite courses, and having enrolled in (or already completed) any co-requisite courses. Waivers of prerequisites are possible at the instructor's discretion; usually, if the student has promise to be successful, the waiver will be granted with the student's signed acceptance of the condition to take the prerequisite concurrently, maintain a minimum C grade at mid-term, and acknowledge (in writing) responsibility for self-learning as far as necessary to compensate the prerequisite deficiency. Appendix J contains an example prerequisite compliance form.

Mathematics Component

Table 5-3 summarizes the required mathematics courses and their credit counts, roughly in the order that these courses are taken:

Table 5-3: Mathematics Component of EET Curriculum

Course	Credits
Offered by Mathematics Dept.	
MATH207 Principles of Statistical Methods	3
MATH111 College Algebra	3
MATH131 College Trigonometry	3
MATH112 Calculus for Business and Life Science	4
Offered by School of Engineering and Technology.	
EGNR140 Linear Algebra & Numerical Applications for Engineers	2
EGNR245 Calculus Applications for Technology	3
Total	18

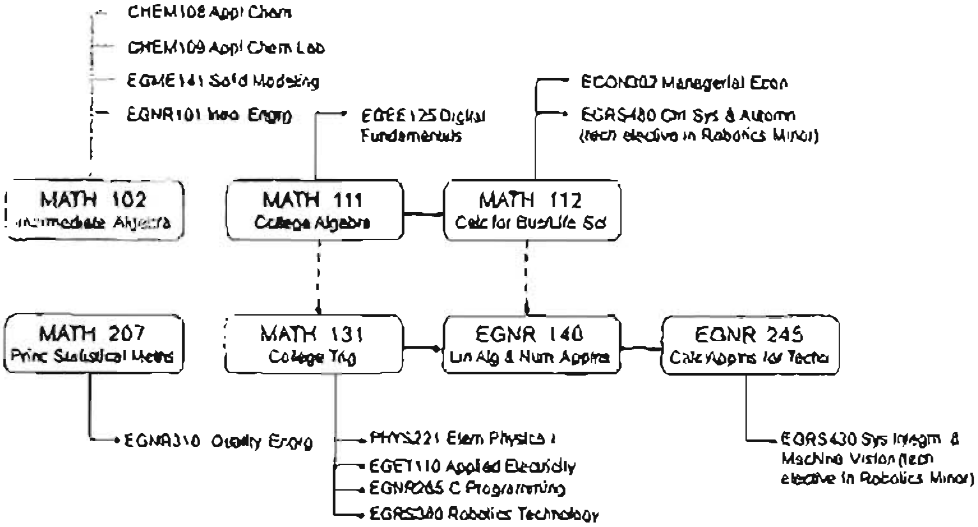
Some students entering the EET program do not possess a sufficient mathematical background, initially, to be placed directly into MATH-111 and MATH-131. These students are instead placed in MATH-102 *Intermediate Algebra*, or, as appropriate to their level of Mathematics preparation, in remedial courses that eventually lead to MATH-102. This course does award 4 college credits, but does not apply toward any degree requirements of the EET program; any remedial courses below MATH-102 provide no college credit.

The program requires all students to complete the two-course math sequence, MATH-111 and MATH-112, as well as a MATH-111 – MATH-131 – EGNR-140 – EGNR-245 sequence. EGNR-140 and EGNR-245 cover a variety of mathematical topics applicable to manufacturing engineering technologists and training in the use of mathematical software. EGNR-245, specifically, expands on integral calculus, introducing multiple integrals and solutions to elementary differential equations. Students also take MATH-207, a statistics course, which provides the mathematical foundation for EGNR-310 *Quality Engineering*, a technical course in the EET program.

As is evident, the Mathematics component includes algebra (MATH-111), trigonometry (MATH-131), and integral and differential calculus (MATH-112 and EGNR-245)

The Mathematics background thus obtained in the curriculum provides skills necessary to solve technical problems in electrical engineering technology, as criterion 5 requires ("… the application of … [mathematics beyond trigonometry/algebra] … appropriate to the student outcomes and program educational objectives."). This becomes clear by way of the various technical and other courses which use the Math courses as pre or co-requisites, as illustrated by Figure 5-2 (no distinction between pre- and co-requisites is made here, except between the Math courses themselves).

Figure 5.2: Mathematics Courses and their Relation to Technical Courses



The dashed lines indicate Mathematics courses that may be simultaneous (co-requisites) whereas the dashed lines indicate that they are taken sequentially (prerequisite sequence), but there is no such distinction made in indicating the relationships of the Mathematics courses to the technical courses.

Importantly, the figure shows how the mathematics content is then applied in following technical courses. These technical courses are not comprehensively listed here, but only examples of those directly following a given mathematics course (more advanced technical courses following these, of course, have the mathematics courses as *indirect* prerequisites, but are not listed here).

As is clear from the figure, the technical content of the curriculum makes use of mathematics, at levels appropriate to the particular technical subjects. These technical courses then, more directly, support the student outcomes and PEOs. So, the mathematics, accordingly, is applied in support of the student outcomes and PEOs as called for by criterion 5.

Science Component

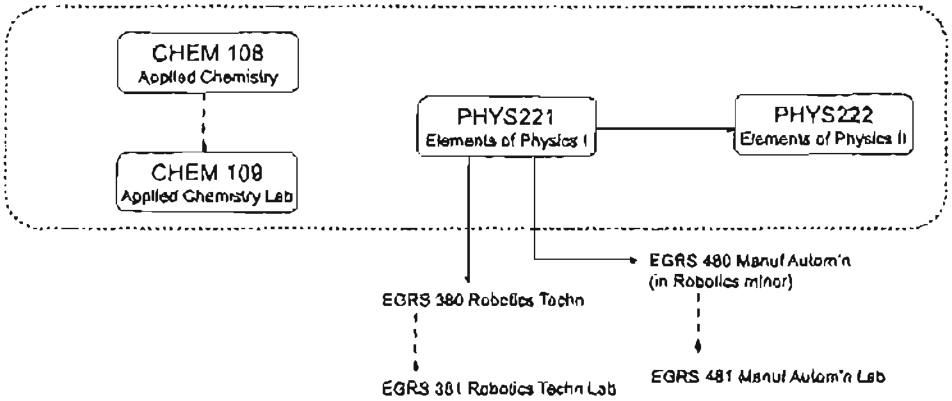
Table 5-4 summarizes the required science courses and their credit counts, roughly in the order that these courses are taken.

Table 5-4: Science Component of EET Curriculum

Course	Credits
CHEM108 Applied Chemistry	3
CHEM109 Applied Chemistry Lab	1
PHYS221 Elements of Physics I	4
PHYS222 Elements of Physics II	4
Total	12

Figure 5-3 illustrates how the science courses relate to the technical curriculum. As with mathematics, it's clear that the technical component of the curriculum is also built upon the foundation of the natural sciences.

Figure 5.3: Science Courses and their Relation to Technical Courses



Technical Component

The core of the discipline is, of course, the set of engineering and engineering technology courses themselves. As noted above, this amounts to 50% of the total credits (63 credits) in the curriculum, falling between the 1/3 and 2/3 limits as called for by criterion 5.

Table 5-5 below lists these courses and their credits, organized into alphabetical subgroupings by 4-letter subject designation, and in increasing numerical order within subgroups.

Table 5-4: Technical Component of Curriculum

Course	Credits
EGEE-125 Digital Fundamentals	4
EGEE-250 Microcontroller Fundamentals	4
EGEE-320 Digital Design	4
EGEE-355 Microcontroller Systems	4
EGET-110 Applied Electricity	4
EGET-175 Applied Electronics	4
EGET-310 Electronic Manufacturing Processes	4
EGME-141 Solid Modeling	3
EGNR-101 Introduction to Engineering	2
EGNR-265 "C" Programming	3
EGNR-310 Quality Engineering	3
EGNR-491 Engineering Design Project I*	3
EGNR-495 Engineering Design Project II*	3
EGRS-365 Programmable Logic Controllers	3
EGRS-380 Robotics Technology	2
EGRS-381 Robotics Technology Lab	1
Technical Electives	12
Total	63

As noted above, the program requires the selection of 12 credits of technical electives; recommended technical elective courses include those shown in below in Table 5-5 below. A Minor in Robotics Technology is readily available using the technical elective credits in the EET program. In that case, the student would select EGRS-215 *Robotics Technology I*, EGRS-430 *Systems Integration and Machine Vision*, EGRS-480 *Manufacturing Automation*, and EGRS-481 *Manufacturing Automation Lab* for 10 of the 12 technical elective credits, plus another course from this list.

Table 5-5: Recommended Technical Electives

Course	Credits
CSCI-163 Troubleshooting and Repair of PC's	3
EGME-110 Manufacturing Processes	3
EGME-240 Assembly Modeling and GD&T	3
EGME-275 Engineering Materials	3
EGME-276 Strength of Materials Lab	1
EGME-310 Vehicle Development and Testing	2
EGMT-216 CAM with CNC Applications	3
EGMT-225 Statics and Strength of Materials	4
EGNR-250 Cooperative Education	2
EGNR-261 Energy Systems/Sustainability	3
EGNR-362 Vehicle Energy Systems	3
EGRS-215 Introduction to Robotics	2
EGRS-430 Systems Integration & Machine Vision	4
EGRS-480 Manufacturing Automation	3
EGRS-481 Manufacturing Automation Lab	1
MATH-215 or higher	3-4

An examination of the subject matter included in technical component, outlined above in Tables 5-4 and 5-5, reveals a broad focus on control of manufacturing processes and embedded digital systems. There is also a theme of quality engineering and management.

Importantly, note that criterion 5 calls for "a technical core…that prepares students for the increasingly complex technical specialties they will experience later in the curriculum." As a comparison Table 5-4 with the prerequisite structure from Figure 5-1 demonstrates, the "technical core" would consist of courses like EGET-110 *Applied Electricity*, EGEE-125 *Digital Fundamentals*, or EGNR-265 *"C" Programming*, etc., upon which many later courses rely as prerequisites. Then, more advanced technical subjects like EGET-310 *Electronics Design Processes*, EGEE-355 *Microcontroller Systems*, EGRS365 *PLCs*, or the automation courses EGRS380/381/480/481, all draw on this core.

The technical component of the curriculum, by way of its many laboratories (note from Table 5-1 which courses have lab activities), exposes the students to the use of the software and tools of the electrical engineering technology discipline. Some examples are:

Software

- Roboguide, Witness and other robotics-simulation related software (EGRS-380-381)
- VAL3, TPP, and KAREL robotic control software (EGRS-380-381)
- Microsoft Visual C# and ATS Smart Vision for machine vision (EGRS-430)
- RS Logix 5000 for programmable logic controllers, and Factorytalk View, for programming the panelview (EGRS-365)

- Quartus (digital synthesis), GoLogic (logic analyzer), and Code Warrior for digital system development (EGEE-125, EGEE-250), EGEE-320, EGEE-355)
- MATLAB computational software (EGNR-140, EGNR-245)
- Creo (Pro-E) solid modeling software (EGME-141)

Hardware, tools, techniques

- Oscilloscopes, function generators, power supplies, and multimeters (EGET-110, EGET-175)
- Surface mount robotic assembly machines, stencils, and ovens (EGET-310)
- Robotics hardware (EGRS courses)

Managerial Component

The ECON-302 *Managerial Economics* course and the MGMT-371 *Business and Operations Analysis* course, each address management and operations of manufacturing organizations as parts of their respective course contents.

Senior Project Capstone Experience

EET students usually take the senior design course sequence, EGNR-491-495, as indicated in table 5-4 above; detailed syllabi for these courses are found in Appendix F. However, there are actually three possible paths for graduates to follow for their senior year capstone experience: *Industrial-based, Co-op, or Research-based*. All of these paths provide a realistic design experience in an academic environment. All students participate in the same initial course (EGNR-491), with a strong emphasis on team and communication skills during the definition and proposal phase, and initial design phase, of a multi-disciplinary project. The majority of students then continue to work on multidisciplinary teams to implement and engineer, *i.e.*, realize, a final design for an industrial customer (EGNR-495). Alternatively, Cooperative Education students may substitute an equivalent design experience during their Co-op for the EGNR-495 course (realization phase). Finally, a research-based project may also be substituted for the industrial-based project. Research-path students again participate in the team/communication skills area of the Senior Year Experience (EGNR-491), but define and execute an academically-oriented research project under the direction of a faculty member. The Senior Year Experience for all of these paths requires the application of student knowledge and skills acquired in earlier course work to enhance their ability to accomplish required objectives.

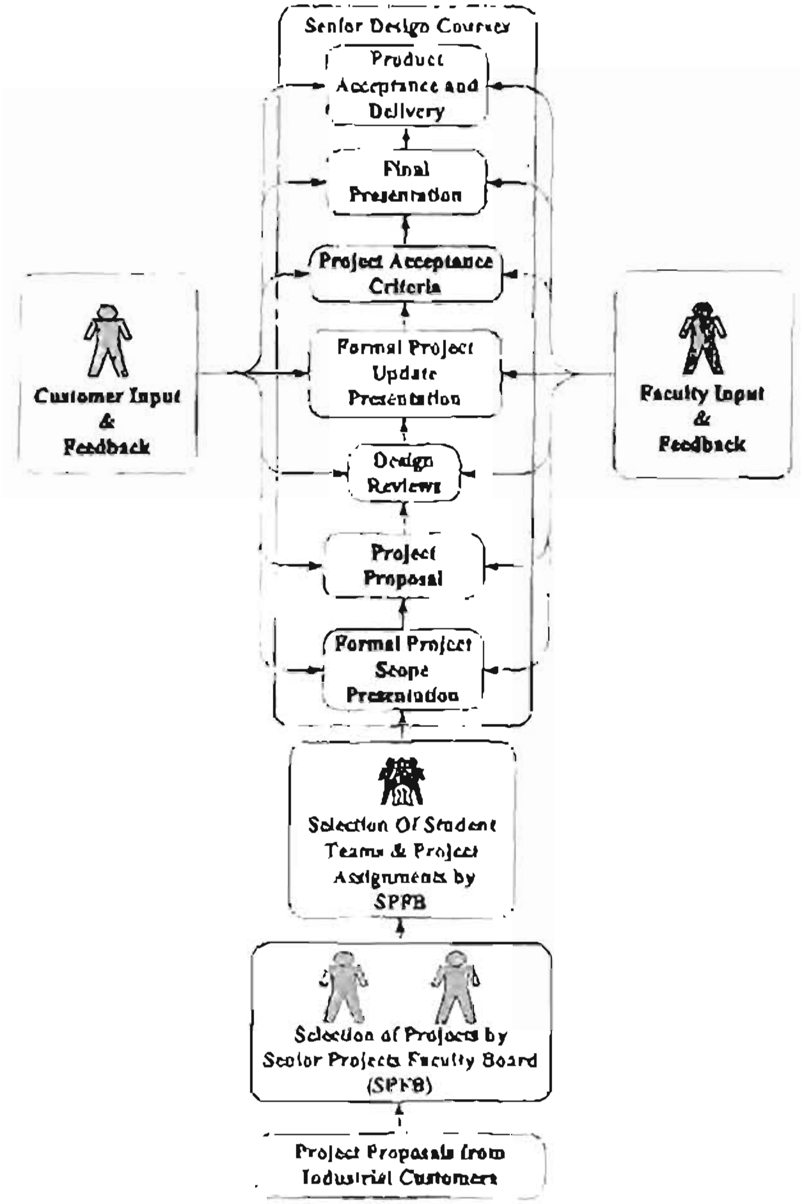
In recent years, most students have chosen the EGNR491-495 sequence, with very few opting for the Coop - EGNR491 alternative. The research option, while remaining available in principle, has been completely inactive for many years.

Thus, for most students, the senior design experience at LSSU involves participating in an intensive design project that spans *two* semesters. Students work on multidisciplinary teams (*i.e.*, typically a mix of students from the disciplines EET, MfgET, CE, EE, and ME), often 4-7 students depending on the scope. They normally design and build a product for an industrial customer; some projects, however, are supported directly by LSSU. Typical project budgets are $5,000 - $30,000, but have occasionally fallen out of that range on both ends. Examples of projects from the past few years which have involved EET students are:

- Design and build of an automated hydraulics control cart for offshore machining operations, and development/implementation of a method for hydraulic leak detection.
- Design and development of a robotics assembly line, incorporating four FANUC robotics, and end-of-arm tooling, and including a robotics-playing-tetris demo, for use in LSSU laboratory courses in robotics.
- Design and development of a stand-alone robotics work cell to be used by pharmacists to fill prescriptions.
- Design and build of a system which utilizes laser measurements to achieve alignment between a robot arm and a steering column. The system replaced a manual method of robot alignment and thereby increased the repeatability and accuracy of the steering column testing procedure.
- Design of a multipurpose robot hand and tutorial guides for the application of advanced program features in an industry-standard robotics simulation software called ROBOGUIDE. The features and applications explored in ROBOGUIDE included machine vision, calibration, robotic path generation, and 3D bin picking.
- Design and construction of two robotic workcells using delta type robots suitable for use in an educational environment and design of a curriculum for a high school students using the workcell.
- Design and implementation of a robotics workcell to simulate the dispensing of a wood filler product into railroad ties. A robot, using custom end of arm tooling and a machine vision system, locates the positions of spike holes on railroad ties as they move by on a continuous conveyor, serving as a proof-of-concept for future development of a wood product dispensing system in the railroad industry.

More information regarding senior design projects, including more extensive descriptions of specific projects, can be found on the School's web site at the URL http://www.lssu.edu/eng/seniors/. The senior design courses are managed by a multidisciplinary team of faculty called the senior projects faculty board (SPFB). Figure 5-4 below depicts the major activities associated with the senior design courses. The display materials available at the time of the visit will also contain portfolios of the design projects.

Figure 5-4: Overview of Senior Design Projects



As is evident from the process illustrated, there are several identifiable phases that put a premium on non-technical skills: multiple presentations (scope, update, final) enhance oral communications skills; written documents such as the project proposal develop technical writing skills; customer meetings, team meetings, design reviews, etc. develop skills in running effective meetings and recording useful minutes; timeline software tools, action items and responsibility charts develop skills in time and resource management; all of these things as well as the project's design and implementation aspects, and various team assignments, all force the development of teamwork skills.

Evidently, as the projects are technical in nature, they require the application of the technical skills of the student throughout; clearly the required design and implementation tasks are the primary avenues for making use of technical skills.

Cooperative Education Experience

Cooperative education opportunities exist for the engineering and technology students at LSSU, although relatively few students pursue them. The most basic co-op course is the 2-credit EGNR-250, which may only be used as an elective in the MfgET program. This course requires that a student write a business report describing the Engineering Technology work accomplished at the employer. An evaluation of the work experience must also be written, and the supervisor's evaluation of the student's work performance is to be submitted.

There are also two upper level co-op courses, EGNR-450 and EGNR-451, totaling 7 credits, which may replace EGNR-495, the second semester of the conventional senior projects capstone experience (described above in section A.6). In this co-op experience, the students must complete a project at the co-op site that requires at least 60% of their time over the course of two semesters. The content of the project is approved by the co-op coordinator and the Senior Projects Faculty Board (SPFB). The academic requirements for the projects are very similar to those of the projects completed by the students in the senior design experience on campus, including graded presentations and written reports. The SPFB reviews the major documents submitted by the student to fulfill the course requirement.

B. Advisory Committee

LSSU has an active Industrial Advisory board (IAB) comprised of approximately 30 members representing various industries throughout the Michigan, Ontario, and elsewhere. The Board meets twice a year. The spring meeting is held on the last day of the Spring semester, coinciding with the Senior Design Project presentations. In the Fall, one of the member companies hosts the meeting on the first Friday in November, or occasionally, this meeting has been shifted to campus. The IAB is led by an elected President, assisted by an elected Secretary.

Sub-committees are designated as needed when action items have been delegated during meetings for follow-up at the next meeting. By far, the most active sub-committee in recent years has been that for student recruitment. A binder was developed under its guidance to provide reference materials for the Admissions Counselors when they visit high schools including mini-CDs with a presentation that highlights the programs. Members participate at the various MACRAO evenings (college fairs) throughout Michigan, on behalf of LSSU Engineering & Technology. They assist the Admissions Counselors as needed and wear their company gear as they promote the

LSSU engineering and technology programs to visiting parents and prospects. Members have also offered job shadowing to students considering Engineering and Technology. In addition to the recruitment efforts, the IAB reviews and provides feedback regarding our curriculum.

Senior design projects have often been sponsored by an IAB member companies (although they are frequently sponsored by others, as well). Members participate in viewing, evaluating and grading the project presentations. Member companies have also provided opportunities for internships and cooperative work experiences.
A great many of the member companies are also final (permanent) employers of graduates, making it representative of the kinds of organizations served by our graduates, on-the-whole. Examples include Superior Fabrication (heavy duty steel components, Kincheloe, MI), Applied Manufacturing Technology (Robotics and Automation integrator, Lake Orion, MI), Continental Automotive (automotive brake systems, Brimley and Auburn Hills, MI), Essar Steel (Sault Ste Marie, Ontario), Nexteer Automotive (automotive steering, Saginaw, MI) and others.

Information about the IAB membership, and meeting minutes, can be found at <www.lssu.edu/eng/iab>

CRITERION 6. FACULTY

The School of Engineering and Technology is comprised of ten (currently one is vacant) full-time faculty members, two full-time laboratory engineers, and two (currently one is vacant) consulting engineers. School leadership rests with one faculty member who receives 25% time release and a $2,721 per semester stipend to be School chair. Departmental leadership rests with one faculty member who receives no release time and no compensation to be coordinator of the Department of Electrical and Computer Engineering, one faculty member who receives no release time and $907 per semester to be coordinator of the Department of Mechanical Engineering, and one faculty member who receives no release time and no compensation to be coordinator of the Department of Engineering and Technology. The School faculty work very well together as a combined team on school related items. For purposes of program direction and planning, the School faculty members also meet as two separate departments: Department of Electrical and Computer Engineering and Department of Mechanical Engineering. The EET program is housed within the Department of Electrical and Computer Engineering, which is comprised of five full-time faculty members, one laboratory engineer, and one consulting engineer.

Because of its small size, the School of Engineering and Technology offers engineering curricula that are significantly impacted by the other engineering disciplines in the School. By the time they leave LSSU, EET graduates, for example, will have taken classes taught (or team-taught) by the entire ten-person School of Engineering and Technology faculty. Furthermore much of the continuous improvement process occurs at the School level, in which the entire School of Engineering and Technology faculty participate. Hence, the discussion provided on the faculty in this section will include all members of the School faculty; however, special attention will be paid to the Department of Electrical and Computer Engineering faculty which directly administers the EET program.

LSSU is dedicated to its primary mission as a teaching institution by offering challenging undergraduate programs and services to students. In recognition of this mission, all members of the LSSU faculty are required by the university contract to devote 50- 75% of their efforts during the academic year toward teaching. The remaining 25-50% is apportioned between advising, scholarship, and service. The emphasis on teaching will come out in the subsequent sections, especially in Faculty Qualifications, Faculty Workload, and Authority and Responsibility of Faculty.

A. Faculty Qualifications

A careful analysis of this section will reveal that the faculty have a proper mix of competencies, that they are mutually complementary in this regard, and that these competencies correspond well to the programs offered, and specifically to the EET program; they demonstrate ownership of the program; and they endeavor to remain professionally competent and invest in the students, in their own professional development, in supporting other faculty, and in the EET program.

The EET program can be characterized as one that emphasizes design of digital systems and application of industrial control processes, with a heavy laboratory component that coordinates with the theoretical content. The faculty members instructing the program, generally share this view of emphasis for the EET program.

Consistent with the institution's primary mission of teaching, and the School's philosophy of maintaining an applied emphasis in its engineering and engineering technology programs, the evaluation process employed in the hiring of new faculty accordingly places a greater emphasis on a candidate's philosophy of engineering education, promise as an instructor, and industrial experience, than it does on academic research credentials.

A candidate for the School of Engineering and Technology faculty is generally expected to have some teaching experience (either as faculty member or a teaching assistant) and to possess excellent communication skills. Each candidate is asked to give a sample lecture (on a topic specified by the hiring committee chair and generally kept the same for all visiting candidates) during the on-campus interview. This lecture is ordinarily given to both students and faculty. Feedback is thereafter solicited from those in attendance, and is given much weight in the subsequent hiring decision.

SET

As was noted before, the EET graduates are affected by nearly all the faculty in the SET due to the small size of the School and the interwoven nature of the engineering disciplines. Some faculty primarily teach courses that are required in the EET program, while other faculty interact with EET students through their participation in project-based courses such as EGNR-101 *Introduction to Engineering* or the EGNR-491-495 *Senior Design Projects I and II* capstone sequence. Background information is therefore presented for all faculty members in the SET in Table 6-1 below.

Table 6-1: Faculty Qualifications

Faculty Name	Highest Degree Earned- Field and Year	Rank[1]	Type of Academic Appointment[2] T, TT, NTT	FT or PT[3]	Years of Experience			Professional Registration/ Certification	Level of Activity[4] H, M, or L		
					Govt./Ind. Practice	Teaching	This Institution		Professional Organizations	Professional Development	Consulting and Work in Industry
David Baumann	PhD – Electrical Engineering – 1992	P	T	FT	3	27	17	PE	L	M	M
Eric Becks	MS – Electrical Engineering/System Science – 1981	O	NTT	PT	31	5	5		M	L	H
Jon Coullard	BS – Mechanical Engineering Technology – 1990	O	NTT	FT	6	20	20	Patent	L	L	M
Jim Devaprasad	MS – Mechanical Engineering – 1986	P	T	FT	1	30	30		H	H	M
Robert Hildebrand	PhD – Acoustics – 2001	ASC	T	FT	5	12	11		L	M	M
Andrew Jones	PhD – Electrical & Computer Engineering – 2002	ASC	T	FT	3	17	11	EIT	M	M	M
Jeff King	BS – Electrical Engineering Technology – 1996	O	NTT	FT	4	18	18		L	M	M
David Leach	MS – Mechanical Engineering – 2017 (anticipated)	I	TT	FT	18	3	8		H	H	L
Zakaria Mahmud	PhD – Mechanical Engineering – 2003	ASC	TT	FT	1	10	2		H	M	L
David McDonald	MS – Electrical Engineering – 1971	P	T	FT	8	43	43	PE	M	H	H
Joe Moening	PhD – Electrical Engineering – 2010	ASC	T	FT		11	6		H	M	L
Sanjiv Sinha	PhD – Mechanical Engineering – 1994	AST	TT	FT	11	8	1		H	M	L
Paul Weber	PhD – Electrical Engineering – 2006	ASC	T	FT	1	9	9		H	H	M

1. Code: P = Professor ASC = Associate Professor AST = Assistant Professor I = Instructor A = Adjunct O = Other
2. Code: TT = Tenure Track T = Tenured NTT = Non Tenure Track
3. At the institution
4. The level of activity, high, medium or low, should reflect an average over the year prior to the visit plus the two previous years.

An overview of the ten full-time and four adjunct faculty members of the School of Engineering and Technology in Table 6-1 indicates the following:

- All faculty members have appropriate BS or higher degrees in engineering or engineering technology
- All full-time faculty members either have or are pursuing appropriate advanced degrees in EE, ME, or CE to teach courses in the respective programs
- An average of 7 years of government and industrial experience
- An average of 16 years of teaching experience
- 30% of full-time faculty members are licensed Professional Engineers
- A medium level of professional society involvement
- A medium of professional development
- A low/medium level of consulting and other industrial involvement

ECE

As will be demonstrated in this section, the ECE faculty is complementary in their mix of competencies, which span the electrical engineering and computer engineering discipline as traditionally understood and subsequently provide the expertise needed to support the EET program. They bring a blend of educational and professional experience. Given below is a brief description of each member of the ECE faculty, along with his strengths and his relationship to curricular areas.

Dr. David Baumann, P.E. (ECE Professor)

Dr. Baumann has BS, MS, and PhD degrees in Electrical Engineering and an MS degree in Statistics from the University Wisconsin. As a graduate student he worked under the direction of Dr. R. A. Greiner in the Electro-Acoustics Laboratory. His research involved acoustic monitoring of machinery condition and active attenuation of noise in air ducts. He has four summers of research experience at the Naval Surface Warfare Center involving active vibration control of submerged propellers. He taught for 5 years at Oral Roberts University and has now taught for 17 years at LSSU. He has expertise and teaches courses in the areas of Electromagnetics, Control Systems, Circuits and Signals, Probability and Statistics, and Power Distribution. He served several years as the coordinator of the Senior Projects Faculty Board and the coordinator of the Department of Electrical and Computer Engineering and now serves as the chair of the School of Engineering and Technology.

Dr. Andrew Jones (ECE Professor)

Dr. Andrew Jones joined LSSU during the 2005-2006 academic year. He has degrees in Electrical Engineering (BS/MS) and in Computer Engineering (PhD). He previously taught at Purdue University for three years. Dr. Jones has research experience in digital and micro-controller systems as applicable to mobile robotics systems. He primarily teaches courses in robotics, software development, digital electronic and micro-controller areas and was awarded with the LSSU Distinguished Teacher Award in 2010. Dr. Jones has also engaged in applied research activities with entrepreneurs interested in developing electronic products as well as consultations for industrial companies. He is also involved with FIRST with coordinating local FLL (FIRST Lego League) tournaments and mentoring the local FRC (FIRST Robotics Competition) team. He is the advisor for the LSSU chapter of IEEE. Dr. Jones is the coordinator of the Department of Electrical and Computer Engineering.

Prof. David McDonald, P.E. (ECE Professor)

Prof. McDonald has been teaching at LSSU for 43 years in the Electrical and Computer Engineering department. His degrees are in Electrical Engineering, and he has recently taken several 500 & 600 level courses in Electrical Engineering and Systems Engineering. His areas of interest include circuit analysis, electrical machines, instrumentation, signal processing, and hybrid/electric vehicle control and power systems. He also teaches courses in these areas in addition to serving as a senior projects advisor. Prof. McDonald has been very active in grant writing and has secured numerous grants for LSSU. He has served as a TAC of ABET evaluator and also as chair of the ECE department. He has done recent consulting as a systems engineer in the electric vehicle industry in the development of testing systems in the controls, test and simulation area.

Dr. Joseph Moening (ECE Professor)

Dr. Moening has been at LSSU since the start of the 2010-2011 academic year. He has BS, MS, and PhD degrees in Electrical Engineering from the University of Toledo. His areas of interest include power electronics, renewable energies, semiconductor devices, analog electronics and micro/nano-device fabrication. He primarily teaches courses related to these areas. He has research experience in laser-based micro-structuring of thin films as well as power processing systems. His is the co-advisor for the Engineering House.

Dr. Paul Weber (ECE Professor)

Dr. Weber has a BS in Computer Engineering, and MS and PhD degrees in Electrical Engineering from Michigan Technological University. While at Michigan Tech, his primary research was in the area of fault-tolerant distributed control algorithms for safety-critical systems (e.g. fly-by-wire aircraft control). After finishing graduate school, he taught for three years as a Visiting Assistant Professor at University of Minnesota Duluth. During his time there, he also developed research in the areas of energy and engineering education, which he has continued while at LSSU since joining the faculty in the fall of 2009. Dr. Weber's primary teaching expertise is in digital design and embedded systems. He is currently the coordinator for Senior Projects.

Mr. Eric Becks (ECE Consulting Engineer)

Mr. Becks earned his BS and MS in Electrical Engineering/System Science from Michigan State University. Prior to joining the LSSU Product Development Center (PDC), Eric Becks was involved in industrial and entrepreneurial activities. His work experience ranges from Engineering Manager in a multi-national company to

President of a diagnostic equipment manufacturing firm. Mr. Becks was involved in the formation of real estate, retail, internet marketing and manufacturing businesses as well as negotiating a leveraged buy out. He has designed numerous products including several that have received industry awards. Besides his duties at the PDC, Mr. Becks also serves as Director of Intellectual Property & Economic Development for LSSU and was recently named President & CEO of SSMart^{SM}, Inc., the Sault Ste. Marie/LSSU SmartZone. He has also served as a school board member for 14years; 12 as president.

Mr. Jeff King (ECE Lab Engineer)

Mr. King is a full-time laboratory engineer for the School of Engineering and Technology. He has a BS degree in Electrical Engineering Technology from LSSU, and is pursuing a BS degree in Mathematics from LSSU on a part-time basis. He has valuable professional engineering experience in industrial electrical controls and PLCs, and is responsible for the School's electronic and computer systems. He occasionally teaches as an adjunct in the areas of electrical circuits, electronics, and PLC's for the engineering technology programs in the School and has instructed sections of the digital fundamentals laboratory. He also assists significantly in the senior design projects on the PLC and electrical design and implementation aspects.

ME

The following faculty members from the ME Department provide teaching and key ancillary support for the EET program:

Dr. Robert Hildebrand (ME Professor)

Dr. Hildebrand has research and publication background in the areas of noise and vibrations, vehicle dynamics, and soil dynamics. He has a good mix of industrial, consulting, research and teaching experience. Accordingly, he strongly supports the program's emphasis on applications of fundamentals, on laboratory instruction, and on communications. He regularly teaches EGME-275 *Engineering Materials*, EGME-276 *Strength of Materials Lab* (co-taught), EGME-310 *Vehicle Development & Testing*, EGNR-310 *Advanced Quality Engineering*, EGEM-320 *Dynamics*, EGME-350 *Machine Design*, EGNR-340 *Advanced Numerical Methods*, EGME-415 *Vehicle Dynamics*, and EGME-425 *Vibrations & Noise Control*, regularly serves as a senior project faculty advisor, and team-teaches MATH-310 *Differential Equations*. Dr. Hildebrand is the coordinator of the Department of Mechanical Engineering.

Prof. James Devaprasad (ME/MfgET Professor)

Prof. Devaprasad has been a professor in the School of Engineering and Technology at LSSU for 30 years. His areas of teaching emphasis include robotics and automation. He was the Coordinator or Chair of Manufacturing Engineering Technology for much of that time, and has also served as Chair of the School of Engineering and Technology for a time while the Dean position was vacant. He is currently the coordinator of General Engineering and Technology as well as the director of LSSU's Robotics Center.

Prof. Devaprasad has been the leader in developing the robotics laboratory through industrial donations and grants, and has been in key leadership roles nationally in the Society of Manufacturing Engineers (SME) and the Robotics Industries Association. He normally teaches several robotics courses in both the engineering and engineering technology curricula and often serves as the advisor or customer for robotics senior projects. He also supports the Robotics Technology minor available for the Engineering Technology students and Computer Science students. He is a recipient of the Outstanding Young Manufacturing Engineer award from SME and the distinguished faculty award from the Michigan Association of Governing Boards of universities. He serves as the director of the Women in Technology summer camps and the Robotics summer camps that he and his colleague founded over 25 years ago.

Mr. David Leach: (ME Instructor)

Mr. Leach started working for the LSSU Product Development Center in 2008, and became a full time faculty member in 2014. He has a BS ME degree from Michigan Technological University, and is currently enrolled in MTU's Graduate School and will earn an MS ME degree in May of 2017. Mr. Leach primarily teaches solid modeling, assembly modeling and GD&T, manufacturing processes, CNC with CAM applications, statics and strength of materials, and assists with senior projects. He has automotive industry experience in product and quality engineering for Class A exterior plastic trim. Mr. Leach is the advisor for LSSU's student chapter of ASME.

Dr. Zakaria Mahmud (ME Professor)

Dr. Mahmud has a BS in Mechanical Engineering from Bangladesh University of Engineering and Technology (Dhaka, Bangladesh), MS in Sustainable Energy Engineering from The Royal Institute of Technology (Stockholm, Sweden), and PhD in Engineering Science and Mechanics from the University of Alabama (Tuscaloosa, Alabama). After graduation, he taught for one year in Aerospace Engineering Department at Texas A & M University (College Station, TX). He then led NASA SBIR phase II project as Principal Research Engineer at Techsburg Incorporated (Blacksburg, VA). Dr. Mahmud then taught in Mechanical Engineering Technology program at Georgia Southern University (Statesboro, GA). Before joining in LSSU since Fall 2014, he taught for seven years in Mechanical Engineering at North Dakota State University (Fargo, ND). His primary research interests are in the areas of experimental aerodynamics and micro-fluidics. He regularly teaches the following courses at LSSU: EGNR 101 Introduction to Engineering, EGNR-140 *Linear Algebra and Numerical Applications*, EGME-337 *Thermodynamics*, EGME-338 *Fluid Mechanics*, EGME-431 *Heat Transfer*, and EGME-432 *Thermal Fluids Laboratory*. Dr. Mahmud is serving as a co-advisor for Engineering house and advisor for the Society of Aumotive Engineers (SAE).

Mr. Jon Coullard: (ME Lab Engineer)

Mr. Coullard is a full-time laboratory engineer for the School of Engineering and Technology. He has a BS MET degree from LSSU, and extensive professional engineering experience in manufacturing and the development of specialty machines. Before earning his bachelors degree he was a professional welder. Accordingly, he strongly supports the traditional manufacturing aspects of the program, and, especially from his long industrial experience, its emphasis on communications and professionalism. Mr. Coullard regularly serves as an adjunct instructor in courses that support the MfgET program.

B. Faculty Workload

The faculty member is understood to have duties in instruction (encompassing teaching and course assessment), advising (encompassing academic advising and student mentoring), scholarly activities, and service (to the institution, profession, and the community). The time distribution of the faculty member's workload (implied based on proportionality to the contractually allowable weights given in the supervisory evaluation of the faculty member) is 50-75% instruction (corresponding to the 24 load hours per year), 10-20% advising, 5-20% scholarly work, and 10-20% service.

Instruction

The instructional portion, specifically, is fulfilled by instructing coursework amounting to 24 contract hours per year (or an average of 12 per semester), where "contract hours" are defined below. Although faculty members are considered full time if they teach 24 contract hours per year (average of 12 contract hours per semester), advising, scholarly work, and service activities are duties that fall outside the 24 measured contract hours.

Faculty time commitment is measured contractually in contract hours (also called "load hours"), which are *not* identical to credit hours earned by a student. A student earns a *credit* hour for each hour of lecture per week, and an additional credit hour for a 1-3 hour lab. On the other hand, one *contract* or *load* hour is one hour of lecture or 1.5 hours of lab (i.e., actual lab time is multiplied by 2/3 to generate contract hours).

The amount of time and energy that faculty are expected to provide to an engineering program greatly influences the general strength of the program. Typical indicators of workload include contract hours, and student-to-faculty ratios (reflective of typical class and lab enrollments). A broad overview of the instructional workload broken down by group (regular faculty, lab engineers, etc) is shown below in Table 6-2.

Table 6-2a: SET Faculty Workload Summary – Fall 2015

Faculty Member (name)	PT or FT[1]	Classes Taught (Course No.-Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to the SET Programs[5,6]
			Teaching	Research or Scholarship	Other[4]	
David Baumann	FT	EGNR340-1.333, EGNR346-1.333, EGNR491-2.0, EGNR460-5.0, EGNR101-0.239	75	0	25	100
Eric Backs	PT	EGNR491-0.306	3	0	97	3
Jon Coulland	PT	EGNR491-2.156	18	0	82	100
Jim Devaprasad	FT	EGNR491-2.016, EGRS381-2.0, EGRS480-3.0, EGRS481-4.0, EGNR101-0.865	67	0	33	100
Robert Hildebrand	FT	EGEM320-5.0, EGNR310-3.0, EGNR340-1.333, EGNR495-2.204, EGME350-5.286, EGNR101-0.451	92	0	8	100
Andrew Jones	FT	EGEE250-5.333, EGNR101-2.002, EGNR265-3.0	92	0	8	100
Jeff King	PT	EGNR491-2.096	18	0	82	100
David Leach	PT	EGME1104.0, EGME141-6.666	100	0	0	100
Zakaria Mahmoud	FT	EGNR101-2.059, EGNR140-5.0, EGME431-3.0, EGME432-2.0	100	0	0	100
David McDonald	FT	EGEE280-4.0, EGEE330-5.0, EGNR491-2.312	100	0	0	100
Joseph Moening	FT	EGEE210-3.0, EGEE370-5.0, EGNR101-0.627	100	0	0	100
Sanjiv Sinha	FT	EGEM220-3.0, EGMT225-4.0, EGME141-3.333, EGRS320-2.0, EGME350-1.714	100	0	0	100
Paul Weber	PT	EGNR250-0.432, EGNR261-3.0, EGNR361-2.0, EGNR491-0.718, EGRS430-9.0	100	0	0	100

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the Self-Study Report is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.
6. Note that no distinction can straightforwardly, or meaningfully, be made between time contributions towards the various programs (EET, MfgET, EE, CE, ME) since they are so intertwined with shared courses.

Table 6-26: SET Faculty Workload Summary – Spring 2016

Faculty Member (name)	PT or FT[1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to the SET Program[5,6]
			Teaching	Research or Scholarship	Other[4]	
David Baumann	FT	EGEE411-3.0, EGNR340-1.333, EGNR495-4.254	75	0	25	100
Eric Becks	PT	EGET310-5.0, EGRS385-4.0	75	0	25	75
Jon Coulliard	PT	EGME110-6.0, EGNR495-4.054	88	0	12	100
Jim Devaprasad	PT	EGNR495-4.081, EGRS385-2.0, EGRS435-6.0	100	0	0	100
Robert Hildebrand	FT	EGNR495-4.373, EGME275-3.0, EGME276-4.0, EGME425-4.333	100	0	0	100
Andrew Jones	FT	EGEE355-7.0, EGNR265-3.0, EGRS385-3.0,	100	0	0	100
Jeff King	PT	EGNR495-4.029	34	0	66	100
David Leach	FT	EGME312-6.0, EGME240-8.0	100	0	0	100
Zakaria Mahmud	PT	EGNR140-2.0, EGME337-4.0, EGME338-3.0	100	0	0	100
David McDonald	FT	EGNR495-4.050, EGEE210-5.0, EGNR245-3.333	100	0	0	100
Joseph Moeaing	PT	EGEE475-3.0, EGRS365-8.0	100	0	0	100
Sanjiv Sinha	FT	EGEM220-3.0, EGME276-4.0, EGME141-3.333, EGME225-3.0	100	0	0	100
Paul Weber	FT	EGEE125-5.666, EGNR260-3.0, EGNR495-0.162	100	0	0	100

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the Self-Study Report is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.
6. Note that no distinction can straightforwardly, or meaningfully, be made between time contributions towards the various programs (EET, MfgET, EE, CE, ME) since they are so intertwined with shared courses.

For the regular faculty, a full-time teaching load is 12 contract hours (or sometimes "load hours") per semester, with the option to take on up to 6 additional load hours per semester with "overload" compensation at a reduced rate, which is currently $907 per load hour. A faculty member may fall under 12 for a given semester, if compensated in the same academic year by an overload in the other semester, such that 24 contract hours are performed per year. Single semester loads are limited to 18, and annual (excluding summer) loads to 32.

The teaching load limits, and the general goals of keeping faculty near to the nominal load of 12 hours per semester and of maintaining a healthy student-to-faculty ratio, are intended to allow faculty time to participate in non-classroom, professional activities as well as provide for quality student interaction and class preparation. Thus, beyond the expectations for teaching, faculty are also expected to hold regular office hours, and to participate in academic advising, student group advising, service activities, and professional development.

Advising

All regular, full-time faculty keep 5 office hours per week, at which they are available to meet students; those teaching less than full-time (e.g., the lab and PDC engineers) have numbers of office hours that are pro-rated by their respective fractions of a full-time teaching load. These office hours permit students to interact with the faculty member to supplement in-class instruction. The University has reinstated recitation sections in some problem-solving courses, for which faculty provide a one-hour recitation and are accordingly relieved of an hour of office hour burden. Thus, the standard is that the total of recitation hours and office hours add up to 5 per week (note that no faculty currently have so far had more than 1 recitation hour per semester, and exceeding 2 recitation hours per faculty member per semester will be discouraged should that situation ever arise, in order that the number of general office hours will remain adequate).

Academic advising, in its aspect as a service to students, is described above. Concerning, on the other hand, its aspect as a faculty activity and time burden, note that the approximately 220 students enrolled in the School are divided amongst the 10 fulltime faculty members as advisees, so that the average is about 22 advisees per faculty member. The advising duties of the faculty member are to meet with each advisee prior to registration, recommend courses for which to register, and discuss course selection alternatives from the perspectives of progress to degree completion, student interests, and career relevance. As a benchmark, 15 minute advising sessions are used for freshmen students in EGNR-101 *Introduction to Engineering* (for students in that course only, these are scheduled during a specific lab session). Thus, an estimate of 5-6 hours of ordinary advising burden per faculty member per semester is reasonable; there is also some additional burden on the program coordinators and the school chair, specifically, in handling supplemental advising related to course overrides, transfer credit evaluation, and waivers.

Most faculty members also advise senior project teams, which provide a substantial amount of additional interaction with students and their respective industrial sponsor contacts in a realistic professional setting. Certainly, advising of senior projects teams is another time-consuming activity for faculty that resembles some of the out-of-classroom student interaction activities described above, but in principle, since this activity is compensated by teaching load from the EGNR-491 and EGNR-495 courses, it is more properly seen as part of team teaching those courses.

The office hour and academic advising burdens are implied extensions of the instructional component of the faculty members' duties; they do not generate additional contract hours, but are rather understood to be a part of the duties inherent in fulfilling the 24 load hours.

Scholarship and Service

The 24-load hour requirement, described above, may be understood to comprise the *instructional* part of the faculty member's duties, only. Outside of the 24 load hours fall the additional duties of service and scholarship. As noted above, this may be up to 40% of the faculty member's workload (scholarship up to 20%, and service up to 20%).

Professional development activities, by their nature, vary considerably in kind and scope from faculty member to faculty member; the reader is referred to the faculty CVs below, for specific activities.

Regarding *service* activities, while these also vary in kind and scope among faculty members, many are School-coordinated to such an extent that a rough overview can be given. Faculty members within the School regularly serve on University-wide committees (e.g., curriculum, general-education, student retention, *etc.*), serve on School committees (e.g., Engineering scholarship awards committee), support the faculty association, and participate in assessment. There are also initiatives within the School, and LSSU, to increase new student enrollment, by means such as high school visits, meeting with prospective students, and lab tours, each of which represent common service activities of the faculty. Faculty members serve as advisors to student chapters of national professional organizations, including ASME, IEEE, SAE, and SWE; such advisorship generally involves overseeing that the clubs operate within their bylaws, recruit, fundraise, manage their budgets, and participate in regional and national events. Faculty members may also participate in summer orientations for incoming students, although the School chair has undertaken the majority of this particular burden.

C. Faculty Size

A review of instructional assignments over the last two years (an ample cycle to capture all courses, including those on an alternating year basis), breaking down the total instructional burden (measured in load hours as defined in 5.B above) by category of instructional personnel, is provided in Table 6-3 below.

Table 6-3: Instructional Load by Faculty Type

Semester	Regular Faculty	Internal Adjuncts*	External Adjuncts	Total
Fall 2014	112.66	9.83	0	122.49
Spring 2015	114.68	20.42	0	135.1
Fal 2015	123.9	4.56	0	128.46
Spring 2016	124.92	23.08	4	152
Total	476.16	57.89	4	538.05
Percentage	88	11	1	

* Lab and PDC Engineers

The table shows that 99% of all instruction was carried out by the instructional staff listed in Table 6-2, i.e., the ten regular faculty complemented by the lab engineers and the PDC consulting engineer(s). Accordingly, only 1% of the instruction was carried out by outside adjuncts. In particular, 88% of the instruction was carried out by the 10 regular, full-time faculty, specifically. As these are very high proportions, it is clear that so long as the 10 positions are filled, there is an adequate faculty size.

All faculty maintain at least 5 hours of some combination of office hours and recitations (in practice, the latter has never exceeded 1 of the 5 hours for any faculty member). Senior student exit surveys consistently support the notion that these interactions are not only sufficient in quantity, but also in quality; a consistent theme is that students have excellent and fruitful access to faculty members.

Each student has a faculty member assigned as an academic advisor, and meet with the faculty member at least once per semester. As noted above (Criterion 6 Section B), there is an average of 22 student advisees per faculty member, suggesting a situation in which sufficient attention can be given to each.

The faculty have, finally, opportunities to interact with industrial and professional practitioners in a variety of contexts, including senior projects, cooperative education projects, PDC-sponsored projects, IAB meetings, and summer work.

D. Professional Development

All of the School faculty members have pursued professional development activities over the past five years. These include grant writing, consulting, review of scholarly articles and texts, conference presentations, taking classes, and attending conferences, but the level of these activities is, consistent with the focus of the LSSU mission on teaching, less than is traditional elsewhere in academia.

Many of the SET faculty members also regularly serve on the Senior Projects Faculty Board (SPFB). The SPFB oversees all senior year experiences within the School of Engineering and Technology. As many projects are sponsored by industry, *senior projects* *provide good opportunities for faculty to work closely with industry.* This interaction has resulted in faculty providing training for industrial based engineers, summer employment opportunities for faculty, and general faculty professional development due to the close industrial ties.

E. Authority and Responsibility of Faculty

Establishing policy

This sub-section addresses the faculty's role, and that of administrators, in defining the program's curriculum, educational objectives, student outcomes, and continuous improvement process. It is the faculty that are the primary authority over all of these areas and who *plan and originate curricular change proposals*, but administrators have approval/veto authority relative to curriculum, specifically.

Curricular matters for the EET program, including prerequisite structure and the detailed course requirements comprising the program, are planned at the Departmental level. The ECE departmental faculty regularly meet (weekly during the academic year), with the ECE coordinator setting the agenda, and it is in this forum that the curriculum (among other business) is addressed in detail, and in which any action to change it originates; i.e., administration does *not* generate its own curricular change proposals. The department ordinarily operates by consensus, although a formal majority vote is, in principle, required to adopt any change; such a vote could be undertaken in the unlikely event there were no clear consensus and a decision could not be forestalled. A change so approved by the ECE faculty is then proposed to the entire School faculty, and a formal vote taken at that level, usually after discussion in a School faculty meeting (discussion may be foregone in the case of minor changes, *e.g.*, prerequisite issues related to courses not common to the MfgET discipline). Upon School faculty approval, the Dean must approve, after which the proposal proceeds to a University-wide Curriculum Committee, a committee consisting primarily of faculty, but also of an administrator and a student, and in which the School is represented by a single voting faculty member. If approved at that level, it must, finally, receive approval by the Provost, usually after advisory discussion in the Provost Council (a body comprised of the Deans and School Chairs).

The educational objectives, student outcomes, and continuous improvement process for the EET and other engineering and engineering technology programs, which are provided in Criterion 2 and Criterion 3 above, and the continuous improvement process outlined in Criterion 4, are defined and revised by the entire faculty of the School of Engineering and Technology (*i.e.*, both ECE faculty and ME faculty collectively). The Dean and higher administrative instances (Provost, etc.) have no formal approval, veto or other role in this process, although their input is welcomed.

Thus, all the regular faculty of the entire School has some kind of a role in the oversight of the EET program. By virtue of the wide involvement of faculty in the assessment process for all of the School's programs, and the similarity in the assessment process for all of these programs, the entire School faculty is in a well-informed position concerning interpreting assessment results for the EET program.

The entire faculty, regardless of academic rank or other factor, regularly attends and participates in the deliberations, and that ample time is taken in these deliberations such that all perspectives are thoroughly heard and considered, and consensus obtained; accordingly, formal votes are unusual.

In summary, the faculty (and all of the faculty members equally) has complete autonomy with regard to defining and revising educational objectives, student outcomes, and the continuous improvement process, but does not despise the input of other constituents. Regarding curriculum, that autonomy is not complete, insofar as administrative approvals are part of the process. The former (educational objectives, student outcomes, continuous improvement) is addressed by the School faculty collectively, while the latter (curriculum) is primarily planned by the Departmental faculty (with later School faculty discussion and approval).

Leadership Responsibilities

Faculty members having some administrative responsibilities relative to the EET program are the ECE coordinator, the ET coordinator, the SET chair, and the Robotics Lab director. The duties of the coordinators are not officially defined, but the university does maintain a list of general chair duties (refer to Table 6-3 below). For an enumerated list of the duties performed by the ECE coordinator, the ET coordinator, the SET chair, please refer to Criterion 8 Section A.

Note, furthermore, that in contrast to what may be typical of "chair-level" positions at other institutions, duties related to faculty supervision are *not* part of either of these positions. Firstly, in accordance with concepts of academic freedom affirmed by the LSSU faculty collective bargaining agreement (see Appendix K *Faculty Agreement*), neither of these positions involves supervision of instruction. Secondly, pursuant to that same agreement, since both positions are occupied by faculty, and as such, members themselves of the collective bargaining unit, neither position may involve responsibility for performance evaluation or for personnel decisions regarding other Departmental faculty.

Table 6-3: Duties and Responsibilities of Chairs

Program/Curriculum: Provide leadership in planning and coordinating academic programs which includes the development, revision, and evaluation of courses, programs and curricula. Represent the unique interests of the School/Department in College and University meetings.

Faculty: Promote professional development such as scholarship, excellence in teaching, and University service among faculty. Assist the Dean with recruitment of future faculty.

Schedule: Assist the Dean with the scheduling of classes by providing a draft schedule.

Students: Assist the Dean in the recruitment of future students and provide leadership in advising current and past students. Approve degree audits, waivers, substitutions, degree changes, and other documents as allowed (or required) by LSSU policy and procedures.

Budget: Assist the Dean in preparation of recommendations for Departmental/School budgets.

Planning: Provide leadership in the development and implementation of strategic planning within the School/Department.

Institutional: Participate in the development and review of academic and university policies.

CRITERION 7. FACILITIES

The EET program is housed within the School of Engineering and Technology, which is located entirely in the Center for Applied Science and Engineering Technology (CASET) Building. Built in 1980, the three-story structure is home to the areas of Engineering, Engineering Technology, Mathematics, Computer Science, and Education. Two additional non-academic facilities associated with Information Technology are also located in the building: Enterprise Application Services and University Support Services.

A. Classrooms, Laboratories, and Other Facilities

The School of Engineering and Technology has approximately 30,000 sq. ft. of usable space, which includes offices, storage areas, labs, and work areas. Details of the classrooms, laboratories, and offices follow.

Classrooms

The CASET building has ten classrooms and one lecture room that are assigned by the Registrar's Office, with engineering, engineering technology, mathematics, and computer science courses receiving the highest priority. Room size and capacity are shown in the Table 7-1 below. The School of Engineering and Technology occasionally uses two laboratories for additional lecture space, but these are not shown below.

Table 7-1. University-Allocated Classrooms in CASET Building

Room	Type	Size (sq.ft.)	Capacity
CAS-107	Classroom	675	28
CAS-108	Classroom	575	28
CAS-119	Classroom	880	48
CAS-123	Classroom	1,010	50
CAS-205	Classroom	1,010	40
CAS-207	Classroom	690	30
CAS-210	Classroom	1,100	56
CAS-211	Classroom	585	27
CAS-212	Lecture Room	1,265	76
CAS-310	Classroom	1,320	30
CAS-311	Classroom	1,320	40

All classrooms are equipped with a whiteboard or chalkboard, a computer, a document camera, a projector, and a screen. The rooms are arranged in a typical fashion with desk and chairs arranged in rows. The lecture room has fixed desks and chairs arranged in a stepped fashion. Since most engineering courses have enrollments with less than 40 students, the classroom facilities within the building are adequate, and nearly all engineering classes take place in the CASET building. Elsewhere in campus, several large classrooms with capacities up to 165 students are available within a five-minute walk of the engineering facilities.

Laboratories

Laboratory experiences are a central component of the EET curriculum at LSSU. Most technical courses either contain labs or are two-course groups with one course involving the classroom and the second the laboratory (*e.g.* EGRS-380 Robotics Technology and EGRS-381 Robotics Technology Lab); in fact, there are only two technical courses without labs (EGNR-265 C Programming and EGNR-310 Quality Engineering) either as part of the main course or as a dedicated accompanying lab course. The chemistry and physics labs are located in Crawford Hall; the remainder of the lab facilities used in the EET program are located in the CASET building. Table 7-2 shows a summary of the lab facilities available to all engineering and engineering technology students, with those used within the EET program denoted as such.

Table 7-2: Laboratory Facilities in the School of Engineering and Technology

Room	Name	Size (sq. ft.)	Capacity	EET
CAS-105	Data Acquisition / Microscopy Lab	370	12	
CAS-106A	Materials Testing Lab PLC Lab	470	12	☒
CAS-106B	Engineering Design Center	1,140	6 Teams (30 students)	☒
CAS-106C	Thermal Fluids Lab	780	10	
CAS-120	Machine Shop	5,180	20	
CAS-120A-120B	Welding Lab Foundry	1,760	10	
CAS-122	Wood Shop	2,240	20	
CAS-124	Surface Mount Assembly Lab Vehicle Testing Lab	1,200	8	☒
CAS-125	Robotics and Automation Center	2,600	16	☒
CAS-209A-209B	Computer Lab	1,100	28	☒
CAS-304	Digital Electronics Lab	1,080	14	☒
CAS-306	Analog Electronics I Lab	1,175	16	☒
CAS-309	Analog Electronics II Lab	1,175	16	☒
CAS-310A	Rapid Prototype Center	580	4	☒

The School of Engineering and Technology provides the necessary hardware and software tools required in the teaching of engineering and engineering technology students. Unlike more research-oriented institutions, LSSU labs are nearly all intended for use by the undergraduate engineering and engineering technology students for instructional purposes. All laboratory facilities are available to students during regular school hours, when they are not in use for lab instruction. Computer labs and some labs with security cameras are available for extended hours. Special access arrangements through University Security are regularly used to permit student access to labs during evening and late night hours. In general, laboratory section sizes are typically 16 students or less. If student enrollment in a section exceeds the suitable lab size, then multiple lab sections are provided.

Programmable Logic Controller (PLC) Laboratory

The Programmable Logic Controller (PLC) course hardware is presently located in CAS-106A. There are ten computer stations, each with an HMI (Allen Bradley PanelView) and a PLC (Allen Bradley ControlLogix) training station. There are also project machines (four "mixing stations" and four "part checkers") designed to provide students with more intense programming experiences similar to what they would encounter in industry. This hardware is used in Programmable Logic Controllers (EGRS-365).

Engineering Design Center

The Engineering Design Center (CAS-106B) is a carpeted office space containing eight cubicles, each equipped with chairs, a computer, a phone, an erasable white marker board, and typical office desk furnishings. The room has a printer common to all cubicles, as well as a large conference table and chairs, and a collection of supplier catalogs. All senior project teams are assigned their own cubicle where they work on their projects, keep their records, organize their information and make vendor communications (via e-mail or phone). The teams typically hold meetings, which may include the company contacts, suppliers and faculty advisors, at the conference table. This laboratory provides the Senior Project students with office space and conveys the look and feel of working in industry. All typical office supplies are provided. This lab is used exclusively for the senior Engineering Design Projects sequence EGNR-491 -495.

The adjacent CAS-106C is primarily a laboratory for Mechanical Engineering courses, but frequently serves as an overflow meeting room for senior project students as well, particularly since it has a large conference table and a telephone set-up for conference calls.

Plastics Molding Lab and Wood Shop

The Plastics Lab and Wood Shop (CAS-122) includes three different plastics manufacturing machines, benches, countertops, saws, planers and sanders. This room is also used as a build area for Senior Design Projects (EGNR-491-495).

Surface Mount Assembly / EPIC Lab

The Surface Mount Assembly Lab (CAS-124) was equipped between 2009 -2010 through a Michigan Economic Development Corporation 21st Century Jobs Fund grant. Additional funding through the Michigan Initiative for Innovation and Entrepreneurship grant in 2013 augmented the facility with the establishment of the Electronic Products Innovation Center (EPIC). The lab is outfitted with two

Surface Mount Technology robotic assembly machines. APS CS40 has a component placement rate of 2100 components per hour handling parts down to EIA 0603 (0.060" by 0.030") while the APS L40 handles EIA 0201 (0.020" by 0.010") components at a rate of 4800 per hour. Both accommodate boards up to 13.5" by 22". Supporting equipment includes 2 SPR-25 stencils and GF12HC reflow oven. Other equipment includes manual hot air rework stations and fluid dispenser for adhesives and solder paste. This lab is primarily used by PDC workers and students in the Electronic Manufacturing Processes (EGET-310) course.

Robotics and Automation Center

The Robotics and Automation Center (CAS125) consists of 13 five or six-axis, industrial robots (equipped with multiple end-of-arm tooling options), 3 conveyor lines with pallets, 4 Programmable Logic Controllers (PLC's), numerous manufacturing sensors and pneumatic devices, 10 vision systems, 15 Dell computers, and 2 printers. Essentially there are three types of flow lines with robot systems: 1) a big rotary index table with four FANUC industrial robots with an Allen Bradley PLC and panel view, 2) an oval line that uses a Bosch Rexroth Varioflow conveyor, housing 4 Staubli robots integrated with an Allen Bradley PLC, and 3) an oval line that uses a Bosch pallet transfer conveyor with 4 FANUC robots integrated with an Allen Bradley PLC. The oval line with the Staubli robots and the oval line with the FANUC robots have vision systems integrated in all of the robots and also different tool change stations and end-of-arm tooling for the robots. It is estimated that the worth of the Robotics and Automation center would be about 2 million dollars.

During the 2015-2016 academic year, the robotics lab went through a major upgrade. The FANUC oval line system was fully updated except for the Bosch conveyor. The oval line system now incorporates 4 M10/iA FANUC robots that run on the latest R30iB controller platform, 4 FANUC iRVision 2D Vision systems, a FANUC 3DL Vision system, a FANUC force/torque system, two robot line tracking systems, an Allen Bradley PLC controller with ethernet configuration, 4 SCHUNK robot tool changers, several robot end-of-arm tools (grippers, suction cups, etc.), 4 Dell computers, and several sensors. 10 seats of the Roboguide robotics simulation software was also purchased. The entire system (engineering, hardware, software and installation) is estimated at $750,000. This new system and the rest of the robotics lab will help LSSU maintain the industrial robotics niche in its undergraduate engineering and engineering technology programs.

During the 2009-2010 academic year, the robotics lab also went through a major upgrade. The Staubli oval line system was newly installed. The system incorporates 4 Staubli robots that run on the latest CS8 controller platform, a new Bosch conveyor system (Varioflow system with 8 pallet location stations), 4 Cognex Vision systems, an Allen Bradley PLC5 controller with device net configuration, 4 robot tool changers, several robot end-of-arm tools, and several sensors. The entire system (engineering, hardware, software and installation) was estimated at $500,000.

The Robotics and Automation Center is utilized in numerous courses including EGNR-101 Introduction to Engineering, EGRS-381 Robotics Technology lab, EGRS-430 Systems Integration and Machine Vision, EGRS-481 Manufacturing Automation Lab, and the EGNR-491-495 Senior Projects I and II sequence. Typically at least one senior project each year is undertaken which involves the use of the equipment in the Robotics and Automation Center. Several of the projects completed in this Center have gained national attention in competitions.

The Robotics and Automation Center is also used extensively for demonstrations for members from business and industry, K-12 students, visiting faculty, and the community. The Robotics and Automation Center is also the key facility that serves as the home for the summer Robotics Camps and Women in Technology programs. These programs that have been offered every summer since 1991 and each year have attracted between 50 to 100 gifted and talented middle school and high school students from Michigan, Ontario, and beyond. The programs have served well to attract bright young individuals to the engineering and technology fields.

Computer Lab

The Engineering Computing Labs (CAS-209B-209C) house 33 current PC-type workstations, two common printers, full network access and all software that is taught in the curriculum. Computers Dell Optiplex 3020 computers with Intel i5 quad-core processors and 8GB of RAM, and network access at 10/100 Mbit/s. CAS-209B-209C is the primary computing lab for engineering and engineering technology students. It is available throughout the workday and evening, except when used for instruction (even then, it is divisible into two halves by an accordion wall, and only one half is ordinarily used for courses, leaving the other half available for open student use). Students from programs outside of the School of Engineering and Technology are not granted access to this room. Specialized software installed on these computers includes Creo (Pro-E), MATLAB, RoboGuide, Ansys Fluent, Arduino, and Witness.

Digital Electronics Lab

The Digital Electronics lab (CAS-304) has a fixed workbench in the center of the room with five computers and space for student circuit development. Additionally, this room has eight smaller workstations located around the perimeter of the room. Available in the room are portable oscilloscopes, digital multi-meters, digital trainers, logic analyzers, and FPGA evaluation boards. This lab can accommodate seven student teams (or 14 students) working at either the central benches or the outer benches. It also serves as an alternate computer lab with 13 stations and the mobile robot programming location. Equipment in this laboratory supports instruction of EGEE-125 Digital Fundamentals, EGEE-250 Microcontroller Fundamentals, EGEE-320 Digital Design, EGEE-355 Microcontroller Systems, and EGNR-260 Engineering Research Methods.

Analog Electronics Labs

The Analog Electronics I Lab (CAS-306) and Analog Electronics II Lab (CAS-309) provide the EET and MfgET students with hands-on experiences in two

Electrical Engineering Technology courses, Applied Electricity (EGET-110), and Applied Electronics (EGET-175). Although these labs are predominantly used by engineering students for a number of Electrical Engineering courses, they are also used to support the design projects portion of Introduction to Engineering (EGNR-101) and extensively by some senior projects in Engineering Design Projects (EGNR-491-495), both of which are in the EET curriculum.

Each of the 16 lab stations (8 in each lab) is equipped with at least one power supply (Agilent/HP E3620), a signal generator (Agilent/HP 33120A), a multimeter (Fluke 45 or Fluke 8846A), an oscilloscope (BK Precision 2530B or Keysight DSO-X2004A), and a computer with PSpice installed.

Rapid Prototype Center

The Rapid Prototype Center (CAS-310A) is overseen by the Product Development Center (PDC) and serves as a laboratory for both PDC projects and Senior Project teams (EGNR-491 and EGNR-495). The majority of the equipment in the lab, with the notable exception of the Stratasys Dimension RP machine, was purchased by the PDC through a Michigan Economic Development Corporation 21st Century Jobs Fund grant. The equipment purchases occurred between 2008 and 2010.

A Stratasys Dimension 3D printer was purchased in late 2015 with donations largely from the IAB. Using ABS+ plastic, the printer can produce parts up to a size of 10"x 10"x12" using Fused Deposition Modeling. The printer is used in a variety of engineering courses (notably, making sample parts for assembly mock-ups in EGNR-491 and EGNR-495), as well as for projects from industry.

A Roland MDX40, a desktop milling machine, purchased in 2009, is used for many of the same activities as the RP machine. It serves as a virtual printer to the 3D CAD software. This device can mill woods, plastics, and soft metals other than aircraft aluminum and steel. This has a serviceable area of 12x12x4 inches and has a rotary axis as well. Prototype parts requiring materials other than ABS can be made on this machine.

A 2013 Michigan Initiative for Innovation and Entrepreneurship grant provided 10 seats of EAGLE Pro Circuit board development software used for creating schematics and printed circuit board artworks for electronic projects. Two licenses are in use by PDC and 8 are located in the computer LAB 209B.

A Next Engine 3D HD Laser Scanner purchased in October, 2009 is used to scan existing parts into a cloud-of-points and from there to 3D CAD. EGNR-491 and EGNR-495, along with the PDC, make use of this machine to scan parts that have no engineering drawing so that modifications or documentation can be made. Two Dell workstations which are set up for CAD and engineering activities are also located in the lab.

These major tools are supplemented by Dremel grinding, drilling and polishing tools and various hand tools.

Other Facilities

The CASET building has 27 dedicated office spaces for use by students, faculty, support staff, and the administration. Some of these offices are used to house student engineering groups or for storage. Additionally, the Engineering House, a living-learning community for approximately 30 students, is located about 100 yards from the CASET building and the SSMart Zone building is located about 1 mile north of campus. These areas are discussed in the following sections.

School Office

The School of Engineering and Technology office suite, has four specialty office spaces that include reception, conference room, photocopy/scan equipment and supplies, and a storage room.

Faculty Offices

Faculty offices are furnished with standard equipment that includes a desk and chair, additional chairs for guests, computer, telephone, bookcase(s), and filing cabinet(s). Many offices being used for storage are available to house additional faculty members should enrollment and/or programmatic growth warrant.

Conference Rooms

The School of Engineering and Technology utilizes several areas for conference rooms. These common areas are used for faculty and student meetings. Four areas, CAS-106B, CAS-106C, CAS-203, and CAS-205, are routinely used for conferences. Room sizes vary and can accommodate 6-15 people at one time.

Student Club Offices

Office space has been made available to the engineering student clubs. IEEE is housed in CAS-316. ASME is housed in CAS-309A. SAE is housed in CAS-117. SWE is housed in CAS-103I. The Engineering and Technology Honor society and other student groups meet in the conference rooms.

Engineering House

The Engineering House is a residence on campus in which a select group of engineering and technology students inhabit. The house is adjacent to a number of other living-learning communities from different academic areas. The house costs the same as traditional dorms, but offers many advantages including larger bedrooms, a kitchen, a laundry facility, as well as common areas where students are able to congregate. The house is open to all engineering and engineering technology students, both male and female (housed on separate floors with separate bathrooms).

There is a good mix of students at different points in their academic careers (from freshmen to senior). Many of the students will be in classes together, allowing them to easily work and study together. The upperclassmen will also have taken many of the same classes, and had many of the same experiences, making them a great resource for help and advice.

In exchange for these additional amenities, the students are required to participate in a group project above and beyond their normal course work. The subject of the project is decided upon by the students themselves, but must be approved by the house advisors. While this project does require some additional work, it is an excellent opportunity to gain experience working in an engineering team. The current project is constructing a 3D printer.

SSMart

LSSU and SSMart, a Michigan Smartzone, have a collaborative use agreement in place that provides access to students and SSMart entrepreneurial clients of the combined equipment owned by the two entities. Specifically SSMart makes available a CNC Lathe (Haas TL-1), a150W Laser cutter/etcher, a consumer grade CUBEX Trio Fused Deposition Modeling 3D printer and high resolution OBJET 30 Pro UV Polymer technology 3D printer.

B. Computing Resources

Lake Superior State University *provides* computer, network and internet services to members of the campus community. These services are intended to assist faculty, staff and students in the accomplishment of their University responsibilities and duties. The computing resources offered by the University adequately supplement those offered within the School of Engineering and Technology and meet the needs of the students in the EET program.

University-wide Computing Resources

Located in the KJS Library, the Courseware lab has 39 Dell GX380 computers. All computers are running Windows XP and have Microsoft Office 2007 installed. Most of the software titles used on campus for classes are also installed on these computers. A high-speed black and white laserjet printer is also installed in the lab for use.

Courseware Lab Hours

Monday	8am - 12am
Tuesday	8am - 12am
Wednesday	8am - 12am
Thursday	8am - 12am
Friday	8am - 7pm
Saturday	11am - 7pm
Sunday	1pm - 12am

The Rathskeller lab has 4 systems that are part of a virtual client platform using NComputing vSpace L-series thin clients and is located in the Walker Cisler Center. All computers are running Windows XP and have Microsoft Office 2007 installed. Most of the software titles used on campus for classes are also installed on these computers. A high-speed black and white laserjet printer is also installed in the lab for use. This lab is separated in to two sections. At times part of the lab is used for training purposes and may not be available for general use.

Rathskeller Lab Hours

Monday	11am - 12am
Tuesday	11am - 12am
Wednesday	11am - 12am
Thursday	11am - 12am
Friday	11am - 5pm
Saturday	12pm - 5pm
Sunday	12pm - 12am

Additional Computing Resources for Students

In addition to the School of Engineering and Technology Computer Lab and the two general LSSU computer labs, there are various computer resources available to EET students located throughout the laboratories in the CASET building.

Engineering Design Center (CAS-106B)

The Engineering Design Center (CAS-106B) is equipped with up to eight computers (one for every senior project team). The computers placed in this room have full network access at 10/100 Mbit/s, have the necessary engineering software installed, typically are at least Intel i5 dual-core with at least 4GB of RAM, and are served by a common printer. Students enrolled in EGNR-491-495 have 24 hour access to these computers.

Robotics and Automation Center (CAS125)

The Robotics and Automation Center (CAS124/125) is equipped with 14 computers. The computers have full network access at 10/100 Mbit/s, are at least Core 2 Duo with at least 2GB of RAM, and are served by a common printer. Numerous software packages and programming languages are used in the Robotics and Automation Center. The Fanuc robots are programmed in the Karel programming language and Teach Pendant language and the Staubli robots are programmed in the VAL3 language. The ladder logic programming for the Allen Bradley PLCs are programmed using the Rockwell software RSlogix. The laboratory also provides access to simulation software packages. The RoboGuide robotics simulation software package is used in EGRS-385 Robotics Engineering, and the WITNESS discrete event manufacturing software package is used in EGRS-381 Robotics Technology Lab. Students enrolled in the aforementioned courses have to these computers from at least 8:00 a.m. to 5:00 p.m., but may receive additional after-hours access as needed.

Digital Electronics Lab (CAS-304)

The Digital Electronics Lab (CAS-304) is equipped with 13 computers. The computers have full network access at 10/100 Mbit/s, are at least Core 2 Duo with at least 2GB of RAM, and are served by a common printer. Specialized software installed on these computers includes Quartus (digital synthesis), GoLogic (logic analyzer), and Code Warrior. All engineering and engineering technology students have access to these computers from at least 8 a.m. to 5 p.m.

Analog Electronics Labs (CAS-306 and CAS-309)

The Analog Electronics Labs (CAS-306 and CAS-309) are each equipped with 8 computers and a printer. The computers have full network access at 10/100 Mbit/s, and are at least Core 2 Duo with at least 2GB of RAM. Specialized software installed on these computers includes ORCAD PSpice. All Engineering and Technology students have access to these computers from at least 8 a.m. to 5 p.m.

Computing Resources for Faculty

All faculty members have computers and network connections in their offices, and all faculty computers are at least at least Intel i5 dual-core with at least 4GB of RAM. The minimum software package on these computers includes Windows 7 or Windows 10, Office2010 or later and Internet Explorer, Google Chrome, or Fire Fox. Other software installed on the faculty computers is based on the courses that they teach.

Network connections are 10/100 Mbits/s. All faculty members have full Internet access as well as Microsoft networking. There is at least one networked laser printer on each floor of the engineering building for faculty to use for printing. There are also several shared network drives for faculty to exchange information amongst themselves and with students.

Several web based packages are available for both faculty and student use:

a. Blackboard Learn 9.1is a course management system that allows faculty to supplement, or deliver wholly, the courses they are teaching. Students enrolled in courses with a Blackboard component have access to support materials posted by the instructor (using syllabi and assignments), links to Web-based materials, discussion boards and chat rooms, and online quizzing. Each instructor customizes Blackboard for his or her course, using a variety of "tools" as mentioned above. Campus-wide, over 40 faculty members at LSSU use Blackboard for more than 100 blended or online courses. LSSU has recently transitioned from Blackboard Learn 9.1 to self-hosted Moodle 3.0 and will shortly transition to Moodle 3.0 hosted by Moonami.

b. The 'my.lssu' campus portal is beneficial to staff, students and faculty. It allows for single sign-on access to email, calendar, Blackboard (and soon Moodle), Anchor Access (see item c. below) and FASS (student course scheduling systems). It also offers improved e-mail, groups, chat/message boards, course studio, file sharing, targeted announcements and customizable pages. The portal is role-based, hence users have access to tools and announcements related to their role as a student or faculty member.

c. Faculty and students regularly use Anchor Access, a self-serve computer system, accessible through the 'my.lssu' portal. Anchor Access is just one part of Banner, which also handles finance, advancement, financial aid and more.

Through it, students are able to view and pay bills online, print copies of their schedules and view and print transcripts. Automated Graduation Verification has been implemented to assist students and staff in confirming the courses needed to complete a program of study. This component is used in tandem with paper-based verification. Notably, it allows students and their advisors to perform a "what if" analysis to see which courses would be required to complete an alternate degree program.

C. Guidance

LSSU takes great pride in the hands-on learning opportunities provided to its students. To ensure the safe operation of tools, equipment, computing resources, and laboratories, it is standard practice for faculty members to first discuss general safety procedures for a given laboratory in a classroom setting. These procedures are reinforced by demonstrations in the appropriate laboratory. For a particular laboratory exercise, the basics and theory surrounding a specific device or experiment is presented. Best practices for the operation of a particular device are subsequently discussed and demonstrated. Students then work under the tutelage of a faculty member or technician when operating the device for the first time, during which time they may ask questions or request a review of the procedure. A faculty member or technician remains proximate in any laboratory settings where the possibility of bodily harm exists. Once rudimentary mastery of a device has been learned, students are then able to use the equipment with faculty/adjunct guidance present throughout the rest of their courses. More detailed accounts of guidance for two specific settings are provided below.

Preparation for correctly and safely operating equipment in the *Manufacturing Lab* utilizes the following steps:

1) The safety procedures are covered in class, and again in lab
2) The assignment is explained and given in lab
3) The basics and theory of the experiment or assignment is covered in class (i.e. the cutting speed and rpm calculation for 1010 mild steel being cut with a high speed cutter), and then it is shown in lab as well
4) The operation of the equipment and the actual assignment is then demonstrated
5) The student is then instructed to do the assignment. If the student has any questions, they are to ask the instructor for further explanation, and if needed the procedure is covered again

The students are encouraged to work together, but are expected to do their own work on their assignments.

Similarly, preparation to properly and safely utilize equipment in the *Electrical and Computer Engineering Laboratories* is summarized as follows:

Equipment

Use of lab equipment is described and demonstrated in the laboratory setting. The students are then required to use the equipment with faculty guidance throughout the rest of their courses.

Software

Cadence circuit simulation and Quartus digital design software are both demonstrated in the lab setting. The students are then required to use the software packages to solve and design different circuits using the software packages. Cadence software is used in the analog circuits courses. Quartus is used throughout the digital course offerings.

Laboratories

The safety procedures are covered in class, and again in lab.

D. Maintenance and Upgrading of Facilities

The University is committed to continually maintaining and improving the educational environment and facilities used to deliver education. Funding for facilities maintenance and improvement are contained in the University General Fund. Grants from NSF, MEDC, Perkins, and industry, along with donations have been instrumental in acquiring new and replacement equipment.

While there is no annual equipment budget, *per se*, for the School of Engineering and Technology, the laboratories are well equipped and receive adequate funding. The two main sources of revenue that support laboratory facilities via the University General Fund are the course fees and program fees that come from students taking engineering and engineering technology courses. Between the two, approximately $209,000 is generated per year. Equipment, software and hardware are upgraded on an "as needed" basis, which has been sufficient.

Most courses have a course fee that depends on the cost of maintaining the equipment and software to support the course. In general, courses that have a lab component have higher course fees than those that do not. Approximately $57,000 was raised in course fees last year. All courses having the "EG" prefix have a differential tuition of $70 per credit hour called a program fee. Approximately $152,000 was raised in program fees last year.

Recent Upgrades

Major acquisitions made within the last six years that directly impact the EET program are noted below.

Programmable Logic Controller (PLC) Laboratory (CAS-106A)

Year	Item	Quantity	Status
2013	Core 2 duo computers	8	new
2013	PLC Trainers, Desktop	10	new
2013	Panelview Trainers, Desktop	6	new
2013	Part Checkers	3	upgrade

2013	Mixing Stations	3	upgrade
2016	Additional PLC Trainers, Desktop	2	new
2016	Additional Panelview Trainers, Desktop	2	new
2016	Additional Part Checker	1	new
2016	Additional Part Checker	1	new
2016	Additional Computer	2	used

Engineering Design Center (CAS-106B)

Year	Item	Quantity	Status
2014	i7 Desktop Computer	7	new

Plastics Molding Lab and Wood Shop (CAS-122)

Year	Item	Quantity	Status
2015	Robotics Cell	1	used

Surface Mount Assembly / EPIC Lab (CAS-124)}.

Year	Item	Quantity	Status
2010	APS CS40 Surface Mount Robotic Assembly	1	new
2010	SPR-25 stencils	2	new
2010	GF12HC reflow oven	1	new
2011	APS L40 Surface Mount Robotic Assembly	1	new

Robotics and Automation Center (CAS-125)

Year	Item	Quantity	Status
2011	Staubli RX90 Robot	3	new
2011	Staubli TX90	1	new
2011	VAL3 Studio (Software Package)	4	new
2011	Bosch Rexroth Conveyor System	1	new
2011	SCHUNK Robotics End-of-Arm Tooling	4	new
2011	ATI Robotics Tool Change System	4	new
2011	Piab Vacuum End-of-Arm Tooling	4	new
2011	RS Logix PLC Software	1	new
2011	Dell Computers	4	2 yrs old
2012	Staubli RX60 Robot	1	new
2013	Fanuc LR Mate Robot	2	new
2013	Fanuc M1iA Robot	1	new
2013	Dell Computers	4	1 yr old
2013	Allen Bradley Panel View	1	new
2014	Roboguide Robotics Simulation software	10	new
2015	Fanuc M10iA Robot	4	new
2015	Allen Bradley PLC	1	new
2015	Fanuc 2d iRVision Systems	4	new
2016	Roboguide Robotics Simulation Software	5	new
2016	SCHUNK Robotics End-of-Arm Tooling	4	new
2016	SCHUNK Robotics Tool Change System	4	new

2016	Piab Vacuum End-of-Arm Tooling	4	new
2016	Dell Computers	5	new
2016	Fanuc 3DL iRVision System	1	new
2016	Fanuc Line Tracking System	2	new
2016	Fanuc Force/Torque Sensing System	1	new
2016	Allen Bradley Panel View	1	new

Computer Lab (CAS-209A-209B)

Year	Item	Quantity	Status
2015	i5 computers	30	new
2016	Core 2 duo computers	3	used

Digital Electronics Lab (CAS-304)

Year	Item	Quantity	Status
2010	Altera DE1 – EVB FPGA boards	10	new
2013	Corobot – mobile robot	1	new
2013	Optiplex 745 – DELL PC	5	used
2013	Optiplex 780 – DELL PC	8	used
2014	Altera DE1-SoC boards	10	new
2014	Altera Cyclone V GX Starter Kit	1	new
2014	Acute TL2118E – Logic Analyzers	10	new
2015	Optiplex 3010 – DELL PC	5	used

Analog Electronics Labs

Year	Item	Quantity	Status
2011	Agilent/HP E3620A power supply	20	new
2011	Agilent/HP 33120A signal generator	20	new
2011	Fluke 8846A multimeter	10	new
2011	BK Precision 2530B oscilloscope	20	new
2015	Keysight DSO-X2004A oscilloscope	10	new

Rapid Prototype Center (CAS-310A)

Year	Item	Quantity	Status
2009	Roland MDX40 Desktop Milling Machine	1	new
2009	Next Engine 3D HD Laser Scanner	1	new
2013	EAGLE Pro Circuit Board Development Software	10	new
2015	Stratasys Dimension 3D Printer	1	new

E. Library Services

Kenneth J. Shouldice Library

The Kenneth J. Shouldice Library and Learning Commons provide the core research materials needed to support the academic curricula offered by the University. The Library is headed by Marc Boucher, Director of Library Services.

In the fall of 1997, a 35,000 square-foot expansion and remodeling of the existing structure to the University Library was formally opened and full resources made available for faculty and student use. The facility includes ample space for study; over 32 personal computer stations with access to specialized library resource databases and the Internet; small and large study and conference rooms; an IT help desk; a small art gallery; the campus's center for testing, tutoring, mentoring and the Faculty Center for Teaching.

Collections

The collection consists of over 140,000 volumes and 850 periodical subscriptions (including both electronic and print), as well as 75,000 microforms. The library uses Ex Libris' Voyager integrated library system and OCLC's WorldShare as a discovery layer to provide access to both print and electronic materials through a single user interface off of the library's Website.

Reference and Instructional Services

Reference service provided by professional librarians, is available every day and evening the Library is open, other than weekends. The Ask Us desk, formerly known as the reference desk, now also serves students looking for IT, tutoring, mentoring or any other academic need. Information literacy and research instructional sessions are not only provided to University students, but local K-12 students, students from Sault Ste. Marie, Ontario, and the surrounding intermediate school district areas such as Paradise, St. Ignace, and Pickford. All research databases are accessible to the general public while on campus, and off campus access restricted databases is provided to all campus students, faculty and staff.

Resource Sharing

Resource sharing has always been a prominent aspect of Library operations at Lake Superior State University. A unique feature of this Library is that it is open to the public (on both sides of the international border) and also offers users a joint library card that serves as both their checkout card for LSSU's library as well as all public libraries in the Eastern Upper Peninsula. Our library catalog is shared with Northern Michigan University. Users can locate materials by specific library or collectively. If patrons find materials that are not available at the campus library, library staff will locate it through Interlibrary Loan. Students at Regional Center sites have direct access to a priority interlibrary loan arrangement and materials are shipped directly to the students.

Resources, Special Facilities, and Services

Resources available to students include access to the Internet from any of the computers located in the Library; but more importantly, over 50 research databases which index thousands of resources, many of which provide full text access to scholarly journals. All of these research databases are available off campus through the library's proxy server. The library's home page also provides links to many sites plus additional resource information. There are many group study rooms located throughout the library and the main floor also serves as a space for group interaction through the intentional layout of comfortable furniture and accessible technology to enable group engagement. Throughout the year the Library hosts several lectures that are open to the entire campus community.

Reserve

The Library maintains library reserve materials for faculty to place materials for specific classes. This allows all students to access materials that are of limited availability. Faculty determine the loan period (one hour, in library use only, overnight, etc.). In most cases, materials are removed from reserve at the end of each semester.

Government Publications

The Library is a selective federal government depository library which means it does not receive all publications from the Government Printing Office (GPO), but select publications that are chosen in addition to those required by the GPO. After evaluating the depository program a few years ago, it was decided to reduce the number of titles selected to those that most directly serve our clientele. Currently, the items selected represent about 16 percent of the total items available to us as a selective government depository.

Special Collections

The Library maintains a small special collections area in secured rooms on the third floor of the library. Access is supervised. The collection includes works about the Upper Peninsula, the Soo Locks, regional history, Great Lakes shipping, and Governor Chase S. Osborn. A special room is dedicated to Senator Philip Hart and contains memorabilia of the late senator. While not extensive, the uniqueness of these collections has attracted researchers from Ontario, Canada, within the state, and occasionally from bordering states.

Information Literacy Instruction

Library instruction is conducted in a state-of-the-art computerized room located on the third floor of the Library. Students are taught how to access and search the many electronic resources available through the KJS Library. While general instructional sessions are offered, most often instruction targets access and databases that directly relate to the faculty members' special class needs. When not being used for information literacy instruction, this room is a general access lab for all students.

F. Overall Comments on Facilities

As noted above, the School has the facilities and resources necessary to meet its program educational objectives and student outcomes.

As noted in Section C, detailed instruction on proper and safe equipment use and operation is provided to students prior to their utilization of any laboratory equipment. Once rudimentary mastery of a device has been learned, students are then able to use the equipment with faculty/adjunct guidance present throughout the rest of their courses.

CRITERION 8. SUPPORT

A. Leadership

As described in Criterion 6 Section E, decisions on the overall direction of the program are indeed the province of the entire faculty of the School of Engineering and Technology (SET), but the primary responsibility for detailed oversight of the program rests with the five faculty members comprising the Department Electrical and Computer Engineering and the one faculty member who is coordinator of the EET and MfgET programs.

Because the entire School of Engineering and Technology is comprised of only ten faculty members and there are three departments (ECE, ME, and ET) and six programs (CE, EE, ME, EET, MfgET, and IT), the curricula are intertwined and there is considerable overlap in the leadership responsibilities for the various programs. Rather than attempting a somewhat artificial distinction between the various leadership roles that affect the EET program, the *de facto* duties of each, the ECE coordinator, the ET coordinator, and the SET chair, relative to the EET program will all be enumerated.

It has been practice for the ECE coordinator to assume the following responsibilities that directly impact the EET program:

- coordinate course assessment for all EGEE, EGNR, and EGRS listed courses which are either specific to the EE, CE, and EET programs (i.e. without students from the ME or MfgET programs);
- prepare EET curriculum change proposals present them at the University level;
- prepare course change proposals related to the EET program and present them at the University level;
- oversee the EET program by setting the agenda for and running ECE departmental meetings;
- assist the School chair in course scheduling for EET course offerings;
- assist the School chair in assigning instructors to EET courses;
- organize and coordinate hiring committees for faculty vacancies in the ECE department;
- lead the ECE department in evaluating the attainment of the EET student outcomes;
- interview all graduating EET seniors;

It has been practice for the ET coordinator to assume the following responsibilities that directly impact the EET program:

- represent the needs of the EET program at weekly "Chair" meetings (dean, School chair, program coordinators);
- lead discussion relevant to the EET program at the Industrial Advisory Board meetings;

- recommend course substitutions, course waivers, and transfer credit evaluations for EET students;
- maintain and update all degree audit forms and plans of study forms for the EET program;
- advise all students in the EET programs;

It has been practice for the SET chair to assume the following responsibilities that directly impact the EET program:

- lead discussion relevant to the entire School of Engineering and Technology at the Industrial Advisory Board meetings;
- coordinate course assessment (in School faculty meetings) for courses common to only to the CE, EE, and EET programs;
- coordinate assessment of EET student outcomes;
- serve as pre-approval authority for course substitutions and waivers for EET students;
- set the agenda and run the meetings of the School of Engineering and Technology;
- set the agenda and run weekly "Chair" meetings (dean, School chair, program coordinators);
- represent the School of Engineering and Technology at weekly "provost Council" meetings;
- conduct scheduling of course offerings;
- assign instructors to courses;
- advise all SET freshman and transfer students upon arrival;
- write "program review" reports for all SET programs on a five-year cycle;
- establish and maintain transfer equivalency ("articulation") agreements with community colleges;
- determine equivalencies for all engineering and engineering technology related transfer courses;

There is also a Dean position (shared with other Schools, as described in Section C below). With respect to the EET program, this position serves as a final approval authority on course scheduling (and changes to instructor, time, or room), course substitutions/waivers, and, of course, budget matters and purchases. The Dean also serves as an approval stage for curricular proposals (new courses, course changes, program changes, etc.) prior to submission to the University-wide Curriculum committee and thence the Provost's office for final approval. The Dean is also the formal supervisor for all faculty and staff within the SET, carrying out performance evaluations, and serving as an approval stage for hiring decisions recommended by Search committees.

B. Program Budget and Financial Support

Budget

LSSU has a Strategic Planning and Budget Committee (SPBC), which is an advisory committee charged with assessing, developing, and monitoring the University's strategic plan, as well as prioritizing resource needs throughout the University. It is a shared governance committee, i.e., has membership representing students, faculty, staff, and administration. The activities of this committee can be reviewed at <www.lssu.edu/sharedgovernance/planningbudget/>.

The Vice President of Finance receives department/school budget requests (one of which is for the SET) and prepares the overall General Fund Budget and Auxiliary Budget Summaries for submission to the SPBC. The SPBC members, including the Vice President of Finance, review individual detailed departmental budgets, the General Fund and Auxiliary Budgets. Recommendations are taken to the President's Cabinet (in June each year) for review and finalization prior to presentation to the Board of Trustees for approval in July.

Recurring LSSU funding for the School of Engineering and Technology, broken down by source, is shown in Table 8-1 below.

Table 8-1: Summary of SET Funding, Recent Years

Allocations	2012-13	2013-14	2014-15	2015-16
Base Operation	33,984	33,984	33,984	33,984
Carry Over	10,675	1,822	27,332	89,017
Course Fees	42,040	48,310	47,970	57,180
Program Fees	68,700	126,788	134,191	152,216
Total Allocation	155,399	210,904	243,477	332,396

The program receives funding from three University sources (base operation allocations, course fees, and program fees), represented by rows in the table. When bona-fide plans for expenditure are articulated to the CFO, funds not utilized in the previous academic year are carried over to the next year, that amount also shown as a row.

CSSM funds are LSSU allocated funds for the basic operation of the unit. These basic operations would include paper, phones, office supplies, copying, travel, small office related equipment, and other similar items.

Students enrolled in Engineering or Engineering Technology courses also pay course fees and program fees, which the SET receives. The course fees vary from course to course but range from $10-$100, with a median of $60 (not counting the zeros); these are set for each course considering the extent of that course's usage of laboratory equipment and expendables, large-volume printing (handouts), and/or renewable license software. The program fee is $70 per credit hour for courses beginning with an EGxx prefix. The School can adjust course fees yearly. Program fees and course fees are adjusted in consultation with the Provost, and require Board of Trustee approval.

As is evident from Table 8-1, the Base Operation component has been stable from year-to-year. On the other hand, course and program fees received have been increasing each year as the overall School of Engineering and Technology has been growing.

As noted earlier, all degree programs are closely-related, sharing all resources. We do not break out funding by program, but the School Chair and Program Coordinators work closely with the Dean to review the needs for each program and make appropriate allocations and purchases.

In addition, not shown in Table 8-1, but consistent enough to regard as "recurring", LSSU is annually eligible to receive a Perkins Voc-Ed Grant. Most years, SET receives $10K; every fourth year, however, SET receives $30K.

Regarding non-recurring, or irregularly recurring, sources of income, there have been equipment sell-offs and donations. Over the last several years, a few thousand dollars have been raised by selling retired equipment on e-bay. Several pieces of donated equipment have been utilized in our labs, including robots for instance.

Occasional targeted donations have been received. For instance, a $10k donation in 2013 donation paid for new PLC trainers. As another example, a fundraising campaign by the IAB in 2015 paid for a 3D printer.

Teaching Support

Teaching is supported by the occasional use of student assistants, and by the availability of teaching workshops, both on-campus and nationally.

Student class assistants are used, occasionally, in some workshop and computer lab courses. Their roles have included assisting students during the labs with accomplishing the lab work (EGNR-101, EGME-141, EGNR-140, EGRS-381), or in recitation/additional help hours (EGNR-265). These would be students who had previously taken the course, and done well enough to satisfy the current instructor.

More exceptionally, two student "graders" were provided in the Spring 2016 offering of the lecture course EGME275 Engineering Materials (not part of the EET program, but perhaps serving as a precedent), which had a large enrollment (38 initially), to check/"pre-grade" homework (give comments and tentative scores to worked problems for the instructor's review). This may serve as a precedent henceforth, and the Dean had verbally-stated that it would be dependent upon enrollment numbers in courses. To some extent, the student workers in EGNR140 have also reviewed and commented homework.

Teaching workshops exist on campus, via the title-III grant supported "Faculty Center for Teaching"; the extent of participation by faculty connected with the EET program is uncertain. There are also usually teaching-related workshops during the development week preceding the Fall semester; as classes are not yet underway at that time, attendance is relatively straightforward for most faculty members.

External workshops are also supported. Jaskirat Sodhi (2014) (no longer with LSSU) and Zakaria Mahmud (2015) each attended the NETI (National Effective Teaching Institute) workshop sponsored by ASEE. David Leach (2016) attended an ABET IDEAL (Institute for the Development of Excellence in Assessment Leadership) workshop. David Baumann and Robert Hildebrand (2013) attended one-day ABET workshop (Program Assessment Workshop).

Finally, in indirect support of teaching, the University maintains a variety of student services, including counseling, library, placement, admissions, registrar, a learning center (instructing academic success strategies), and tutoring.

Infrastructure Support

Both course and program fees are used for major equipment purchases, computers, lab supplies, equipment maintenance, software, and other related items. Table 8-2 provides a summary of the expenses categories denoting how funds have been spent for the last few years.

Table 8-2: Expense categories and spending

AccountNumber	AccountDescription	Actual 2013	Actual 2014	Actual 2015	YTD 2016
7001	Supplies-Office	4,074.16	4,198.41	3,622.33	1,134.21
7002	Reference Books	914.55	238.99	905.31	624.81
7003	Central Stores	2,043.75	1,958.00	1,700.00	1,840.00
7004	Supplies-Lab	11,558.03	22,427.06	21,372.44	25,202.24
7005	Supplies-Aud Visual	534.80	1,190.25	428.46	14.95
7006	Supplies-Photo-Print	-	-	-	-
7010	Awards-Plaques	95.95	395.61	493.09	99.45
7015	Supplies-LSSU Name-Logo Items	4,067.93	334.56	1,290.79	558.00
7020	Supplies-Other	23,054.14	5,295.99	16,490.33	18,564.99
7030	Copies	12,595.20	13,448.32	10,913.56	14,785.64
7031	Printing	1,227.63	1,399.99	1,134.52	2,558.41
7040	Postage	373.46	180.79	1,355.92	1,099.59
7050	Telephone	5,604.12	4,291.85	5,204.88	4,491.54
7055	Fax	2.05	-	-	-
7060	Software	-	-	57.90	5,000.00
7061	Software Licenses and Maintenance	12,729.20	19,217.45	15,076.84	12,923.00
7065	Computer Hardware	93.80	3,953.03	3,392.87	13,237.42
7070	Equipment <2500	17,360.90	21,040.30	12,034.77	18,392.14
7101	Travel in State	4,117.76	6,356.25	3,883.37	4,363.70
7102	Travel out of State	6,399.61	5,833.01	10,891.48	5,947.30
7103	Travel Students	-	53.00	-	-
7110	Meetings-Luncheons	4,348.33	5,128.36	4,864.81	10,776.89
7111	Guest Lodging-Meals	146.50	14.73	-	100.70
7112	Conferences	585.00	2,710.00	5,168.87	2,945.00
7131	Recruitment--Student	958.36	302.88	244.19	1,267.15
7211	Rental-Equipment	-	-	-	1,300.00
7225	Rental-Other	-	-	-	2,536.50
7230	Product Development Center Services	4,000.00	-	-	-
7253	Contracted Services	-	-	200.00	45,000.00
7261	Equipment Mtnce and Repair	2,994.90	4,078.26	550.00	-
7272	Accreditation	67.99	-	-	-
7290	Linen Service	76.00	-	292.50	292.50
7320	License-Permits-Fees	6,364.00	-	-	539.50
7340	Memberships	2,420.00	2,923.00	2,671.00	7,387.04
7341	Subscriptions-Magazines	-	-	-	-
7345	Advertising	-	-	77.55	-
7365	Professional Development	300.00	619.47	1,928.50	5,447.00
7395	Miscellaneous	-	92.08	-	-
7399A	Academic Base, Carryover and Fees	-	-	-	-
7520	Haz Material Dispose	504.00	-	-	1,406.58
7960	Capitalized Equipment Purch	4,982.50	55,900.00	22,470.90	23,199.45
Grand Total		134,594.62	183,581.64	148,717.18	233,035.70

Resource Adequacy for Teaching and Infrastructure

The budget has also allowed the School of Engineering and Technology to sufficiently meet the *teaching* needs of the EET program. Although teaching assistants or graders are rarely used, funding has been adequate for the occasional instances in which they were necessary.

The budget has also allowed the School of Engineering and Technology to sufficiently meet the *equipment* needs of the EET program. Although no comprehensive five or ten year equipment replacement plan exists, funding has been adequate for critical and necessary upgrades as well as needed maintenance activities.

C. Staffing

The staffing of the School of Engineering and Technology is described in the following, in terms of compensated positions (full or part time; salaried, release-time, or stipend assignments); evidently, as is typical in academia, much additional work is also available in the form of service activities by faculty members. All of the positions described have some responsibility, to varying degrees, for the EET program (as well as other programs).

Clerical Staff

Throughout the vast majority of the last 6-year cycle, support staff (for the School of Engineering Technology) has included 1-1/2 full-time positions, i.e., a full-time secretary, and a half-time administrative assistant. Only very recently (indeed June 2016) was the half-time position discontinued.

The Secretary provides clerical support to the faculty and Dean, manages day-to-day activities in the School's office, processes purchase requisitions and manages faculty cardholder accounts, organizes special events (e.g., annual School banquet), provides coordination support for Summer programs (camps for high-school-age and younger), and pursues various other duties as well. The administrative assistant position had provided assistance for marketing and recruitment, implementation of Engineering admissions policies, and maintenance of assessment and accreditation records. Given the very recent discontinuance of this position, it's unclear to whom these duties will devolve, but undoubtedly, some will be expected to shift to the full-time Secretary, some to the Chair, some to others, and some may be discontinued.

Furthermore, there has continuously been a part-time student assistant in place to help the Secretary, including summertime.

Administrative Staff

Dean. (see Criterion 8 Section A above for the Dean's role) The School was administered, at the onset of the 6-year cycle, by its own full-time Dean, but during most of the cycle the Dean has been divided with the Lukenda School of Business under the auspices of a combined college. Beginning July 1 (the date of this report), a reorganization will place the SET together with both Business and Criminal Justice within a Division of Professional Studies and Outreach under a Dean (position vacant, but led by the Interim Provost Dr. Finley, the former Dean of Business and Engineering, assisted by the Associate Provost, Dr. Myton, in the interim); that academic unit will belong to a larger College of Professional Studies.

Chair. The Chair (see Criterion 8 Section A above for his/her role) is a 3-release hour (1/4-time) appointment, plus $2721 stipend per semester, and $2000 Summer stipend ; that has been consistent during the entire 6-year cycle, except for the Summer stipend, which has varied from $0 to $2000.

Coordinators. During some early portions of the 6-year cycle, both Coordinators (see Criterion 8 Section A above for their respective roles) received 2 release hours (out of 12 for full time) per semester, i.e., these were 1/6 time assignments, but during the majority of the cycle they received 1 release hour (1/12-time) and most recently receive no release time.

As of January 2016, the ET departmental coordinatorship is henceforth uncompensated, and the ECE departmental coordinatorship is likewise uncompensated. Accordingly, there is not presently any compensation for administrative work specific to the EET program, and the tasks/roles described in Criterion 8 Section A above could not therefore accurately be described as required "duties"; nevertheless, they accurately represent who is doing what work for the program, at least on a voluntary basis.

Robotics Director. There is a 3-release hour (1/4-time) assignment for running the Robotics laboratory of the SET. Note that courses such as EGRS-381 (in the EET core) and EGRS-215, EGRS-430, and EGRS-481 (in the Robotics Technology minor) make extensive use of this laboratory. The director develops the robotics laboratory through industrial donations and grants, and plays key leadership roles nationally in the Society of Manufacturing Engineers and the Robotics Industry Association.

Academic Staff

Instructional Staff. The ten full-time faculty positions (all tenured or tenure-track) have already been detailed in Criterion 5.

In addition, some usage is made of adjunct faculty. In particular, the two Laboratory Engineers frequently act in this capacity, and the courses they typically instruct (or co-instruct) all belong to the MfgET program, including the lab components of EGET-110 *Applied Electricity* and EGET-175 *Applied Electronics*, project advising in the capstone EGNR-491-495 sequence, and occasionally the EGRS-365 *PLC's*.

The PDC (Product Development Center) of the larger College also employs a full-time Engineer, and has employed two during most of the 6-year cycle; these have sometimes served as adjuncts (notably for EGNR-245 *Calculus Applications for Technology*, EGME-141 *Solid Modelling*, with some lecturing in the capstone courses as well).

An external adjunct is also sometimes used, especially for the lecture component of EGME-141 *Solid Modelling*.

Technical Staff. Two-full time Laboratory Engineers are assigned to the School of Engineering and Technology. An Electrical/Computer Laboratory Engineer is responsible for the maintenance and operation of all electrical and computer equipment in the laboratories. A Mechanical Laboratory Engineer is similarly responsible for the maintenance and operation of all mechanical equipment in the laboratories. Both Laboratory Engineers design and manufacture equipment for use by faculty in the laboratory, or the classroom. These positions are full-time, twelve month appointments.

Resource Adequacy for Clerical, Administrative, and Academic Staffing

The School of Engineering and Technology has had sufficient *clerical* staffing to meet the needs of the EET program. However, the recent loss of the half-time administrative assistant may jeopardize this or result in diverting teaching and administrative resources away from the day-to-day needs of the academic programs.

Budgetary allocations may not be sufficient to meet the *administrative* staffing needs of the EET program. Although the School chair receives 25% release time supplemented by a $2721 per semester stipend, that position encompasses administrative leadership for all six programs in the School; furthermore the ECE departmental coordinator and the ET program coordinator receive neither release time nor a stipend.

The School of Engineering and Technology currently has sufficient *instructional and technical* staffing to meet the needs of the EET program, provided the ten positions remain filled. The ten regular faculty members, supplemented by the aforementioned adjunct instructors, are able to deliver all the courses that are required to support the EET program. Furthermore, the two full-time laboratory engineers have the resources to maintain all equipment and facilities used by the EET program.

D. Faculty Hiring and Retention

Faculty Hiring Process

The reader is referred to appendix K *Faculty Agreement*, the contract between the faculty and the University, wherein its appendix B (appendix B of the Faculty Agreement, but appendix K of this document) provides a detailed description of the procedure for formation and conduct of a faculty hiring committee. This is a University-wide procedure to which we adhere (in-fact, this procedure for the whole University was modelled after our longer-standing practices in the School of Engineering & Technology), but it does not address some of the specific additional practices that have developed for, and the philosophy for the conduct of, searches in within the School of Engineering and Technology. Although there have been no searches conducted for CE/EE/ EET faculty within the last 6 years, there have been seven searches for ME/MfgET faculty during that time.

Consistent with the institution's primary mission of teaching, and the School's philosophy of maintaining an applied emphasis in its engineering and technology programs, the evaluation process employed in the hiring of new faculty accordingly places a greater emphasis on a candidate's promise as an instructor and on industrial experience than it does on academic research credentials (although the latter *is* also a factor of lesser weight). A faculty candidate is generally expected to have some teaching experience (either as faculty member or a teaching assistant) and to possess excellent communication skills.

After initial screening of CVs, we typically extend invitations for phone interviews to up to a dozen candidates. These are contacted by a committee member, by phone, at which time, as a matter of transparency, the salary (usu. about $65,000 for these openings, which is considered low on the market) is related, as well as something of the geographical and climatological features of the region (rural and wintery), and the nature of the position (heavy teaching loads with little research emphasis). One or more of these factors may cause some of the candidates to withdraw at this point, saving them and the committee needless time expenditure. The remaining phone interview candidates then speak with the entire committee on the telephone for about 20 minutes to half-an-hour, at which time we question them on teaching interests, inclinations to teach laboratories, capstone projects, etc. Up to 3 of those candidates, whichever are most promising (if enough are), are then selected for campus visits.

During the campus visit, candidates give a sample lecture (on a topic specified by the hiring committee chair and generally kept the same for all visiting candidates); this lecture is ordinarily given to both students and faculty (including those not participating in the search committee). Feedback is thereafter solicited from the students and faculty in attendance, and is given much weight in the subsequent hiring decision. Besides the guest lecture, consideration is also given to the candidate's performance in an informal research (or professional) presentation, to collegiality as observed at interactions throughout the day, including meals and one-on-one interviews (including with HR, the Provost, and sometimes the President, who convey their respective feedback), and to feedback from the candidates' references. However, it remains the guest lecture that most often proves decisive.

Historically (and into the early phases of the 6-year cycle), the search committee would.select the best candidate, and also rank the other candidates in case of an offer being declined (as happens fairly frequently). The Dean and Provost then had formal authority to negotiate and hire, but tended to support the committee decisions. More recently, the search committees have been discouraged from selecting and ranking, in favor of merely indicating "qualified" or "not qualified.

Faculty Retention

Retention of qualified faculty is partially a matter of correct selection in the search and hiring process, i.e., by identifying a "good fit" faculty hire for the SET. The optimal faculty hire, given the relatively high instructional load, should be committed to instruction, rather than exclusively to research, as well as adaptable to the geographical and climatological particulars of Michigan's Eastern Upper Peninsula (i.e., relative remoteness in a wintery setting). Moreover, while such a person may well be a subject matter expert, the willingness to function as a generalist, and with bonafide laboratory and project skills, is ideal. Given these attributes, a faculty member is likely to find a degree of satisfaction in the work that is conducive to retention.

A School-specific PD fund (beyond that of the University), to bolster faculty retention, has also been available during the 6-year cycle, and still continues in more restricted form. In 2012, subsequent to the EAC of ABET visit which had cited the various Engineering programs for issues of faculty retention (these being the same faculty who cover the Engineering Technology programs), the SET committed to provide a fund for workshops/conferences, summer stipends for scholarly endeavors, and other PD activities. Accordingly, for a portion of the cycle, these funds have been available for the purposes described, and may be allocated to Engineering Technology-related PD just as well as to Engineering-related. In the last year, however, stipends have been discontinued, so that the fund is now limited to travel reimbursement and materials/equipment.

Retention has not been an issue for the ECE Department, having retained all faculty members over the past six years. However it has been an issue for the ME Department, which has hired and lost six (one due to retirement) faculty members in the past six years, and has impacted the ECE faculty workload somewhat.

E. Support of Faculty Professional Development

The "Agreement" (ref. appendix K) between Lake Superior State University and the Faculty Association provides each faculty member with $1000 per academic year for professional development; earlier in the 6-year cycle (through 2013), this level was at $800, so it has undergone a $200 annual increase during the cycle. A faculty member's professional development fund can carry over from academic year to academic year, but not to exceed $4,000 (unchanged). Expenditures from professional development funds must be related to the faculty member's professional development or teaching objectives. In addition, faculty members, who are officers of professional organizations or presenters at national conferences, have received additional support to travel to workshops and conferences from departmental and/or Dean's budgets.

Note also the additional SET PD fund described in Criterion 8 Section D. For a couple of years during the 6-year cycle, these provided stipends for scholarly work, as well as travel and materials reimbursement. Although the stipends have been discontinued, the funding continues to exist for travel and materials.

The "Agreement" between Lake Superior State University and the Faculty Association also provides a total of up to three semesters of sabbatical leave at full pay per academic year (it had been four, through 2013). A tenured faculty member is eligible for a Sabbatical Leave after five (5) academic years of employment as a faculty member at the University, so long as s/he has not had a Sabbatical Leave within the previous five (5) years. A Sabbatical Leave Committee comprised of two Deans, appointed by the Provost, and six faculty members elected by the faculty shall consider the applications for sabbatical leave and make recommendations to the Provost. One engineering faculty member, Professor David McDonald of the Electrical and Computer Engineering department, has been awarded a sabbatical during the last 6-year cycle; he received a full-time sabbatical for the 2011-2012 academic year.

PROGRAM CRITERIA

To satisfy program criteria for EET programs, it is, firstly, necessary that the curriculum contain courses that teach the specific topics mentioned, and, secondly, that the faculty maintain currency in these specialty areas. Criterion 6 of this self-study report documents that the LSSU EET program makes use of qualified faculty, with areas of specialty matching each of the requirements of program criteria, so attention in this section will be primarily devoted to an explanation of how the curriculum supports these criteria, and to an explanation of how the various elements of the EET curriculum are integrated into a coherent whole.

Program Criterion (A)

> *"Graduates ... must demonstrate knowledge and hands-on competence appropriate to the objectives of the program in ... the application of circuit analysis and design, computer programming, associated software, analog and digital electronics, microcomputers, and engineering standards to the building, testing, operation, and maintenance of electrical/electronic(s) systems. "*

Table 9-1 below shows how the courses in the EET curriculum relate to the technical skills enumerated in program criterion A. Note that the table only includes the *engineering and engineering technology* courses in the core of the EET curriculum and does not include technical electives.

Table 9-1: Coverage of Program Criterion A in EET Curriculum

Course	circuit analysis	circuit design	computer programming	associated software	analog electronics	digital electronics	microcomputers	engineering standards	building	testing	operation	maintenance
EGEE-125				x		x			x	x		
EGEE-250			x	x		x	x			x		
EGEE-320			x	x		x				x		
EGEE-355			x	x		x	x		x	x		
EGET-110	x				x							
EGET-175	x				x							
EGET-310	x	x		x	x				x	x	x	
EGME-141				x								
EGNR-101								x	x	x		
EGNR-140			x	x								
EGNR-265			x									
EGNR-310			x	x								x
EGNR-491								x	x	x		
EGRS-365			x	x						x	x	
EGRS-380				x				x				
EGRS-381				x				x		x	x	

Program Criterion (B)

> *"Graduates ... must demonstrate knowledge and hands-on competence appropriate to the objectives of the program in ... the application of natural sciences and mathematics at or above the level of algebra and trigonometry to the building, testing, operation, and maintenance of electrical/electronic(s) systems."*

Table 9-2 below shows how the courses in the EET curriculum relate to the science and mathematics competencies enumerated in program criterion B. Note that the table only includes the *natural science, mathematics, engineering, and engineering technology* courses in the core of the EET curriculum and does not include technical electives.

Table 9-2: Coverage of Program Criterion B in EET Curriculum

Course	natural science	algebra	trigonometry	math above	building	testing	operation	maintenance
EGEE-125								
EGEE-250								
EGEE-320								
EGEE-355								
EGET-110	x	x			x	x		
EGET-175	x	x	x		x	x		
EGET-310								
EGME-141			x					
EGNR-101								
EGNR-140								
EGNR-265								
EGNR-310				x				x
EGNR-491								
EGRS-365								
EGRS-380								
EGRS-381								
CHEM-108	x							
CHEM-109	x							
PHYS-221	x							
PHYS-222	x							
MATH-111		x						
MATH-112		x						
MATH-131			x					
EGNR-245				x	x	x		

Program Criterion (C)

> *"Graduates ... must demonstrate ... the ability to analyze, design, and implement one or more of the following: control systems, instrumentation systems, communications systems, computer systems, or power systems."*

Table 9-3 below shows how the courses in the EET curriculum relate to the areas of proficiency enumerated in program criterion C. Note that the table only includes the *engineering and engineering technology* courses in the core of the EET curriculum and does not include technical electives.

Table 9-3: Coverage of Program Criterion C in EET Curriculum

Course	control systems	instrumentation systems	communications systems	computer systems	power systems	analyze	design	implement
EGEE-125				x		x	x	
EGEE-250				x		x	x	
EGEE-320				x		x	x	x
EGEE-355				x		x	x	x
EGET-110								
EGET-175								
EGET-310								
EGME-141								
EGNR-101								
EGNR-140								
EGNR-265				x			x	
EGNR-310								
EGNR-491	x					x	x	x
EGRS-365	x					x	x	x
EGRS-380	x					x	x	
EGRS-381	x							x

Program Criterion (D)

> *"Graduates ... must demonstrate ... the ability to apply project management techniques to electrical/electronic(s) systems."*

Table 9-4 below shows how the courses in the EET curriculum relate to management techniques required by program criterion D. Note that the table only includes the *management, engineering, and engineering technology* courses in the core of the EET curriculum and does not include technical electives.

Table 9-4: Coverage of Program Criterion D in EET Curriculum

Course	theory of management	application of management techniques
EGEE-125		
EGEE-250		
EGEE-320		
EGEE-355		
EGET-110		
EGET-175		
EGET-310		
EGME-141		
EGNR-101		
EGNR-140		
EGNR-265		
EGNR-310		
EGNR-491	x	x
EGRS-365		
EGRS-380		x
EGRS-381		
ECON-302	x	
MGMT-371	x	

Program Criterion (E)

> *"Graduates ... must demonstrate ... the ability to utilize differential and integral calculus to characterize the performance of electrical/electronic(s) systems."*

Table 9-5 below shows how the courses in the EET curriculum relate to the mathematics competencies enumerated in program criterion E. Note that the table only includes the *mathematics, engineering, and engineering technology* courses in the core of the EET curriculum and does not include technical electives.

Table 9-5: Coverage of Program Criterion E in EET Curriculum

Course	theory of differential calculus	utilization of differential calculus	theory of integral calculus	utilization of integral calculus
EGEE-125				
EGEE-250				
EGEE-320				
EGEE-355				
EGET-110				
EGET-175				
EGET-310				
EGME-141				
EGNR-101				
EGNR-140				
EGNR-265				
EGNR-310				
EGNR-491				
EGRS-365				
EGRS-380				
EGRS-381				
MATH-111				
MATH-112	x		x	
MATH-131				
EGNR-245	x	x	x	x

Signature Attesting to Compliance

By signing below, I attest to the following:

That Electrical Engineering Technology has conducted an honest assessment of compliance and has provided a complete and accurate disclosure of timely information regarding compliance with ABET's *Criteria for Accrediting Engineering Technology Programs* to include the General Criteria and any applicable Program Criteria, and the ABET *Accreditation Policy and Procedure Manual.*

David R. Finley, Ph.D., P.E.
Interim Provost, Lake Superior State University
Dean, School of Engineering and Technology
Dean, Lukenda School of Business

David R. Finley

Signature

July 1, 2016

Date

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering and Technology**
Document Title (If attached) or Filename (If emailed):	**Degree Audit**
This documentation is relevant to Question number:	**15**
Briefly summarize the content of the file and its value as evidence supporting program review:	

School of Engineering and Technology
BS Degree in Electrical Engineering Technology – *Degree Audit*

(For Students Entering the Program in 2015 or later)

Student Name: ______________________

Student ID #: ______________________ Advisor Approval: ______________ Date: ________

Intended Month of Graduation: ______________________ Chair Approval: ______________ Date: ________

All information below should be from the student's most recent transcript and/or transfer evaluation.

GENERAL EDUCATION REQUIREMENTS

Communication Skills (9 credits required)

ENGL110 - 3 ______

ENGL111 - 3 ______

COMM101, 201, or 225 - 3 ______

Humanities (6 credits required)

Elective (see catalog) __________ - ___ ______

Elective (see catalog) __________ - ___ ______

Social Science (Also listed as Dept. Requirement)

ECON302[1] - 4 ______

Social Science (3 credits required, cannot use ECON class)

Elective (see catalog) __________ - ___ ______

Diversity (3 credits required)

Elective (see catalog) __________ - ___ ______

Mathematics (Also listed as Dept. Requirement)

MATH111 - 3 ______

Natural Sciences (Also listed as Dept. Requirement)

CHEM108 - 3 ______

CHEM109 - 1 ______

PHYS221 - 4 ______

☐ Gen-Ed Requirements met by MACRAO

Students must satisfy all of the following minimum requirements for graduation:

- ☐ 2.0 overall GPA
- ☐ 2.0 General Education GPA
- ☐ 2.0 departmental GPA
- ☐ 125 total credits
- ☐ 32 credits earned at LSSU
- ☐ 22 credits 300/400 level in major earned at LSSU

[1] Theses courses may be offered only every other year

[2] Technical elective credits may be substituted for this course if EGRS215 is not offered.

DEPARTMENT REQUIREMENTS

Electrical Engineering Technology Core (82 credits required)

CHEM108 - 3 ______

CHEM109 - 1 ______

ECON302 - 4 ______

EGEE125 - 4 ______
(C or better required)

EGEE250 - 4 ______

EGEE320[1] - 4 ______

EGEE355[1] - 4 ______

EGET110[1] - 4 ______
(C or better required)

EGET175[1] - 4 ______
(C or better required)

EGET310[1] - 4 ______

EGME141 - 3 ______

EGNR101 - 2 ______

EGNR140 - 2 ______

EGNR245[1] - 3 ______

EGNR285 - 3 ______
(C or better recommended)

EGNR310[1] - 3 ______

EGRS385 - 3 ______

EGRS380 - 2 ______

EGRS381 - 1 ______

MATH111 - 3 ______
(C or better required)

MATH112 - 4 ______

MATH131 - 3 ______

MATH207 - 3 ______

MGMT371 - 3 ______

PHYS221 - 4 ______
(C or better required)

PHYS222 - 4 ______

Senior Year Experience (6-13 credits required)

<u>Industrial Project</u>		or	<u>Cooperative Project</u>	
EGNR491 - 3	______		EGNR250 - 2	______
EGNR495 - 3	______		EGNR450 - 4	______
			EGNR451 - 4	______
			EGNR491 - 3	______

Technical Electives (12 credits required)

__________ - ___ ______ __________ - ___ ______ __________ - ___ ______

__________ - ___ ______ __________ - ___ ______ __________ - ___ ______

Recommended technical electives include: CSCI163, EGEE365, EGME110, EGME240, EGME275, EGME276, EGME410, EGMT225[1], EGME312, EGRS215*, EGRS430*, EGRS480*, EGRS481*, and MATH215 or higher.

* Students wishing to complete the <u>Robotics Technology minor</u> should take EGRS215[2], EGRS430, EGRS480, and EGRS481 as technical (or free) electives.

Free Electives (3 credits required)

__________ - ___ ______ __________ - ___ ______ __________ - ___ ______

18-Nov-18

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	Engineering and Technology
Document Title (if attached) or Filename (if emailed):	EGET 310 Course Report
This documentation is relevant to Question number:	15
Briefly summarize the content of the file and its value as evidence supporting program review:	Provides a single example of a course report containing course and program assessment

LAKE SUPERIOR
STATE UNIVERSITY
Engineering and Technology

EGET310 “Electronic Manufacturing Processes” (3,3)
Spring 2017

COURSE ASSESSMENT SUMMARY

Offering Details

Lecture Times: SU 5:00PM*	Lecturer: E. Becks
Lab Times: SU 5:PM *	Lab Instructor: E. Becks
Recitation: None	Number of Students: 4 (3-Sr, 1-Jr)
Textbook: None	
Lab Manual: None	

* Directed study meeting time

Context within Curriculum

Student Population: junior and senior -level MfgET, EET, EE
Previous Courses Required: (EGET110 & EGET175) or EGEE210
Current Courses Required: None

Relationship to ABET Student Outcomes

ETAC of ABET Student Outcomes				BAC of ABET Student Outcomes	
a	***	✓✓✓	(EET report)	A	Not Applicable
b	*	✓✓	(EET report)	B	
c				C	
d	*	✓	(EET report)	D	
e	*	✓✓		E	
f				F	
g	*	✓✓	(EET report)	G	
h				H	
i				I	
j	**	✓✓	(EET report)	J	
k				K	

✓ = exposure (e.g., one graded assignment)
✓✓ = stress (e.g., one course objective)
✓✓✓ = focus (e.g., multiple objectives, course title)

* = foundational – ready for further development
** = developed – prepared for practical application
*** = high – approaching that of a practicing engineer

Student Grades (4, no one dropped)

F	D-	D	D+	C-	C	C+	B-	B	B+	A-	A	A+	GPA
0	0	0	0	0	0	0	0	1	2	1	0	0	3.325
								IEE	IMET IEET	IMET			3.26 (S15)

Course Objectives

1. understand properties of insulators, semiconductors and conductors as applied to electronic components;
2. perform schematic capture and circuit board layout using specialized CAD software;
3. program SMT equipment to automatically populate circuit boards;
4. perform feeder, stencil and oven setup;
5. perform soldering and rework operations; and,
6. effectively use assembly tools.

Summary of Course Assessment

- **Assessment Results:** (note only 4 responses)

Measure	Topic	Quantitative	Subjective
Objective 1	Conductors, Semiconductors & Insulators in electronic components	81	92.5
Objective 2	Schematic&Artwork Layout using specialized CAD software	81	87.5
Objective 3	Program SMT equipment for automatic board assembly	100	85
Objective 4	Perform feeder, stencil and oven setup	78	80
Objective 5	perform soldering and rework operations	100	92.5
Objective 6	effectively use assembly tools	100	85

Analysis of Objectives

1. **Explain basic properties of insulators, semiconductors and conductors as applied to electronic components.**

   Student Self Assessment: (Subjective) 92.5%
   Faculty Grades of Student Work: (Quantitative) 81%

   Student Comments

- • Yes, I learned most of this in EGET175
- Took EGEE370 prior to this course. But Becks explained it in a way I actually understood

   Faculty Comments

   • I suspect other students might say too much time was spent on the subject. It does lead to understanding of length, volume, voltage and power limitations in selecting components for the surface mount process.

2. **Perform schematic capture and circuit board layout using specialized CAD software.**

   Student Self Assessment: (Subjective) 87.5%
   Faculty Grades of Student Work: (Quantitative) 81%

   Student Comments

   Faculty Comments

- Labs needed to move along to get to the SMT process in the final week

3. **Program SMT equipment to automatically populate circuit boards.**

   Student Self Assessment: (Subjective) 85%
   Faculty Grades of Student Work: (Quantitative) .... **

   ** Students elected to have quiz 4 points applied to final project grade
   Q 4 solutions were provided as study guide for Final Prep
   Power outages affected open times for labs / final / quizes
   Testing center situation prohibited independent scheduling of quiz 4

   Student Comments

- The programming is rather basic

Faculty Comments

- Setup and run of SMT occurred in the last two lab sessions so survey occurred prior to lab

4. **Perform feeder setup on pick and place machine.**

Student Self Assessment: (Subjective) 80%
Faculty Grades of Student Work: (Quantitative) 78%

Student Comments

- Setup explained but not demos for feeder

Faculty Comments

- Parts arrived later than planned so feeders were loaded by instructor. Instructor walked through, demo'd, the feeder setups in lab just before running final project.

5. **Set up and use solder paste stencil and oven.**

Student Self Assessment: (Subjective) 92.5%
Faculty Grades of Student Work: (Quantitative) 100%

Student Comments

- Yes, I had soldering skills and this course increased it

Faculty Comments

- Teams all completed the process steps and the boards were assembled correctly except for a component orientation error due to a last minute change in the feeder.
- Future offering can be adjusted to delineate this score on a per student basis by recording grades over additional labs.
- Stencil lab used example boards and stencil along with chilled toothpaste to stand in for the solder paste. This avoids the problem of generating a waste product that would require special handling. Instead the students were free to simply wipe the toothpaste off the board try again. This year the execution on the paste lab was excellent with all students generating a proper pattern on the first try. All were present and participated in the program verification for the final assembly run.

6. **Perform soldering and rework operations and use assembly tools.**

Student Self Assessment: (Subjective) 85%
Faculty Grades of Student Work: (Quantitative) 100%

Student Comments

Faculty Comments

- Soldering rework stations allowed for a more thorough coverage of the topic including iron and hot air soldering, hot air de-soldering and vacuum through hole de-soldering.

Analysis of Pre-Requisite Courses

A. Did your previous prerequisite engineering (EGET 110 and EGET175) or EGEE210 classes provide you with adequate preparation for this class?

Student Self Assessment: (Subjective) ………………… 92.5%

Comments:

- Made the course easier having had the prior circuit theory

Suggestions to improve accomplishing the learning objectives in the prerequisite classes:

- Could probably get by without since material is covered at the beginning. EGET 175 has been taken at same time by several students in previous offerings

Part III: The following questions relate to delivery as a directed study.

A. Participants needed the course for graduation or as a technical elective during this term. Rate delivery method as compared to general course delivery?

Student Self Assessment: (Subjective) ………………… 95%

Comments:

- I liked that I could take the course at my own pace and it made it easier to complete while taking with senior projects
- I liked the self paced structure
- Less lab time but professor made time to be available if needed

Faculty Comments

- Initially kind of a disconnect in creating the lecture videos. Labs went efficiently with only 4 students. Final project was 1 team of 4 (3 were in senior projects) Each student got to do SMT of their own copy of the board. Usually only one member of the team runs a board.

General Comments

Student Comments

Faculty Comments

The directed study process went well allowing those that needed the course in the off year to take it. Definitely required additional effort and scheduling to make it happen.

Action Plans

From Previous Offering (Spring 2016) targeted for 2018

- Moved circuit board CAD activities closer to beginning of class but really need to move final project earlier for sufficient time for student creation of board, instructor merging boards and parts ordering process {ERB}
- Separate individual PC boards

For Next Offering (Spring 2019)

- Be more intentional on test question wording to address outcome j. In the process of modifying previous offering exam for use with current offering the topic was retained for the question but could have elicited an answer that more clearly addressed understanding of outcome j. {ERB}
- Consider creating a circuit board and purchasing the board and components prior to the course offering. Programming, verification, feeder setup and assembly run could be done earlier in the semester. The initial offering of EGET310 used an existing board with teams working on program verification. However, the students were not able to see the results of a circuit board that their teams designed. {ERB}

Evaluation of ABET-ETAC Student Outcome a (EGET-310 Spring 2017)

ABET Statement

an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities

Extent of Coverage in Course

✓✓✓ = focus

Expected Level of Achievement in Course

**** = high – approaching that of a practicing engineer*

Performance Indicator

the ability to use Surface Mount Technology equipment to automate placement of electronic components on a printed circuit board {EET}

Student Work to Evaluate

the ability to interpret a section of SMT program code to identify column and row information for the starting point fiducial mark of each board in a multi-board panel and to select appropriate handling parameters based upon component characteristics.

Final Exam question 12 and Quiz 4 question 8

Evaluation of Student Work Relative to Student Outcome

- The student work evaluated was a final exam question on determining fiducial mark locations to program for a multi-board panel (Final Exam question 12) as well as programming for appropriate tool to handle component (Quiz 4 question 8).
- For the assignment, the students were given information about the multi-board panel dimensions and, in question 8, information regarding the tool required to properly manipulate the component.
- The student work was evaluated by Eric Becks (ERB).

Final Exam question 12

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Avg
ERB	EET				1

- Only one EET was in this particular offering.
- There is a definite cause for concern since EET student performed "Unacceptable" on a key understanding of panelization which is widely used in industry.
- As noted on page 3 # 3 only Quiz 4 was not given during this offering so only Final Exam question 12 was evaluated.

Recommendations for Future Relative to Outcome

- Continue to use similar problems.
- Add more panelization example problems to future lectures.
- merge question information into a single Final Exam question

Evaluation of ABET-ETAC Student Outcome b (EGET-310 Spring 2017)

ABET Statement

an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies

Extent of Coverage in Course

✓✓= *stress*

Expected Level of Achievement in Course

* = *foundational – ready for further development*

Performance Indicator

the ability to apply knowledge of energy levels to determine whether materials are insulator, semiconductor or conductor { EET}

Student Work to Evaluate

EGET-310 Mid-Term Exam question 8 parts a-c

Evaluation of Student Work Relative to Student Outcome

- The student work evaluated was a mid term exam question on identifying whether the material represented by energy band diagram would be Insulator, Conductor or Semi-conductor.
- The student work was evaluated by Eric Becks (ERB).
- For the assignment, the students were given a diagram showing the Fermi-Dirac probability density function, band gaps and charge indicators along with a line representing the Fermi level for this topic.

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
ERB				EET	4

- Only one EET was in this particular offering
- Materials correctly identified along with Fermi Level

Recommendations for Future Relative to Outcome

- Continue to use similar problems.

Evaluation of ABET-ETAC Student Outcome d (EGET-310 Spring 2017)

ABET Statement

an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives

Extent of Coverage in Course

✓ = *exposure*

Expected Level of Achievement in Course

* = *foundational – ready for further development*

Performance Indicator

the ability to design library objects linking the symbolic schematic representation to physical package and contact locations for creation of circuit board artwork { EET}

Student Work to Evaluate

Library Object Lab – instructor selects specific component for which students will obtain datasheet via web search – component is modeled in the EAGLE library linking the symbolic schematic section to the physical package(s) for the component in the artwork section into a complete device that may be used in a circuit design (e.g. SX1213 UHF receiver integrated circuit).

Evaluation of Student Work Relative to Student Outcome

- The student work evaluated was an EAGLE Library file submitted by the student.
- The student work was evaluated by Eric Becks (ERB).
- For the assignment, the students were given a component to look up and build into a library element. The students were given access to internet and EAGLE software for this topic.

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
ERB				EET	4

- Exemplary for an initial use of EAGLE to create a library element.
- Only one EET was in this particular offering

Recommendations for Future Relative to Outcome

- Continue to use similar problems.
- Greater emphasis should be placed on aesthetics.

Evaluation of ABET-ETAC Student Outcome g (EGET-310 Spring 2017)

ABET Statement

an ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature

Extent of Coverage in Course

✓✓ = stress

Expected Level of Achievement in Course

** = foundational – ready for further development*

Performance Indicator

the ability to research and use technical specification sheets and application examples to implement a useful design element (EET)

Student Work to Evaluate

Team Lab Project – students will obtain datasheet(s) from web search, will model component(s) in the CAD library then combine with other components to design a schematic and implement circuit board artwork and participate in verifying component place locations and rotations using the SMT machine optical system and manual adjustments. The schematic is to clearly communicate the flow and function of the circuit in an organized manner. (e.g. Spring 2017 Bar Graph meter display circuit board).

Evaluation of Student Work Relative to Student Outcome

- The student work evaluated were EAGLE Library, Schematic and Artwork files submitted by the team and participation in the SMT program verification and assembly process.
- The student work was evaluated by Eric Becks (ERB).
- For the assignment, the students were given a component to look up and build into a library element. The students were given access to internet and EAGLE software for this topic.

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
ERB			Team comprised of EET,MET,MET,EE		3

- Minor mistakes included text overlap
- Final assembled board functions.
- Only one EET was in this particular offering

Recommendations for Future Relative to Outcome

- Continue to use similar final lab projects.
- Greater emphasis should be placed on aesthetics.
- Move design portions of project earlier in semester for longer team collaboration and to relieve sourcing issues mentioned in general summary.

Evaluation of ABET-ETAC Student Outcome j (EGET-310 Spring 2017)

ABET Statement

a knowledge of the impact of engineering technology solutions in a societal and global context

Extent of Coverage in Course

✓✓ = *stress*

Expected Level of Achievement in Course

** = *developed – prepared for practical application*

Performance Indicator

the ability to recognize the Material Safety Data Sheet as a resource to understand the impact of materials on individuals and the global environment. {EET}

Student Work to Evaluate

Final Exam question 2 on the Material Safety Data Sheet

Evaluation of Student Work Relative to Student Outcome

- The student work evaluated was a final exam question on the topic of the Material Safety Data Sheet
- The student work was evaluated by Eric Becks (ERB).
- The various parts of example Material Safety Data Sheets are discussed identifying where the safety and environmental precautions are found. Illustrations of older common practice are highlighted in the context of today's knowledge such as the common use of open vats of Freon ca. 1975 to remove flux residues left from the wave soldering process in circuit board cleaning and consideration of doping materials used in semiconductor fabrication such as Arsenic and how this presents regulatory challenges in some countries.

Reviewer	(1) Unacceptable	(2) Below Standard	(3) Meets Standard	(4) Exemplary	Ave
ERB				EET	4

Recommendations for Future Relative to Outcome

- Continue to use similar problems.
- Question should be framed to determine the depth of the student understanding of the information contained in a typical MSDS.

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	Engineering and Technology
Document Title (if attached) or Filename (if emailed):	Senior Project Posters
This documentation is relevant to Question number:	**16**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Provides example(s)** of projects involving **students** in this major.

Automation Controls

Senior Projects: 2016-2017

Project Statement

Along with team Conveying Automation Solutions (CAS), team Automation Controls Engineering (ACE) created an educational KUKA robotic platform for students at Lake Superior State University. The new robotic platform allows students to familiarize themselves with KUKA systems and also train students how to correctly follow safety standards used in industry today.

This project features two KUKA KR5 R1400 robots. These robots offer new capabilities such as synchronous robot movement. The cell includes a linear slide that allows the robots to send items between each other. The cell also features safety equipment including light curtains and an area scanner. These features are new to LSSU's robotics lab and offer a unique learning experience for students. This project helps keep LSSU's robotics lab current with technology used in industry today.

The Cell

PLC (Programmable Logic Controller)
Team ACE is using an Allen-Bradley CompactLogix PLC and also a Banner safety controller. The PLC is responsible for all inputs and outputs while the safety controller is responsible for the safety aspects of the cell.

HMI
For the HMI, an Allen-Bradley PanelView Plus 1250 with 12.1 inch touch screen capabilities is utilized.

Servo Drive/Motor
The cell features an Allen-Bradley Kinetix 350 servo controller. This controls the movement of the conveyor.

Sensors
Primary sensors in the cell are for end-of-arm tooling identification and gripper sensors. A limit switch at each end of the conveyor will limit the distance the conveyor can travel.

I/O Switch Boxes
The switch boxes utilize eight toggle switches and eight LED lights for educational purposes.

Faculty Advisor
Jeff King,
Electrical/ Computer
Laboratory Engineer

Automation Controls Engineering Team
[redacted]

Industrial Customer
Eric Nedia
Engineering Projects Manager/Director

Please scan the QR code to learn more about this project.

Project Made Possible By:

SCHUNK
LAKE SUPERIOR STATE UNIVERSITY
Parker
COGNEX
KUKA
TECHNOLOGY GROUP
JR AUTOMATION TECHNOLOGIES LLC
Baumer

KUKA Robot Features

The KUKA robots have a reach of about 1.4 meters. The robots are placed in such a way that their work envelopes slightly overlap. This allows the robots to operate with each other when utilizing RoboTeam. The KR5 R1400 have a maximum payload of 5kg. The three largest joints on the robot, axis 1-3, have a maximum speed of 210°/s while the three smaller joints at the end of the arm, axis 4-6, have a maximum speed of over 492°/s. The robot is very precise with a pose repeatability of ±0.04mm.

Key Robot Features

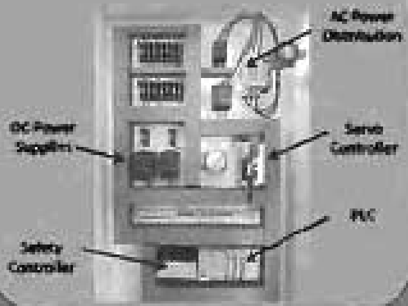
- KUKA SmartPAD
- KR C4 small-size controller
- Robot collaboration software - RoboTeam
- Cognex VisionTech

Electrical

The cell needs various hardware that requires both power and communication wiring. Team ACE developed the power distribution and communication required for the cell.

Junction Boxes
Junction boxes are used for cleanly routing signals to the PLC. This allows the PLC to monitor and control actions within the cell.

PLC Cabinet
The PLC is installed in the main cabinet. The cabinet houses all main power distribution, network communications, and control systems.



PART 2: Degree-Level Review

Degree Program: _ **Manufacturing Engineering Technology (AS)**

Explain how the program works to address each of the following questions. For each question, respond with a narrative and supporting evidence.

Assessment (CC 4.B and CC 4.C)

13. Provide evidence that the degree-level program outcomes are clearly stated and are effectively assessed, including the "use of results." Attach the 4-Column Program Assessment Report.

14. Explain how results from degree assessments were used to improve the degree program. Include specific examples.

Program review and feedback from students using course assessment summary documents allow faculty to note changes and improvements from the prior assessment, as well as documenting future changes for the next course assessment. These details can be seen in the sample course assessment summary included in the following pages. As an example, student performance and self-assessment in milling and turning feed and speed calculations for EGME110 Manufacturing Processes needed improvement. Based on review of assessment data, feeds and speeds calculation methodology has been strengthened in both the laboratory and lectures, and improvements have been seen in student performance. For Fall 2017, the EGME110 laboratory projects were updated to include more NIMS-based (National Institute for Metalworking Skills) skills training by including activities for a milling project and turning project that closely resemble certification training test parts. This change strengthens the technology skills focus of the MET-AS program. Also, laboratory activities and tools needed for each laboratory project have been organized to improve efficiency.

Quality, Resources and Support (CC 3.A)

15. Explain how the program ensures that degree program-level and course-level learning outcomes are at an appropriate level. Attach evidence, including a degree audit for the program.

A recipient of the AS degree in Manufacturing Engineering Technology will possess the fundamental technical skills in engineering technology, spanning mechanical, manufacturing, and electrical applications, required to either work as an entry-level technician in industry, or to be in a position to complete a Bachelor's degree in an engineering technology discipline with two remaining years of full-time study. These skills include engineering drawing, electronics, manufacturing processes, and mechanics.

The objective identifies the requisite skills to follow either of the paths (industrial employment or continued academic study) identified as appropriate to AS recipients in this discipline. Accordingly, the accomplishment of the objective is dependent on the degree to which the respective skills identified are, in fact, acquired by the student. The goal of the assessment protocol herein described is to assure that the courses in place in the program curriculum are the right ones to deliver the skills identified, that the courses are effective in doing so, and that they are continuously improved to ensure a consistent, continuous and long-term viability in doing so.

Acquisition of the skills is effected through a two-year full-time curriculum of study at LSSU, as specified in appendix A, "plan of study". It will be apparent that all of the skills identified in the objective correspond to courses in that plan of study; specifically,

Skill		Course
Engineering Drawing	is acquired from the course(s)	EGME141, EGME240
Electronics	" " " "	EGET110, EGET175, EGEE125
Manufacturing Processes	" " " "	EGME110
Mechanics	" " " "	EGMT225

Although these mappings of courses on to skills are suggested solely on the basis of the course titles, further examination of any of the corresponding course-specific objectives will demonstrate the same. These objectives may be found in the respective course syllabi, which are maintained in the y:-drive of the School of Engineering & Technology. Having established that the set of courses comprising the MfgET AS curriculum does impart the set of skills required by the objective, it remains then to establish that each identified course is effective in delivering its content, and undergoes continuous improvement. In other words, the remaining assessment of the program outcome objective reduces to assessment of the various constituent courses. All identified courses are regularly assessed according to the School's course assessment protocols, and continuously improved on the basis of these assessments, with new action plans established after each offering. A sample degree audit, syllabi, and course assessment summary is provided on the following pages.

See the following Appendix attachments:

- Degree Audit for MET-AS
- Sample Syllabus – EGME110 Manufacturing Processes (F2018)
- Sample Course Assessment Summary – EGME110 Manufacturing Processes (S2018)

Intellectual Inquiry (CC 3.B).

16. Explain what the program does to engage students in collecting, analyzing, and communicating information; mastering modes of inquiry or creative work; developing skills integral to the degree program. Attach examples of undergraduate research, projects, and creative work.

Select courses in the Manufacturing Engineering Technology (AS) plan of study have laboratory components as well as student projects. Laboratory experiences engage students in collecting and analyzing data, as well as reporting data in laboratory reports. In EGME110 Manufacturing Processes, students analyze and calculate machine variables such as feeds and speeds using calculations, machinery handbooks, and tool supplier data. These inputs are used to machine laboratory project parts using various manual and CNC machining Centers. In EGME141 Solid Modeling, first year and transfer students engage in a semester-long Human-Centered Design (HCD) project. Each student selects a community in need while building empathy, identifying important problems, brainstorming product ideas, narrowing down product options, and developing concepts. Using their creativity and data collection, students then design a final product using 3D parametric CAD software with the end goal of improving the condition of their community. Below are student samples of the final poster deliverable in EGME141:

Kenya Rural Community Cooking Fuel

[redacted] *Lake Superior State University*

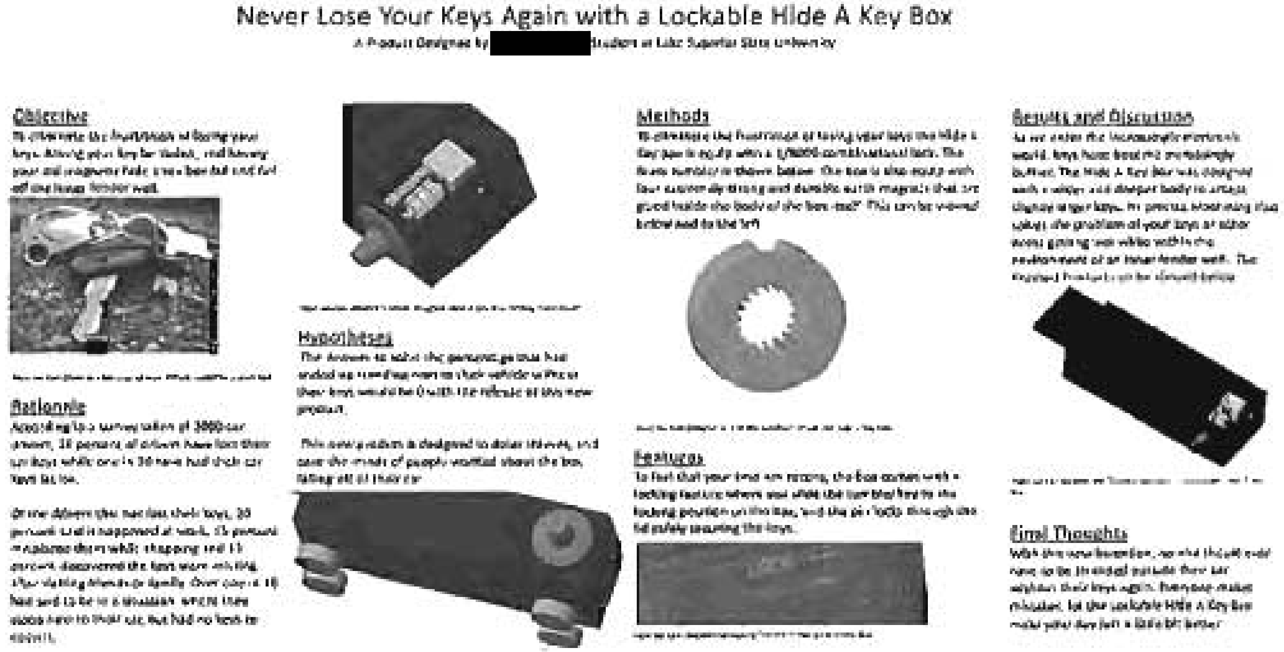
Why did I do This?

Rural Kenya Background

Thinking of Ideal

Present State

Future State



Never Lose Your Keys Again with a Lockable Hide A Key Box

A Product Designed by [redacted] Student at Lake Superior State University

Objective

Rationale

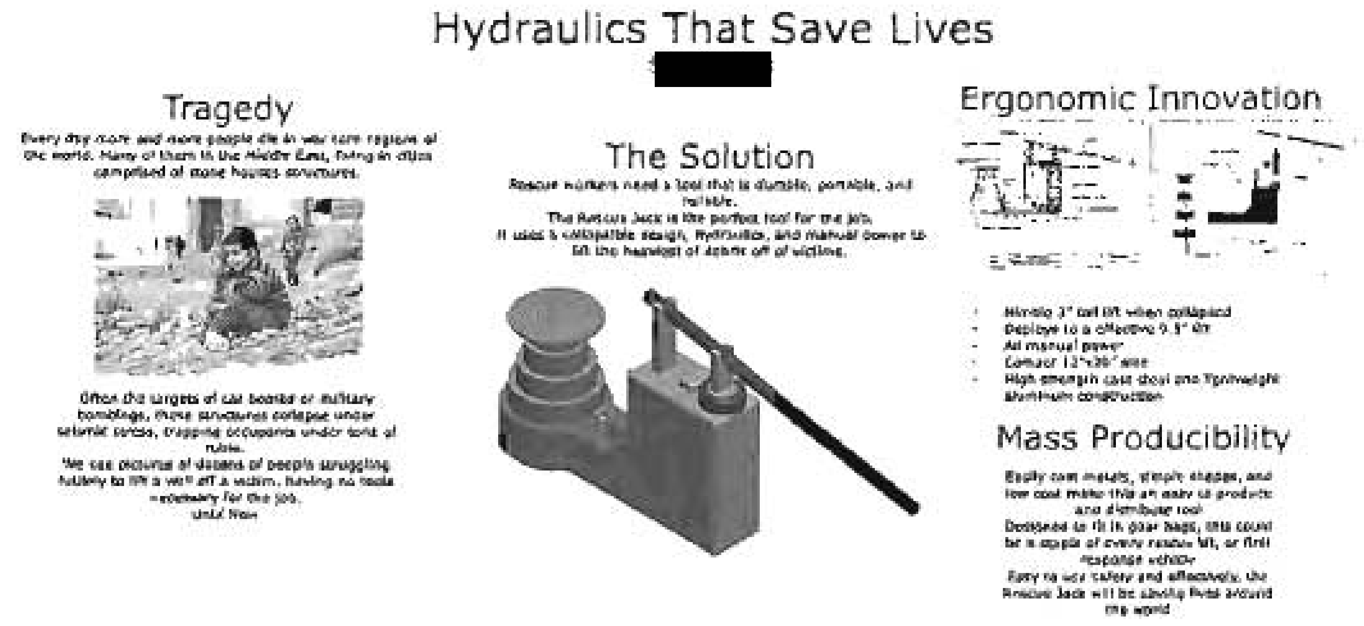
Hypotheses

Methods

Features

Results and Discussion

Final Thoughts



Hydraulics That Save Lives

[redacted]

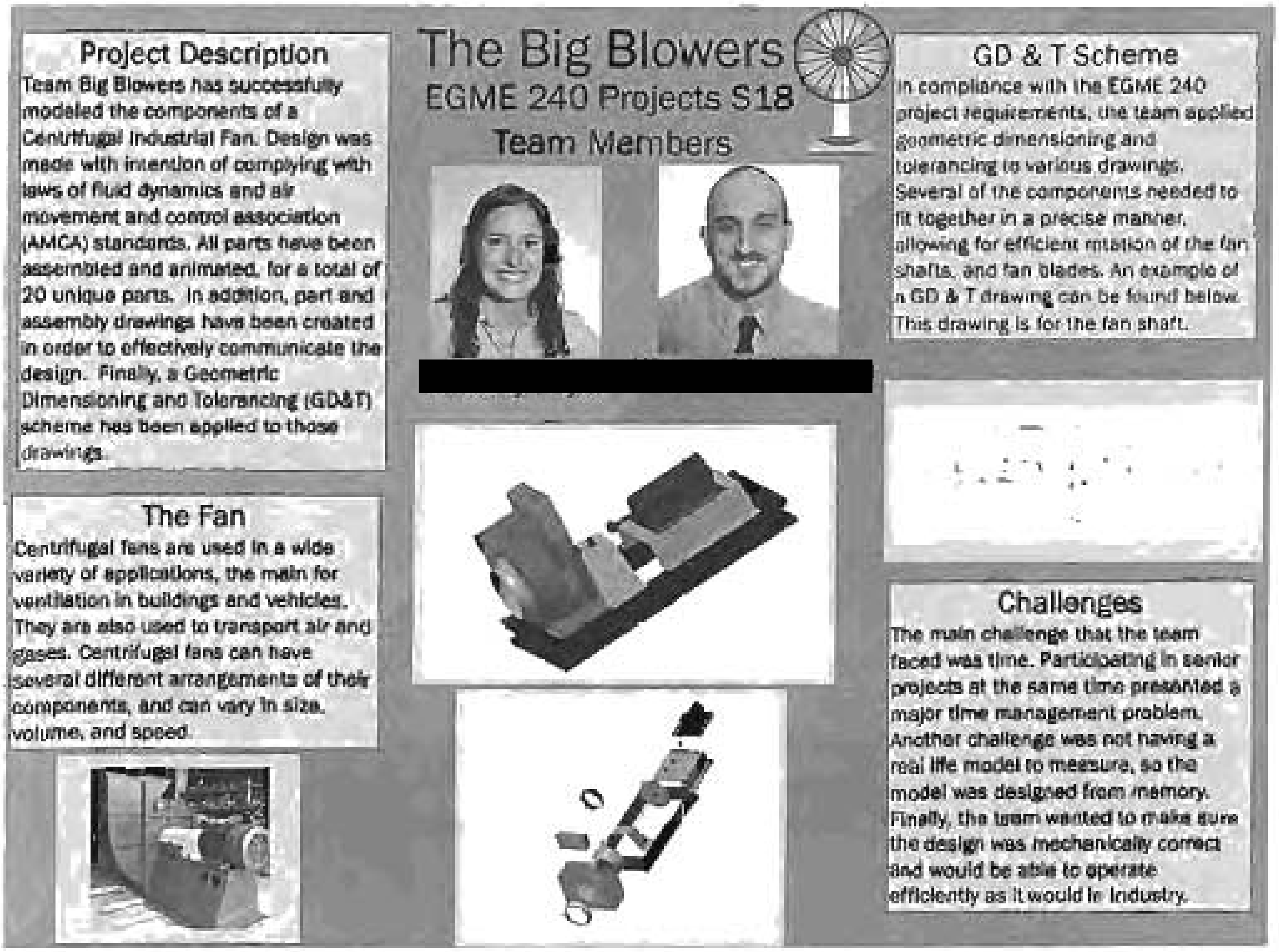
Tragedy

The Solution

Ergonomic Innovation

Mass Producibility

In EGME240 Assembly Modeling and GD&T, students work on a final project that culminates a semester-long course in assembly modeling and the application of geometric tolerancing and dimensioning. Sample final posters of student work are included below:



Project Description

Team Big Blowers has successfully modeled the components of a Centrifugal Industrial Fan. Design was made with intention of complying with laws of fluid dynamics and air movement and control association (AMCA) standards. All parts have been assembled and animated, for a total of 20 unique parts. In addition, part and assembly drawings have been created in order to effectively communicate the design. Finally, a Geometric Dimensioning and Tolerancing (GD&T) scheme has been applied to those drawings.

The Fan

Centrifugal fans are used in a wide variety of applications, the main for ventilation in buildings and vehicles. They are also used to transport air and gases. Centrifugal fans can have several different arrangements of their components, and can vary in size, volume, and speed.

The Big Blowers

EGME 240 Projects S18

Team Members

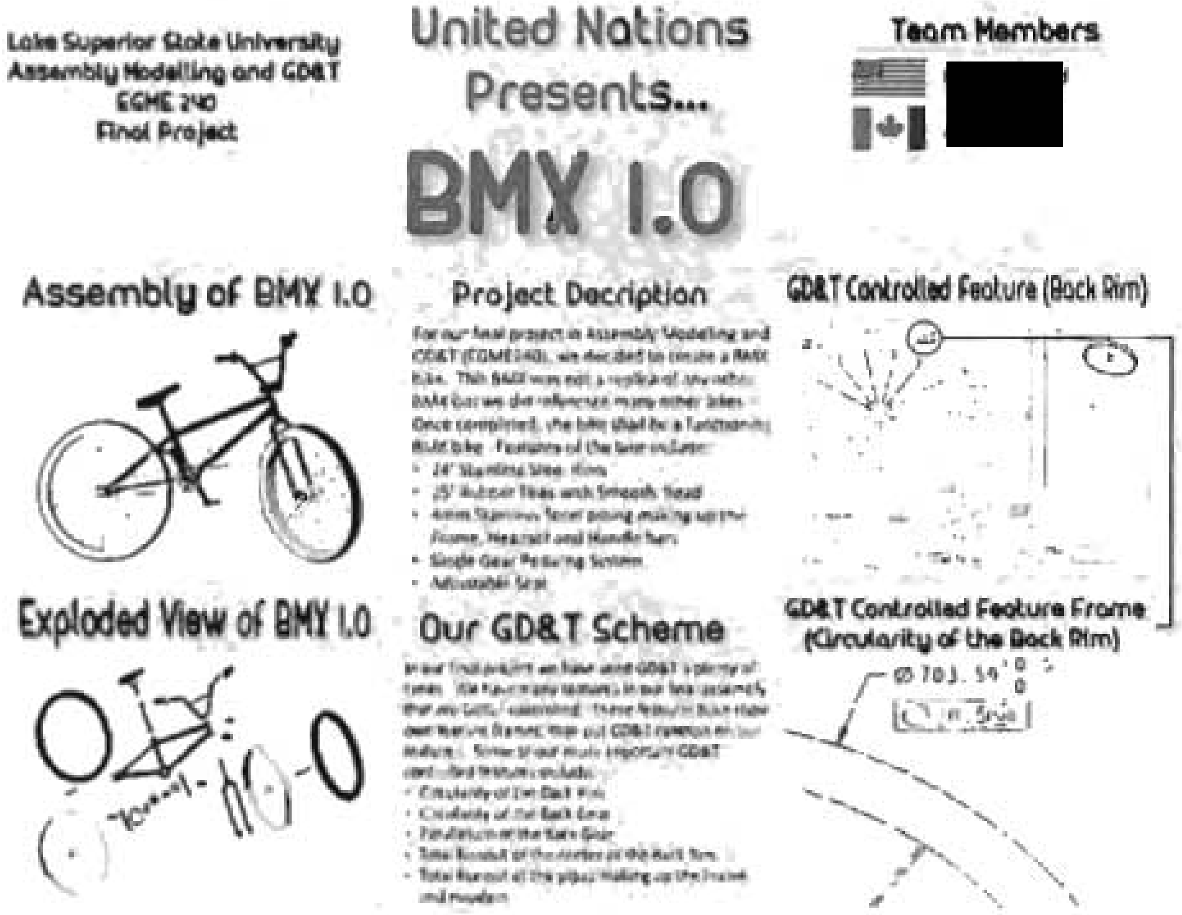
[redacted]

GD & T Scheme

In compliance with the EGME 240 project requirements, the team applied geometric dimensioning and tolerancing to various drawings. Several of the components needed to fit together in a precise manner, allowing for efficient rotation of the fan shafts, and fan blades. An example of n GD & T drawing can be found below. This drawing is for the fan shaft.

Challenges

The main challenge that the team faced was time. Participating in senior projects at the same time presented a major time management problem. Another challenge was not having a real life model to measure, so the model was designed from memory. Finally, the team wanted to make sure the design was mechanically correct and would be able to operate efficiently as it would in Industry.



Lake Superior State University
Assembly Modelling and GD&T
EGME 240
Final Project

United Nations Presents...

BMX 1.0

Team Members

[redacted]

Assembly of BMX 1.0

Project Description

For our final project in Assembly Modelling and GD&T (EGME 240), we decided to create a BMX bike. This BMX was not a replica of any other bike but we did reference many other bikes. Once completed, the bike shall be a functioning BMX bike. Features of the bike include:

- 24" Standard Steel Rims
- 2.5" Rubber Tires with Smooth Tread
- 4mm Stainless Steel piping making up the Frame, Headset and Handle bars
- Single Gear Pedaling System
- Adjustable Seat

GD&T Controlled Feature (Back Rim)

Exploded View of BMX 1.0

Our GD&T Scheme

In our final project we have used GD&T a plenty of times. [illegible] GD&T controlled. [illegible] Some of our more important GD&T controlled features include:

- Circularity of the Back Rim
- Circularity of the Back Gear
- Parallelism of the Back Gear
- Total Runout of the center of the Back Rim
- Total Runout of the pipes making up the Frame and Headset

GD&T Controlled Feature Frame (Circularity of the Back Rim)

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	Engineering and Technology
Document Title (if attached) or Filename (if emailed):	Four-Column Report
This documentation is relevant to Question number:	13
Briefly summarize the content of the file and its value as evidence supporting program review:	Evidence that Four-Column Report was completed.

Assessment: Program Four Column

Program (CoIS) - Manufacturing Eng Technology AS

Assessment Contact: Dr. Paul Weber, Chair

Mission Statement: A recipient of the AS degree in Manufacturing Engineering Technology will possess the fundamental technical skills in engineering technology, spanning mechanical, manufacturing, and electrical applications, required to either work as an entry-level technician in industry, or to be in a position to complete a Bachelor?s degree in an engineering technology discipline with two remaining years of full-time study. These skills include engineering drawing, electronics, manufacturing processes, and mechanics.

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
Communication - Students will be able to communicate in a technical environment. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Level 2 (Skills and Concepts) (Webb) **Institutional Learning:** ILO1 - Formal Communication - Students will develop and clearly express complex ideas in written and oral presentations. **Assessment Year:** AY16-17, AY17-18, AY18-19	Performance Indicator: ability to compose a technical log Evaluated Material: final project team logbook produced in Introduction to Engineering (EGNR-101) **Criteria Target:** Target: an average grade of 70% or higher	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Fall 2017: 78% (01/01/2018)	**Use of Result:** No concern at this time. Continue to evaluate in Fall 2018. (09/04/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** Yes Fall 2016: 80% (01/01/2017)	**Use of Result:** No concern at this time. Continue to evaluate in Fall 2017 (01/01/2017)
	Direct - Writing Intensive Assignment - Performance Indicator: ability to write written lab reports Evaluated Material: Students in EGET175 (Applied Electronics) will develop written lab reports based on results from experiments. **Criteria Target:** An average of 70% or higher on student work on this objective. **Schedule/Notes:** EGET175 is an alternate year course.	**Finding Reporting Year:** 2016-2017 **Goal met:** Yes Spring: Average of 89% on student for this objective. (05/01/2017)	**Use of Result:** No concerns at this time. Need more direct means to measure outcome. Reassess in Spring 2019. (05/01/2017)

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
Use of Technical Tools - Students will be able to use technical tools to solve engineering problems. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Mid-Level (Analyzing/Applying) (Bloom) **Institutional Learning:** ILO3 - Analysis and Synthesis - Students will organize and synthesize evidence, ideas, or works of imagination to answer an open-ended question, draw a conclusion, achieve a goal, or create a substantial work of art. **Assessment Year:** AY16-17, AY17-18, AY18-19	**Direct - Laboratory, Clinical, Skill/Competency Assessments** - Performance Indicator: Be able to create three-dimensional parts using advanced techniques of CAD software, like draft, sweep, variable section sweep, boundary blend, warp, project and surface modeling. Evaluated Material: lab work in EGME 240 Assembly Modeling and GD&T **Criteria Target:** Target: an average grade of 80% or higher	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes An average of 97.0% on this objective. (05/01/2018)	**Use of Result:** Most of the modeling topics were a review from the solid modeling course and the students seemed to have retained the material across courses. There are no concerns at this time. (05/01/2018)
	Direct - Laboratory, Clinical, Skill/Competency Assessments - Performance Indicator: 3. Students will be able to perform basic set-up and operation of the machines for the following processes: Casting and Molding, Welding and Cutting, Metal Forming, Turning, Milling, Grinding Evaluated Material: lab assignments in EGME110 Manufacturing Processes **Criteria Target:** An average of 80%	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes 90% average on this objective (05/01/2018)	**Use of Result:** We made improvements to standardizing each lab to include having all the tools and materials needed for each lab in one spot (tool box area). This improved lab efficiency There are no concerns at this time. (09/04/2018)
Engineering System Analysis - Students will be able to analyze mechanical systems by applying math, science, and/or engineering equations and techniques **Goal Status:** Active **Goal Category:** Student Learning **Institutional Learning:** ILO2 - Use of Evidence - Students will identify the	**Direct - Exam/Quiz - within the course** - Performance Indicator: Students in EGET110 (Applied Electricity) will apply analysis techniques to series and parallel resistor circuits under DC conditions. Evaluated Material: final exam problem that solely measures the	**Finding Reporting Year:** 2016-2017 **Goal met:** Yes Fall 2016 (01/01/2017)	**Use of Result:** No concerns at this time. Continue to evaluate in Fall 2018 (01/01/2017)

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
need for, gather, and accurately process the appropriate type, quality, and quantity of evidence to answer a complex question or solve a complex problem. **Assessment Year:** AY16-17, AY17-18, AY18-19	performance indicator **Criteria Target:** Target: an average grade of 70% or higher **Schedule/Notes:** EGET110 is an alternate year course.		
	Direct - Exam/Quiz - within the course - Performance indicator: Students in EGMT 225 (Statics and Strength of Materials) will be able to calculate stress and strain in axial loading of a bar Evaluated Material: exam 3, problem on axial loading **Criteria Target:** An average of 3 out of 4. **Schedule/Notes:** 1- Unacceptable, 2-Below Standard, 3-Meets Standard, 4-Exemplary	**Finding Reporting Year:** 2017-2018 **Goal met:** No Fall 2017: 2.0 (09/04/2018)	**Use of Result:** There is definitely a cause for concern since only two out of seven student work samples were "Meets Standard" or higher, while the coverage is extensive and expectation for achievement is high. (01/01/2018)

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**Degree Audit Form – Manufacturing Engineering Technology – AS**
This documentation is relevant to Question number:	**15**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Degree Audit form with required courses listed for program completion.**

School of Engineering and Technology

Associates Degree in Manufacturing Engineering Technology Fall 2016 & Later

Name: ______________________________ ID #: ______________________________

Intended Month/Year of Graduation: ____________

____

Plan of Study Advisor Approval Date

All information below should be from the student's most recent transcript and/or transfer evaluation sheet. Attach substitution/waiver forms as necessary.

GEN-ED REQUIREMENTS (24)

Communications (9)

COMM101 - 3 ______

ENGL110 - 3 ______

ENGL111 - 3 ______

Mathematics (3)

*MATH207 - 3 ______

Other General Education Requirements (12)

*CHEM108 - 3 ______

*CHEM109 – 1 ______

*PHYS221 - 4 ______

Humanities – 4 ______
OR
Social Science – 4 ______

* The Math, Chemistry, and Physics courses listed satisfy the general education and departmental requirements.

DEPARTMENTAL REQUIREMENTS (49)

*CHEM108 - 3 ______

* CHEM109 - 1 ______

EGEE125 - 4 ______

EGET110 - 4 ______

EGET175 - 4 ______

EGME110 - 3 ______

EGME141 - 3 ______

EGME240 - 3 ______

EGMT225- 4 ______

EGNR101 - 2 ______

EGNR265 - 3 ______

MATH111 - 3 ______

MATH131 - 3 ______

*MATH207 - 3 ______

*PHYS221 - 4 ______

[1]Tech Elective - 2 ______

[1] EGRS215 Robotics Technology I (2 credits) or another approved course can be used as a technical elective

2.0 Overall GPA ______
2.0 Dept. GPA ______
62 Total Credits ______
Residency ______
(16 of last 20)

____

Chair Approval Date

REGISTRAR'S AUDIT AT GRADUATION

Total Credits: ______
Department GPA: ______
Overall GPA: ______

November 8, 2016

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School:	**Engineering & Technology**
Document Title (If attached) or Filename (If emailed):	**Sample Syllabus – EGME110 Manufacturing Processes**
This documentation is relevant to Question number:	**Question #15**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Sample syllabus for EGME110 Manufacturing Processes showing course requirements and learning objectives**

LAKE SUPERIOR
STATE UNIVERSITY

School of Engineering and Technology **Fall 2018**
EGME 110 Manufacturing Processes **3 Credits**

COURSE OUTLINE

Prerequisites / Co requisites: EGME 141 and MATH 111

Instructor: David Leach

Office: CAS 129
Phone: 906-635-2635
E-mail: dleach@lssu.edu

Office Hours:

Monday	Tuesday	Wednesday	Thursday	Friday
10-11AM, 3-4PM	9-10AM	9-10AM	9-10AM	

Textbook: **Fundamentals of Modern Manufacturing,** Groover, Mikell P., Sixth Ed., John Wiley & Sons, Inc, 2016

Course Description: This course introduces students to basic manufacturing processes. Both theory and application of various processes are covered in lecture and laboratory. Topics include:

- Metal forming processes
- Plastic forming processes
- Welding and related processes
- Measuring instruments
- Machining processes
- Shop Safety

Course Objectives:

1. Students will be able to define the common terms associated with the following processes:
    - Casting and Molding
    - Welding and Cutting
    - Metal Forming
    - Turning
    - Milling
    - Grinding
    - Quality Control
    - Computer Numerical Control (CNC)
2. Students will be able to describe the following processes:
    - Casting and Molding

   - Welding and Cutting
   - Metal Forming
   - Turning
   - Milling
   - Grinding
3. Students will be able to perform basic set-up and operation of the machines for the following processes:
   - Casting and Molding
   - Welding and Cutting
   - Metal Forming
   - Turning
   - Milling
   - Grinding
4. Students will be able to apply speed and feed formulas to determine proper machining rates.
5. Students will be able to accurately measure dimensions of parts.
6. Students will be able to create basic code for CNC plasma torch, milling machine, and CNC lathe.
7. Students will be able to operate the CNC plasma torch, milling machine, and lathe with instructor assistance.

College of Engineering and Technology **Fall 2018**
EGME 110 Manufacturing Processes (2, 3)

GRADING SCALE AND POLICIES:

Point Values:

Three Exams	300 points
Final Exam	200 points
Laboratory handout questions and projects	850 points
Homework	100 points

Grading:

98-100	A+	70-77	C
92-97	A	68-69	C-
90-91	A-	66-67	D+
88-89	B+	62-65	D
82-87	B	60-61	D-
80-81	B-	0-59	F
78-79	C+		

Course Policies:

1. Attending class, completing assignments on time, and keeping up with the class material is important for success in this course and in college. The method of how an instructor chooses to handle late or missed assignments is left up to the instructor. Generally, late or missed assignments will not be accepted except for legitimate (pre-approved when possible) reasons as determined by the instructor. Examples of legitimate reasons are: illness, death in family, etc. The method of handling late or missed work is determined by the instructor and listed in below under Course Policies.
2. A passing grade (60% or more) must be achieved in both the lecture (exams) and the laboratory (lab assignment/projects) to pass the course.
3. Exams are closed book and notes. Missed exams will not be repeated and a zero will be recorded for the exam.
4. A grade sheet must be handed in with each laboratory assignment.
5. Students are required to attend each lab session. Unexcused absences will result in a grade of zero for that specific lab assignment. It is difficult, if not impossible, to repeat lab demonstrations. Excused absences require prior approval from the lab instructor.
6. Students are expected to perform all assigned work themselves. Students caught cheating will receive an "F" for the course.
7. Multiple safety violations and/or housekeeping violations, as determined by the lab instructor, lab engineer, or other LSSU faculty or staff could result in a decrease of your final course grade.
8. Cell phone use is restricted to videotaping lab demos. Cell phones must not be used during class lectures, quizzes, and exams; unless otherwise required in the event of an emergency.

University Policies and Statements:

College of Engineering and Technology **Fall 2018**
EGME 110 Manufacturing Processes (2, 3)

Policies, including those below, are posted on the Provost's website www.lssu.edu/provost/forms:

- Academic Integrity Policy
- Online and Blended Course Attendance Policy
- The Americans with Disabilities Act & Accommodations
- IPASS (Individual Plan for Academic Student Success)
- Policy on Student Absences

Honor Pledge:

As a student of Lake Superior State University, you have pledged to support the Student Honor Code of the School of Engineering & Technology. You will refrain from any form of academic dishonesty or deception such as cheating, stealing, plagiarism or lying on take-home assignments, homework, computer programs, lab write-ups, quizzes, tests or exams which are Honor Code violations. Furthermore, you understand and accept the potential consequences of punishable behavior.

Tentative EGME 110 Syllabus

Session Number	Week	Day	Date	Topic	Reading Assignment	LAB ACTIVITY
Lec 1	1	M	8/27	Course Introduction, Manufacturing Processes & Materials	Chapters 1, 2.5,3	Casting
Lec 2	1	W	8/29	Casting Processes	Chapters 10,11	
NO Class		**M**	**9/3**	**LABOR DAY**		
Lec 3	2	W	9/5	Casting, Sawing, & Drilling Processes, Fabrication of Plastics	Chapters 13, 21.3, 21.6.3, 22.3.2	Gas Cut
Lec 4	2	M	9/10	Fundamentals of Joining, Gas and Flame Processes	Chapters 28,29	
Lec 5	3	W	9/12	Resistance and Solid State Welding Processes and Other Welding Processes, Mechanical Assembly	Chapter 30,31	MIG Welding
Lec 6	3	M	9/17	Fundamentals of Metal Forming ,Sheet Forming, Bulk Forming	Chapters 17, 18	
Lec 7	4	W	9/19	Sheet Forming, Bulk Forming, Review Exam 1	Chapters 19	Plasma Cut
Lec 8	4	M	9/24	**EXAM 1**		
Lec 9	5	W	9/26	Numerical Control	Chapter 21.5, 37.3	CNC Plasma
Lec 10	5	M	10/1	Fundamentals of Machining	Chapter 20,21.6	

Lec 11	6	W	10/3	Machining &Turning Processes	Chapter 21.1, 21.2, 21.3	Lathe Set-up
No Class		**M**	**10/8**	**Mid-Semester Break**		
Lec 12	6	T	10/9	Cutting Tools for Machining	Chapter 22.1, 22.2, 22.3	
Lec 13	7	W	10/10	Threads & Threading	21.7.1	Lathe
Lec 14	7	M	10/15	Measurements	Chapter 5.1,5.2	
Lec 15	8	W	10/17	Review Bending Calculations, Speeds and Feeds for Turning	19.2, 21.2.1	Lathe
Lec 16	8	M	10/22	Milling Processes & Exam 2 Review	Chapter 21.4,	
Lec 17	9	W	10/24	**EXAM 2**		Tram Mill
Lec 18	9	M	10/29	Speeds and Feeds for Milling	21.4.2	
Lec 19	10	W	10/31	Speeds and Feeds for Milling	21.4.2	Mill
Lec 20	10	M	11/5	Abrasive Machining Processes	Chapter 24	
Lec 21	11	W	11/7	Writing CNC Code		Mill
Lec 22	11	M	11/12	CNC Code & Exam 3 review		
Lec 23	12	W	11/14	**EXAM 3**		Victor CNC
Lec 24	12	M	11/19	CNC Code		
No Class		**W**	**11/21**	**Thanksgiving Break**		
Lec 25	13	M	11/26	Creo Manufacturing CAM		HAAS CAM
Lec 26	13	W	11/28	Creo Manufacturing CAM		
Lec 27	14	M	12/3	Quality Control	Chapter 40	Clean-Up
Lec 28	14	W	12/5	Final Review & Assessment		
FINAL EXAM		**M**	**12/10**	**3:00pm-5:00pm CAS107**		

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School:	**Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**Sample Course Assessment – EGME110 Manufacturing Processes**
This documentation is relevant to Question number:	**Question #15**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Sample course assessment summary from EGME110 Manufacturing Processes, Spring 2018. Shows student self-assessment and faculty assessment of learning objectives, as well as action plans for improvement.**

LAKE SUPERIOR
STATE UNIVERSITY

EGME110 Manufacturing Processes (2,3) 3 Credits
Spring 2018

COURSE ASSESSMENT SUMMARY

Offering Details

Lecture Times: M/W 1:00pm to 1:50pm	Lecturer: David Leach
Lab Times: Lab A: M 2:00pm to 4:50pm Lab B: W 2:00pm to 4:50 pm Lab C: R 3:00pm to 5:50 pm	Lab Instructor: David Leach
Number of Students: 26	Evaluator: David Leach

Context With-in Curriculum

Student Population: ME, MET, GE
Previous Courses Required: EGME141 (Pre or Co-Req) and MATH111 (Pre or Co-Req)
Subsequent Courses: EGME240, EGMT216, and EGNR491/495

Relationship to ABET Student Outcomes

ETAC of ABET Student Outcomes			EAC of ABET Student Outcomes		
a	✓	•	a	✓	e
b	✓	•	b		
c			c		
d			d		
e			e		
f			f		
g			g		
h			h		
i			i		
j			j		
k			k	✓	•

✓ = exposure (e.g., one graded assignment)
✓✓ = stress (e.g., one course objective)
✓✓✓ = focus (e.g., multiple objectives, course title)

• = foundational – ready for further development
•• = developed – prepared for practical application
••• = high – approaching that of a practicing engineer

Student Grades

F	D-	D	D+	C-	C	C+	B-	B	B+	A-	A	A+	GPA
1					2	1	1	3	5	4	9		**3.28** *F17 3.57*

General Comments

Faculty Comments

- Good group of freshman. Many of these students will be great contributors to future courses.
- Overall, the lecture content is dry. As an instructor, I will find a way to improve student engagement, while introducing more manufacturing topics and calculations to increase active learning. This semester I introduced more videos on manufacturing subjects and the student response was positive.

EGME110: Outcomes	Average Student Grade	Average Student Self Assessment	Average Faculty Subjective Assessment
Objective 1 (define manufacturing processes terms)	91%	95%	90%
Objective 2 (describe manufacturing processes)	89%	94%	90%
Objective 3 (set-up and operation of machines)	90%	94%	90%
Objective 4 (apply speeds and feeds formulas)	88%	91%	85%
Objective 5 (accurately measure parts)	97%	98%	95%
Objective 6 (create CNC code for plasma and mill)	82%	83%	90%
Objective 7 (operate CNC plasma and mill)	84%	97%	95%

Action Plans

For Next Offering

- Prepare samples of lab projects at different stages
- Purchase BobCAM V30 for plasma machine
- Update lab manual
- Include more manufacturing topics and calculations in lecture

From Previous Offering

- More book and handout style homework assignments (done)
- Transition the course to include more content on Moodle (done)
- Show videos of manufacturing processes (done)
- Update lecture slides & perform more chalkboard calculations (done)
- Prepare samples of lab projects at different stages (forward to F18)
- Investigate alternative CAM software for plasma (Bobcad V30 is in budget)
- Continue to standardize tools and materials for labs (done)

Analysis of Objectives

1. ***Students will be able to define the common terms associated with the following processes:***
    - ***Casting and Molding***
    - ***Welding and Cutting***
    - ***Metal Forming***
    - ***Turning***
    - ***Milling***
    - ***Grinding***
    - ***Quality Control***

Faculty Grades of Student Work.........91%
Student Self Assessment.................95%

Student Comments

- **Learned through lectures and hands-on labs.**
- **I can complete because we have completed all these tasks in lab.**
- **The lectures were very informative and easy to follow.**
- **The labs and homework helped.**
- **We covered this a lot.**
- **Ran out of time to discuss grinding.**
- **It was taught.**
- **Everything was demonstrated clearly.**
- **Got to use all these machines and carry out all these processes in lab.**
- **I know those processes.**
- **Very familiar with all of these, except we did not spend much time on grinding.**
- **Not 100% positive about metal forming.**
- **With the lecture and help in labs I can define and do most tasks.**

- **Was taught well enough to me.**
- **Covered this in class.**

Faculty Comments

Grinding was covered extensively in lecture, but was not covered in lab, as in previous semesters. We will consider adding it back to the lab activity.

2. ***Students will be able to describe the following processes:***
    - ***Casting and Molding***
    - ***Welding and Cutting***
    - ***Metal Forming***
    - ***Turning***
    - ***Milling***
    - ***Grinding***

Faculty Grades of Student Work..........89%
Student Self Assessment..................94%

Student Comments

- **We covered this well in class.**
- **Was taught in lab.**
- **Grinding was not talked about a lot.**
- **Not sure about metal forming.**
- **These are very broad topics.**
- **I have a solid understanding of what these processes are.**
- **I know these processes.**
- **Experience doing it was great. Defining it with slides in class was helpful too.**
- **All info is always available.**
- **It was taught.**
- **Didn't go over grinding – ran out of time.**
- **We practiced these in lab.**
- **Each process was cover for at least a full lecture period making for a lot of information given to us.**
- **Had hands on experience.**
- **Practiced most processes by hand and on paper.**

Faculty Comments

Students who have had previous shop experience performed at a high level. The lectures were designed to discuss lab topics just before the activities were demonstrated in the lab.

3. ***Students will be able to perform basic set-up and operation of the machines for the following processes:***
   - ***Casting and Molding***
   - ***Welding and Cutting***
   - ***Metal Forming***
   - ***Turning***
   - ***Milling***
   - ***Grinding***

Faculty Grades of Student Work..........90%
Student Self Assessment...................94%

Student Comments

- **Practiced repeatedly in class.**
- **Lab instruction was very informative along side the lecture.**
- **The practice in lab helped with this.**
- **Very well explained in lecture/lab.**
- **I know from first hand experience.**
- **Good demonstration.**
- **Lots of experience.**
- **I was taught how to do them in lab.**
- **Very familiar with all except metal forming.**
- **Still don't have enough experience will them to do it alone.**
- **Learned in labs.**
- **Metal forming set up is?**
- **All done in lab.**
- **This was taught well in class.**

Faculty Comments

For the most part, students paid attention to the lab demos and did not need one on one help for each step in their projects. We made improvements to standardizing each lab to include having all the tools and materials needed for each lab in one spot (tool box area). This improved lab efficiency.

4. ***Students will be able to apply speed and feed formulas to determine proper machining rates.***

Faculty Grades of Student Work ....
Student Self Assessment: ....

Student Comments

- **This was covered well in class.**

- **Don't fully understand equation for this.**
- **Don't have the equations memorized.**
- **Basic math, information always sufficiently provided.**
- **Easy formulas and utilized them on tests and in lab.**
- **Speed and feed didn't ever seem like a big deal in lab.**
- **Yes, I was taught this in class.**
- **Very easy.**
- **I had to do this multiple times in lab and at work.**
- **Learned formulas and used them in labs.**

Faculty Comments

Speeds and feed used to be a high risk / high failure rate topic. Through proper instruction (and encouragement), it is not so scary for the students anymore. NIMS methods (machining certification) have been employed to simplify and clarify the approach to speeds and feeds.

5. ***Students will be able to accurately measure dimensions of parts.***

Faculty Grades of Student Work 97%
Student Self Assessment: 98%

Student Comments

- **We were shown how to do this in class.**
- **Taught in lab.**
- **With help.**
- **I can do it, might screw up.**
- **I know how to measure items.**
- **Lab experience.**
- **Yes, I was taught and practiced in lab.**
- **Very easy.**
- **I have done it a lot.**
- **Offered multiple forms of measurement tools.**

Faculty Comments

Measuring was covered in lecture, in handouts, and in lab. Students, for the most part, responded well to the instruction.

6. ***Students will be able to create basic code for CNC plasma torch and milling machines.***

Faculty Grades of Student Work 82%
Student Self Assessment: 83%

Student Comments

- **This was taught in class.**
- **Still a little ify on this.**
- **Basic understanding, not much in depth.**
- **I know roughly, but I could definitely use practice.**
- **Never did it.**
- **Was shown how.**
- **Very well explained in handouts and lab demos**
- **I didn't do enough to COMPLETELY remember each step.**
- **Learned hands-on.**

Faculty Comments

Students usually perform well here and new software would help, although the handout is self-explanatory.

7. ***Students will be able to operate the CNC plasma torch and milling machine with instructor assistance.***

Faculty Grades of Student Work 84%
Student Self Assessment: 97%

Student Comments

- **Practiced multiple times**
- **The torches were a little scary but it worked out.**
- **Instructor does excellent job at assisting.**
- **I can do this because I was taught.**
- **I can do it with Master Leach walking me through the steps.**
- **I have been able to do that.**
- **We were taught well.**
- **With assistance it was fairly easy.**
- **With teacher help yes.**
- **This was covered in class.**

Faculty Comments

The intent here is to have the instructors assist the students. Not all students completed this project, however. The ones that did, ran around 100% the first time.

EXTRA QUESTIONS

A. *Do you feel comfortable with basic manufacturing processes and could you work safety in an industrial environment? Explain your response.*

- Yes, this course taught a lot and was very helpful with the basic manufacturing processes.
- Yes, was all taught to me in class
- Yes.
- Yes, this class was very informative.
- Definitely, because that's what we learned.
- Maybe I'm not comfortable enough yet.
- Yes, I learned a great deal about the overall atmosphere and processes in a manufacturing facility.
- Yes, because we learned how to properly use all the machines safely.
- Yes, I have basic understanding of all processes.
- Yes, lab safety was important and lab gave me experience with all sorts of processes.
- Yes, the skills I learned make me comfortable in the industry.
- Yes, I learned a lot from this course, especially about safety.
- Yes, we had a lot of practice.
- Because of the lab, yes. The lab for this course was very practical and helpful as well as very fun. Would recommend.
- Yes, this class helped.
- Basics yes but I would like more experience with welding and other processes.
- Yes, projects in lab helped me to understand how machines worked.
- Yes, because I was instructed well and was given opportunities to practice skills.

B. *Do you have suggestions to improve accomplishment the course objectives?*

For the Lecture/Class

- No.
- N/A.
- Lecture is boring.
- Yes with both my background experience and what I have learned in this class I feel safe in an industrial environment.
- Better speakers in class for videos.
- More videos for better visual representation of concepts.
- No.
- Yes, we were taught safety and how to perform various manufacturing processes.

- I was bored often, really enjoyed review packets to study for exams. Slides were also helpful.
- Really drive home the formulas and equations.
- More handouts each lecture.
- More homework from book/slides.
- The videos were a nice break in the lecture.
- More videos of processes.
- More videos.

For the Lab

- No.
- CNC lathe project.
- A few more lab times.
- Milling shorter.
- Get more milling machines.
- Maybe have more instructors to help with the labs.
- No suggestions, great experience.
- No.
- Maybe more practice handouts like the sheet metal handout.
- Provide refreshments, it's a long class period.
- No suggestion.
- Maybe one less lab assignment. Although there was extra time, if any mistake were made then a time issue could easily occur.

PART 2: Degree-Level Review

Degree Program: **General Engineering Technology (AS)**

Explain how the program works to address each of the following questions. For each question, respond with a narrative and supporting evidence.

Assessment (CC 4.B and CC 4.C)

13. Provide evidence that the degree-level program outcomes are clearly stated and are effectively assessed, including the "use of results." Attach the 4-Column Program Assessment Report.

14. Explain how results from degree assessments were used to improve the degree program. Include specific examples.

Program review and feedback from students using course assessment summary documents allow faculty to note changes and improvements from the prior assessment, as well as documenting future changes for the next course assessment. These details can be seen in the sample course assessment summary included in the following pages. As an example, student performance and self-assessment in milling and turning feed and speed calculations for EGME110 Manufacturing Processes needed improvement. Based on review of assessment data, feeds and speeds calculation methodology has been strengthened in both the laboratory and lectures, and improvements have been seen in student performance. For Fall 2017, the EGME110 laboratory projects were updated to include more NIMS-based (National Institute for Metalworking Skills) skills training by including activities for a milling project and turning project that closely resemble certification training test parts. This change strengthens the technology skills focus of the MET-AS program. Also, laboratory activities and tools needed for each laboratory project have been organized to improve efficiency.

Quality, Resources and Support (CC 3.A)

15. Explain how the program ensures that degree program-level and course-level learning outcomes are at an appropriate level. Attach evidence, including a degree audit for the program.

A recipient of the AS degree in General Engineering Technology will possess the fundamental technical skills in engineering technology, spanning both mechanical and electrical applications, required to either work as an entry-level technician in industry, or to be in a position to complete a Bachelor's degree in an engineering technology discipline with two remaining years of full-time study. These skills include engineering drawing, electronics, as well as other technology or engineering topics.

The objective identifies the requisite skills to follow either of the paths (industrial employment or continued academic study) identified as appropriate to AS recipients in this discipline. Accordingly, the accomplishment of the objective is dependent on the degree to which the respective skills identified are, in fact, acquired by the student. The goal of the assessment protocol herein described is to assure that the courses in place in the program curriculum are the right ones to deliver the skills identified, that the courses are effective in doing so, and that they are continuously improved to ensure a consistent, continuous and long-term viability in doing so.

Acquisition of the skills is effected through a two-year full-time curriculum of study at LSSU, as specified in appendix A, "plan of study". It will be apparent that all of the skills identified in the objective correspond to courses in that plan of study; specifically,

Skill		Course
Engineering Drawing	is acquired from the course	EGME141
Electronics	" " " "	EGET110
Other Engrg/Techn	" " " courses	EGXX electives (9 cr)

Although these mappings of courses on to skills are suggested solely on the basis of the course titles, further examination of any of the corresponding course-specific learning objectives will demonstrate the same. A sample syllabus with student learning outcomes can be viewed in the appendix attached to this document.

Having established that the set of courses comprising the GET AS curriculum does impart the set of skills called for by the objective, it remains then to establish that each identified course is effective in delivering its content, and undergoes continuous improvement. In other words, the remaining assessment of the program outcome objective reduces to assessment of the various constituent courses. All identified courses are regularly assessed according to the School's course assessment protocols, and continuously improved on the basis of these assessments, with new action plans established after each offering. A sample such course assessment summary can also be found in the appendix attached to this document.

See the following Appendix attachments:

- Degree Audit for GET-AS
- Sample Syllabus – EGME141 Solid Modeling (F2018)
- Sample Course Assessment Summary – EGME141 Solid Modeling (S2018)

Intellectual Inquiry (CC 3.B).

16. Explain what the program does to engage students in collecting, analyzing, and communicating information; mastering modes of inquiry or creative work; developing skills integral to the degree program. Attach examples of undergraduate research, projects, and creative work.

Some of the courses in the General Engineering Technology (AS) plan of study have laboratory components as well as student projects. Laboratory experiences engage students in collecting and analyzing data, as well as reporting data in laboratory reports. In the EGME141 Solid Modeling course, students develop 3D parametric models using dimensional data and software tools. Data is then applied directly to model parts assigned during the laboratory sessions. In the solid modeling course, first year and transfer students engage in a semester-long Human-Centered Design (HCD) project. Each student selects a community in need while building empathy, identifying important problems, brainstorming product ideas, narrowing down product options, and developing concepts. Using their creativity and data collection, students then design a final product using 3D parametric CAD software with the end goal of improving the condition of their community. Below are student samples of the final poster deliverable in EGME141:

Rain Filtration in the DRC

[redacted], Lake Superior State University EGME 141

Water Storage In Nicaragua

[redacted], Lake Superior State University

Water for the Waterless

The Unit

Before the Storage Unit

Water Storage Unit

Impact on the Community

Cite Sources:

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering and Technology**
Document Title (If attached) or Filename (if emailed):	**Four-Column Report**
This documentation is relevant to Question number:	**13**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Evidence that Four-Column Report was completed.**

Assessment: Program Four Column

Program (CoIS) - General Engineering Technology AS

Mission Statement: A recipient of the AS degree in General Engineering Technology will possess the fundamental technical skills in engineering technology, spanning both mechanical and electrical applications, required to either work as an entry-level technician in Industry, or to be in a position to complete a Bachelor?s degree in an engineering technology discipline with two remaining years of full-time study. These skills include engineering drawing, electronics, as well as other technology or engineering topics.
Assessment Contact: Dr. Paul Weber

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
Communication - Students will be able to communicate in a technical environment. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Level 2 (Skills and Concepts) (Webb) **Institutional Learning:** ILO1 - Formal Communication - Students will develop and clearly express complex ideas in written and oral presentations. **Assessment Year:** AY16-17, AY17-18, AY18-19	Performance Indicator: ability to compose a technical log Evaluated Material: final project team logbook produced in Introduction to Engineering (EGNR-101) **Criteria Target:** Target: an average grade of 70% or higher	**Finding Reporting Year:** 2016-2017 **Goal met:** Yes Fall 2016: 80% (01/01/2017)	**Use of Result:** No concern at this time. Continue to evaluate in Fall 2018. (01/01/2017)
		Finding Reporting Year: 2017-2018 **Goal met:** Yes Fall 2017: 78% (01/01/2017)	**Use of Result:** No concern at this time. Continue to evaluate in Fall 2017. (08/30/2018)
Use of Technical Tools - Students will be able to use technical tools to solve engineering problems. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Mid-Level (Analyzing/Applying) (Bloom) **Institutional Learning:** ILO3 - Analysis and Synthesis - Students will organize and synthesize evidence.	Performance Indicator: ability to create three-dimensional parts using CAD software Evaluated Material: final project documentation and CAD work in Solid Modelling (EGME-141) **Criteria Target:** Target: an average grade of 70% or higher	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Fall 2017: 83% (08/30/2018)	**Use of Result:** No concern at this time. Continue to evaluate in Fall 2018. (08/30/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** Yes Fall 2016: 80% (01/01/2017)	**Use of Result:** No concerns at this time. Continue to evaluate in Fall of 2017. (01/01/2017)

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
ideas, or works of imagination to answer an open-ended question, draw a conclusion, achieve a goal, or create a substantial work of art. **Assessment Year:** AY16-17, AY17-18, AY18-19			
Engineering System Analysis - Students will be able to analyze electro-mechanical systems by applying math, science, and/or engineering equations and techniques. **Goal Status:** Active **Goal Category:** Student Learning **Institutional Learning:** ILO2 - Use of Evidence - Students will identify the need for, gather, and accurately process the appropriate type, quality, and quantity of evidence to answer a complex question or solve a complex problem. **Assessment Year:** AY16-17, AY17-18, AY18-19	**Direct - Exam/Quiz - within the course** - Performance Indicator: Students in EGET110 (Applied Electricity) will apply analysis techniques to series and parallel resistor circuits. Evaluated Material: final exam problem that solely measures the performance indicator **Criteria Target:** Target: an average grade of 70% or higher **Schedule/Notes:** EGET110 is an alternate year course.	**Finding Reporting Year:** 2016-2017 **Goal met:** Yes Fall 2016: 77% (01/01/2017)	**Use of Result:** No concern at this time. Continue to evaluate in Fall 2018. (08/30/2018)

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	Engineering & Technology
Document Title (if attached) or Filename (if emailed):	Degree Audit Form – General Engineering Technology – AS
This documentation is relevant to Question number:	15
Briefly summarize the content of the file and its value as evidence supporting program review:	Degree Audit form with required courses listed for program completion.

School of Engineering and Technology

AS Degree in General Engineering Technology

(Students graduating 2017 - 2018)

Student Name: ____________________

Student ID #: ____________________ Advisor Approval: ____________ Date: ______

Intended Month of Graduation: ____________________ Chair Approval: ____________ Date: ______

All information below should be from the student's most recent transcript and/or transfer evaluation.

GENERAL EDUCATION REQUIREMENTS

Communication Skills (9 credits required)

- COMM101 - 3 ______
- ENGL110 - 3 ______
- ENGL111 - 3 ______

Mathematics (Also listed as Dept. Requirement)

- MATH111 - 3 ______

Natural Sciences (Also listed as Dept. Requirement)

- PHYS221 - 4 ______
- CHEM108 - 3 ______
- CHEM109 - 1 ______

Approved Humanities or Social Science Elective (4 credits required)

________ - ___ ______

________ - ___ ______

Total credits required in Gen Ed = 24

DEPARTMENT REQUIREMENTS

General Engineering Technology Core (34 credits required)

- CSCI101 - 3 ______
- EGET110 - 4 ______
- EGNR101 - 2 ______
- EGME141 - 3 ______
- MATH111 - 3 ______ (C or better required)
- MATH112 - 4 ______
- MATH131 - 3 ______
- MATH207 - 4 ______
- CHEM108 - 3 ______
- CHEM109 - 1 ______

Engineering Technical Electives (9 credits required)

________ - ___ ___ ________ - ___ ___ ________ - ___ ___

Choose any EGxx course.

Additional Technical Electives (7 credits required)

________ - ___ ___ ________ - ___ ___ ________ - ___ ___

Choose PHYS222, MATH151 or higher, or any EGxx course.

Additional Electives (4 credits required)

________ - ___ ___ ________ - ___ ___ ________ - ___ ___

Students must satisfy the following for graduation:

- ☐ 2.0 Overall GPA
- ☐ 2.0 Dept. GPA
- ☐ 62 Total Credits (minimum)
- ☐ Residency (15 credits at LSSU)
- ☐ Residency (50% departmental credits at LSSU)

26-Oct-17

Appendix Cover Sheet

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering & Technology**
Document Title (If attached) or Filename (If emailed):	**Sample Syllabus – EGME141 Solid Modeling F2018**
This documentation is relevant to Question number:	**Question #15**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Sample syllabus for EGME141 Solid Modeling showing course requirements and learning objectives**

LAKE SUPERIOR
STATE UNIVERSITY

School of Engineering and Technology — **Fall 2018**
EGME141-001 Solid Modeling (2, 2) — **3 Credits**

Pre- or Corequisite: MATH102

Instructor & Meeting Times:
Mr. David Leach, CAS129, 635-2635, dleach@lssu.edu
Section 001: Lecture M/W 11:00AM-11:50AM, Lab A: 12:00PM-12:50PM CAS209-B

Office Hours:

Monday	Tuesday	Wednesday	Thursday	Friday
10-11AM, 3-4PM	9-10AM	9-10AM	9-10AM	

Required Texts: **Daily Course Handouts via Shared Folders and Moodle LMS**

Recommended Text: None

Course Description: This course covers an introduction to creating 3D computer models of mechanical parts and the creation of 2D drawings, with proper dimensioning, for the models. The course utilizes 3D solid modeling software to cover the above content. The current software is CREO/Pro Engineer version 2.0.

Course Objectives: At the conclusion of EGME141 students will be able to:

1. Create three-dimensional parts using CAD software with the following techniques:
   a) Sketching of basic shapes.
   b) Creation of datum lines and planes.
   c) Use of extrude and revolve.
   d) Creation of holes.
   e) Creation of pattern and mirror features.
   f) Use of blend and sweep methods.
   g) Use of shell methods.
2. Use the history tree to modify solid models and drawings.
3. Create and identify standard 2D views of a 3D model.
4. Apply dimensions and notes to models using 2D drawings.
5. Create assemblies using multiple parts.
6. Animate assembly models.

School of Engineering and Technology **Fall 2018**
EGME141-001 Solid Modeling (2, 2) **3 Credits**

Grading Scale and Policies:

Point Values:

Class Exercises (Attendance)	5 points each session	120 points
Lab Exercises	20 points each session	430 points
Drawing Assignments	50 points each week	650 points
Exams	100 points each	300 points
Final HCD Project		475 points
		Total 1975 points

Grading:

98-100	A+	70-77	C
92-97	A	68-69	C-
90-91	A-	66-67	D+
88-89	B+	62-65	D
82-87	B	60-61	D-
80-81	B-	0-59	F
78-79	C+		

Course Policies:

1. Attending class, completing assignments on time, and keeping up with the class material is important for success in this course and in college. Generally, late or missed assignments **will not** be accepted except for legitimate **(pre-approved when possible)** reasons as determined by the instructor. Examples of legitimate reasons are: illness, death in family, job interview, etc.

   LSSU sanctioned travel related absences (athletics, conference presentations, conference attendance) are approved by the Provost. Instructors are expected to accommodate students in these situations. However, students are expected to make arrangements with the instructor before the travel occurs. Failure to do so may result in "F" grades being assigned for the missed work.

2. Students are expected to perform all assigned work themselves unless otherwise noted. Any form of cheating or plagiarism will be handled in accordance with the University policy on Academic Integrity: See Academic Policies

3. All course work will be submitted electronically to your Y drive EGME141 folder. Work must be placed in your Class, Lab, HW, Exam, and Project folders, respectively. Work will be reviewed by the instructor and a grade will be posted in Moodle, or handed out individually. Grades will be posted within 1 week of assignment completion, when possible.

4. Exams will be printed during the exam period, with a signed exam document and a screen shot of the solid model and history tree. Exams will also be saved in your Y drive Exam folder. If files are not saved to your Y drive folder, it will be assumed that you did not complete the work.

5. All 2D drawings must be printed in an 8.5" x 11" pdf format, where applicable. This is so appropriate feedback can be provided.

6. All courses at LSSU are required to provide the students with an educationally challenging culminating experience; typically referred to as a final exam. The final exam period for this course is scheduled on: **Wednesday, December 12, 10AM-12PM. CAS209-B.** Final projects will be presented during the final exam period.

7. General Electronic Device Policy: Tablet computers, cell phones, and personal laptops may be used during class to display lecture and lab hand-outs.

8. Cell Phone Policy: Cell phone usage other than for displaying hand-outs during class is not allowed, unless under emergency situations. No cell phones are allowed during exams.

University Policies and Statements:

Your syllabus may either contain the full statements of the policies shown below OR you may choose to provide students notification of the policies by directing them on the syllabus to the Provost's web page where these policies are also provided. See Academic Policies

Online and Blended Course Attendance Policy
Students in online or blended classes are required to log in to the Course Management System (e.g. Moodle) and complete at least one "Academic Related Activity" within the Add/Drop period.

The Americans with Disabilities Act & Accommodations
In compliance with Lake Superior State University policies and equal access laws, disability-related accommodations or services are available to students with documented disabilities.

If you are a student with a disability and you think you may require accommodations you must register with Accessibility Services (AS), which is located in the KJS Library, Room 233, (906) 635-2355 or x2355 on campus. AS staff will provide you with a letter of confirmation of your verified disability and authorize recommended accommodations. This authorization must be presented to your instructor before any accommodations can be made.

Students who desire such services should meet with instructors in a timely manner, preferably during the first week of class, to discuss individual disability related needs. Any student who feels that an accommodation is needed – based on the impact of a disability – should meet with instructors privately to discuss specific needs.

IPASS (Individual Plan for Academic Student Success)
If at mid-term your grades reflect that you are at risk for failing some or all of your classes, you will be contacted by a representative of IPASS. The IPASS program is designed to help you gain control over your learning through pro-active communication and goal-setting, the development of intentional learning skills and study habits, and personal accountability. Contact Academic Services or email ipass@lssu.edu if you would like to sign up early in the semester or if you have any questions or concerns.

HONOR PLEDGE

As a student of Lake Superior State University, you have pledged to support the Student Honor Code of the School of Engineering & Technology. You will refrain from any form of academic dishonesty or deception such as cheating, stealing, plagiarism or lying on takehome assignments, homework, computer programs, lab reports, quizzes, tests or exams which are Honor Code violations. Furthermore, you understand and accept the potential consequences of punishable behavior.

School of Engineering and Technology
EGME141-001 Solid Modeling (2, 2)

Fall 2018
3 Credits

Tentative EGME 141 Syllabus

Note: Weeks shown below are actual calendar weeks, not course weeks. There are 14 weeks of instruction in 15 calendar weeks due to holidays

Session Number	Week	Day	Topic	Reading Assignment	Assignment Due
Lec & Lab 1	1	M	Policies, Creo Introduction, Definitions, Basic Skills, Dimensioning	Handout 1	Class & Lab Exercises Due End of Period
Lec & Lab 2	1	W	Datums, Holes, Sketching, Extruding, References **HCD Intro / Empathy.**	Handout 2	Class & Lab Exercises Due End of Period
Lec & Lab 3	2	M	Datums, Holes, Sketching, Extruding, References, Constraints	Handout 3	HW1 Due at Midnight, Class & Lab Exercises Due End of Period
Lec & Lab 4	2	W	Datums, Holes, Extrude, Sketching, Constraints, History Tree. **Storytelling.**	Handout 4	Class & Lab Exercises Due End of Period
Lec & Lab 5	3	M	Centerlines, Datums, Holes, Pattern, Sketching, History Tree.	Handout 5	HW2 Due at Start of Period, Class & Lab Exercises Due End of Period
Lec & Lab 6	3	W	Datums, Revolve, Sketching, Constraints, Patterns, History Tree. **Personas.**	Handout 6	Class & Lab Exercises Due End of Period
Lec & Lab 7	4	M	Datums, Construction Lines, Sketching, Extrude, Constraints, Patterns, History Tree	Handout 7	HW3 Due at Start of Period, Class & Lab Exercises Due End of Period
Lec & Lab 8	4	W	Datums, Sketching, Revolve, Patterns. **Team Building.**	Handout 8	Class & Lab Exercises Due End of Period
Lec & Lab 9	5	M	Exam #1		HW4 Due at Midnight, Exam Due End of Period

Session Number	Week	Day	Week of	Topic	Reading Assignment	Assignment Due
Lec & Lab 10	5	M	9/27	Sketching, Revolve, Lettering Relations	Handout 10	Class & Lab Exercises Due End of Period
Lec & Lab 11	6	W	10/2	Sketching, Patterns, Mirror	Handout 11	HW5 Due at Start of Period, Class & Lab Exercises Due End of Period
Lec & Lab 12	6	R	10/4	Sketching, Shell, Rib **Brainstorming.**	Handout 12	Class & Lab Exercises Due End of Period
		T	10/9	**No Class – Attend Monday Classes**		
Lec & Lab 13	7	R	10/11	Blends, 2D Sweeps	Handout 13	HW6 Due at Start of Period, Class & Lab Exercises Due End of Period
Lec & Lab 14	8	T	10/16	Helical Sweeps, 3D Sweeps	Handout 14	Class & Lab Exercises Due End of Period
Lec & Lab 15	8	R	10/18	Sweep-Blends, Helical Sweeps, Sketching **Conceptual design.**	Handout 15	HW7 Due at Start of Period, Class & Lab Exercises Due End of Period
Lec & Lab 16	9	T	10/23	Blend, 3D Sweeps	Handout 16	Class & Lab Exercises Due End of Period
Lec & Lab 17	9	R	10/25	Exam #2		HW8 Due at Start of Period, Exam Due End of Period
Lec & Lab 18	10	T	10/30	Final Project, Multi-View Drawings & Dimensioning	Handout 18	Class & Lab Exercises Due End of Period
Lec & Lab19	10	R	11/1	Multi-View Drawings, Tolerancing, & Dimensioning **Final Design.**	Handout 19	HW9 Due at Start of Period, Class & Lab Exercises Due End of Period

School of Engineering and Technology **Fall 2018**
EGME141-001 Solid Modeling (2, 2) **3 Credits**

Session Number	Week	Day	Week of	Topic	Reading Assignment	Assignment Due
Lec & Lab20	11	T	11/6	Multi-View Drawings, Section Views, & Dimensioning	Handout 20	Class & Lab Exercises Due End of Period
Lec & Lab21	11	R	11/8	Multi-View Drawings, Section Views, & Dimensioning Prototype.	Handout 21	HW10 Due at Start of Period, Class & Lab Exercises Due End of Period
Lec & Lab22	12	T	11/13	Multi-View Drawings, Section Views, & Dimensioning	Handout 22	Class & Lab Exercises Due End of Period
Lec & Lab23	12	R	11/15	Exam #3		HW11 Due at Start of Period, Exam Due End of Period
Lec & Lab24	13	T	11/20	Assemblies	Handout 24	Class & Lab Exercises Due End of Period
No Class		R	11/22	**Thanksgiving Break**		
Lec & Lab25	14	T	11/27	Assemblies	Handout 25	HW12 Due at Start of Period, Class & Lab Exercises Due End of Period
Lec & Lab26	14	R	11/29	Assemblies Posters.	Handout 26	Class & Lab Exercises Due End of Period
Lec & Lab27	15	T	12/4	Assemblies and/or Final Project	Handout 27	HW13 Due at Start of Period, Class & Lab Exercises Due End of Period
Lec & Lab28	15	R	12/6	Final Project, Assessment		
Exam Week	16			Final Project	**HCD Project Presentation and Poster session**	

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	Engineering & Technology
Document Title (if attached) or Filename (if emailed):	Sample Course Assessment Summary EGME141 Solid Modeling, Spring 2018
This documentation is relevant to Question number:	Question #15
Briefly summarize the content of the file and its value as evidence supporting program review:	Sample course assessment summary from EGME141 Solid Modeling, Spring 2018. Shows student self-assessment and faculty assessment of learning objectives, as well as action plans for improvement.

LAKE SUPERIOR
STATE UNIVERSITY

EGME141 Solid Modeling (2,2) 3 Credits Spring 2018

COURSE ASSESSMENT SUMMARY

Offering Details

Lecture Times: M/W 2:00pm to 2:50pm Section 001	Lecturers: Masoud Zarepoor
Lab Times: M/W 3:00pm to 3:50pm Section 001	Lab Instructors: Masoud Zarepoor
Number of Students: 15	Evaluator: Masoud Zarepoor

Context within Curriculum

Student Population: ME, EE and MET(required)
Previous Courses Required: None
Subsequent Courses: EGME240, EGME350, EGME315, EGNR491, and EGNR495

Relationship to ABET Student Outcomes

TAC of ABET Student Outcomes	EAC of ABET Student Outcomes	
	a	*
	b	
	c	*
	d	
	e	
	f	
	g	*
	h	
	i	*
	j	
	k	*
= exposure (e.g., one graded assignment) = areas (e.g., one course objective) = focus (e.g., multiple objectives, course title)	* = foundational – ready for further development ** = developed – prepared for practical application *** = high – approaching that of a practicing engineer	

Context Within Curriculum

Student Population: freshmen ME, Manufacturing, and Electrical Engineering
Previous Courses None
Current Courses Required: None
Subsequent Courses: EGME240, EGME350, EGME315, EGNR491, and EGNR495

Student Grades

EGME141

F	D-	D	D+	C-	C	C+	B-	B	B+	A-	A	A+	GPA
									1	2	12		3.91

Analysis of Objectives

EGME141: Outcomes	Average Student Grade	Average Student Self Assessment	Average Faculty Subjective Assessmen
Objective 1 (use of CAD tools for 3D parts)	97%	98.6%	98%
Objective 2 (history tree)	100%	99.3 %	100%
Objective 3 (multi-view drawings)	93%	95 %	92%
Objective 4 (dimensioning)	93%	98.6 %	95%
Objective 5 (assemblies)	98.5%	95.7 %	95%
Objective 6 (animation)	100%	90.7 %	95%

1. ***Students will be able to create three-dimensional parts using CAD software with the following techniques.***
    1. ***Sketching of basic shapes.***
    2. ***Creation of datum lines and planes.***
    3. ***Use of extrude and revolve.***
    4. ***Creation of holes.***
    5. ***Creation of pattern and mirror features.***
    6. ***Use of blend and sweep methods.***
    7. ***Use of shell methods.***

Faculty Grades of Student Work 97%
Student Self Assessment 98.6%

Student Comments

- I have 5 years' experience with a similar program
- Help is provided, easy to follow instructions
- Clear lectures with detailed examples and notes
- I gained sufficient knowledge in order to use all techniques
- I was taught how
- PowerPoints along with instructor aid was sufficient for learning how to complete the required tasks

Faculty Comments

Faculty grade based on class exercises from Labs 1-12.

2. *Students will be able to use the history tree to modify parts.*

Faculty Grades of Student Work 100%
Student Self Assessment: 99.3%

Student Comments

- I often go back to history tree to edit parts because lecture notes gave a clear understanding
- I can use this to edit one specific part and do with it as I please
- I was shown how
- Same as previous

Faculty Comments

Faculty grade based on class and lab exercises 6. Although this does not seem to be an appropriate objective, since it is very easy to modify the part using history tree, and they use it all the time in all classes.

3. *Students will be able to create and identify standard views of an object.*

Faculty Grades of Student Work 93%
Student Self Assessment: 95%

Student Comments

- I understand how to move objects and some created view
- I can create multiple views of a certain part
- I am ok, but could use more practice
- Same as previous

Faculty Comments

Faculty grade based on class exercises from Labs 18-22 (lectures corresponding to generate 2-D drawings of 3D parts)

4. ***Students will be able to dimension parts.***

Faculty Grades of Student Work 93%
Student Self Assessment: 98.6%

Student Comments

- I know how to create drawings and use dimensions tool
- I can edit parts however I need to
- Taught how
- Same as previous

Faculty Comments

Faculty grade based on class exercises from Labs 18-22

5. ***Students will be able to create assemblies.***

Faculty Grades of Student Work 98.5%
Student Self Assessment: 95.7%

Student Comments

- I understood how to assemble parts and apply the knowledge in final project
- I can make assemblies of multiple parts
- Was shown
- Same as previous

Faculty Comments

Faculty grade based on course final project.

6. ***The students will be able to create a simple animation of an assembly.***

Faculty Grades of Student Work 100%
Student Self Assessment: 90.7%

Student Comments

- Moderately new, not much experience
- I know how to assemble multiple parts to fit together and how to make the parts move
- I can create a moving animation of my assemblies if need be
- Was taught
- Same as previous, however limited practice on this task

Faculty Comments

Faculty grade based on lecture 26, which teaches the student how to create animation of an assembly.

7. Do you feel comfortable in creating solid models with the CAD software? Explain your Response.

Why or why not?

Student Self Assessment: 97.1%

- I feel comfortable with creating solid models with CAD software. My high school offered CAD course so I had a basic idea of what I am doing
- I know how to do the things, but have limited experience with it
- I understand many of the tools and how to use them to create a designed part
- The software, once you get used to it, is a simple, easy to use program that is great for making models
- Yes, I feel like I can create solid models with CAD because I learned hands on how to do it
- Yes I do, with weekly practice and new problems I feel comfortable
- Class did a good job teaching this skill
- Yes, teacher was helpful with helping out if you didn't understand something
- I feel comfortable with making solid models because of the material I have learned in the class
- Have worked a lot with 3D CAD software. This class offered a lot of experience. This kind of thing really helps by being repetitive and doing a lot of small detail

Action Plans

From Previous Offering

- No comments. I think the current teaching class style works fine.

Comments on Implementation

For Next Offering

- The used software for this class should be updated from Creo 3 to Creo 5 version.

PART 2: Degree-Level Review

Degree Program: **Electrical Engineering Technology (AS)**

Explain how the program works to address each of the following questions. For each question, respond with a narrative and supporting evidence.

Assessment (CC 4.B and CC 4.C)

13. Provide evidence that the degree-level program outcomes are clearly stated and are effectively assessed, including the "use of results." Attach the 4-Column Program Assessment Report.

14. Explain how results from degree assessments were used to improve the degree program. Include specific examples.

Program review and feedback from students using course assessment summary documents allow faculty to note changes and improvements from the prior assessment, as well as documenting future changes for the next course assessment. These details can be seen in the sample course assessment summary included in the following pages. As an example, complex numbers and phasors were not only introduced, but used (and continue to be used) in EGET110 and plans have been made for their continued use in EGET175. More reinforcement of Boolean Algebra and K-Maps was added to EGEE 125. More design projects were also added to EGEE 125. In EGEE 250, based on assessment results the students were provided with more assembly debugging tools through an early lab. These are only a few examples. Assessment reports are stored in CAS 203 for further reference.

Quality, Resources and Support (CC 3.A)

15. Explain how the program ensures that degree program-level and course-level learning outcomes are at an appropriate level. Attach evidence, including a degree audit for the program.

A recipient of the AS degree in Electrical Engineering Technology will possess the fundamental technical skills in engineering technology, spanning both mechanical and electrical applications (but with greater emphasis on electrical applications), required to either work as an entry-level technician in industry, or to be in a position to complete a Bachelor's degree in an engineering technology discipline with two remaining years of full-time study. These skills include engineering drawing, electronics, as well as other technology or engineering topics.

The objective identifies the requisite skills to follow either of the paths (industrial employment or continued academic study) identified as appropriate to AS recipients in this discipline. Accordingly, the accomplishment of the objective is dependent on the degree to which the respective skills identified are, in fact, acquired by the student. The goal of the assessment protocol herein described is to assure that the courses in place in the program curriculum are the right ones to deliver the skills identified, that the courses are effective in doing so, and that they are continuously improved to ensure a consistent, continuous and long-term viability in doing so.

Acquisition of the skills is effected through a two-year full-time curriculum of study at LSSU, as specified in appendix A, "plan of study". It will be apparent that all of the skills identified in the objective correspond to courses in that plan of study; specifically,

Skill		Course
Engineering Drawing	is acquired from the course	EGME141
Electronics	" " " "	EGET110, EGET 175
Microcontroller Fund.	" " " courses	EGEE 250

Although these mappings of courses on to skills are suggested solely on the basis of the course titles, further examination of any of the corresponding course-specific learning objectives will demonstrate the same. A sample syllabus with student learning outcomes can be viewed in the appendix attached to this document.

Having established that the set of courses comprising the EET AS curriculum does impart the set of skills called for by the objective, it remains then to establish that each identified course is effective in delivering its content, and undergoes continuous improvement. In other words, the remaining assessment of the program outcome objective reduces to assessment of the various constituent courses. All identified courses are regularly assessed according to the School's course assessment protocols, and continuously improved on the basis of these assessments, with new action plans established after each offering. A sample such course assessment summary can also be found in the appendix attached to this document.

See the following Appendix attachments:

- Degree Audit for EET-AS
- Sample Syllabus – EGME141 Solid Modeling (F2018)
- Sample Course Assessment Summary – EGME141 Solid Modeling (S2018)

Intellectual Inquiry (CC 3.B).

16. Explain what the program does to engage students in collecting, analyzing, and communicating information; mastering modes of inquiry or creative work; developing skills integral to the degree program. Attach examples of undergraduate research, projects, and creative work.

Some of the courses in the Electrical Engineering Technology (AS) plan of study have laboratory components as well as student projects. Laboratory experiences engage students in collecting and analyzing data, as well as reporting data in laboratory reports. In the EGME141 Solid Modeling course, students develop 3D parametric models using dimensional data and software tools. Data is then applied directly to model parts assigned during the laboratory sessions. In the solid modeling course, first year and transfer students engage in a semester-long Human-Centered Design (HCD) project.

Each student selects a community in need while building empathy, identifying important problems, brainstorming product ideas, narrowing down product options, and developing concepts. Using their creativity and data collection, students then design a final product using 3D parametric CAD software with the end goal of improving the condition of their community. Below are student samples of the final poster deliverable in EGME141:

Rain Filtration in the DRC

[redacted], Lake Superior State University EGME141

Clean Water for Those in Need

The Democratic Republic of Congo is the poorest country in the world. Not only does this play a large factor in making these citizen's lives hard, but so does the fact that the country is now recovering from the largest war conflict since WWII, which claimed the lives of millions. Being the poorest country in the world and having to recover from such large scale conflict, the recent Cholera outbreak in groundwater throughout the country has been no help. From this, I decided to design a rain filtration unit so that rainwater may be filtered, captured, and easily stored in a 5 gallon bucket.

Water Filtration Unit

My water filtration unit consists of a 5 gallon bucket, a filter comprised of 296 .1" DIA holes, and a flanged funnel. The bucket has 4 compressible absorbers resting on a flat plate surface in order to equally distribute the 42 pound water weight capacity. The filter, having threads, allows it to be screwed onto the funnel, and then be removed when replacement is needed. The funnel attains a flange in order for it to rest evenly on the top lip of the bucket. With this unit, I am hopeful that the people of the DRC will now be able to have a renewable source of clean, filtered water that is Cholera free!

Bucket Filter Funnel

Before the Filtration Unit

Before my unit was being used throughout the Congo, the people's only source of water was from lakes, streams, or even puddles. This water, moving across ground surfaces and who knows what else, allowed for a Cholera outbreak to occur, killing "528 people and now affect[ing] 20 of the 26 provinces[since July, 2017]... [3]. With the cases of Cholera-related sickness rising each year in the DRC, something had to be done or created in order to help the citizens in dire need of clean water.

Impact on the Community

Now used widely throughout the DRC, every family has access to clean, disease free water. Although this water is attained from precipitation, the DRC has decent levels of rainfall seeing as it holds "the second largest rainforest in the world[4]," which shows that the climate of the country is quite tropical. These units, being comprised of only 3 parts, allows them to be easily serviceable, sold cheaply, and distributed widely. Now having vast amounts of clean water, the last case of Cholera was years ago! Families are now together more than ever, and the people of the country are more focused on bettering their communities and country rather than the constant fear of dying from bad water.

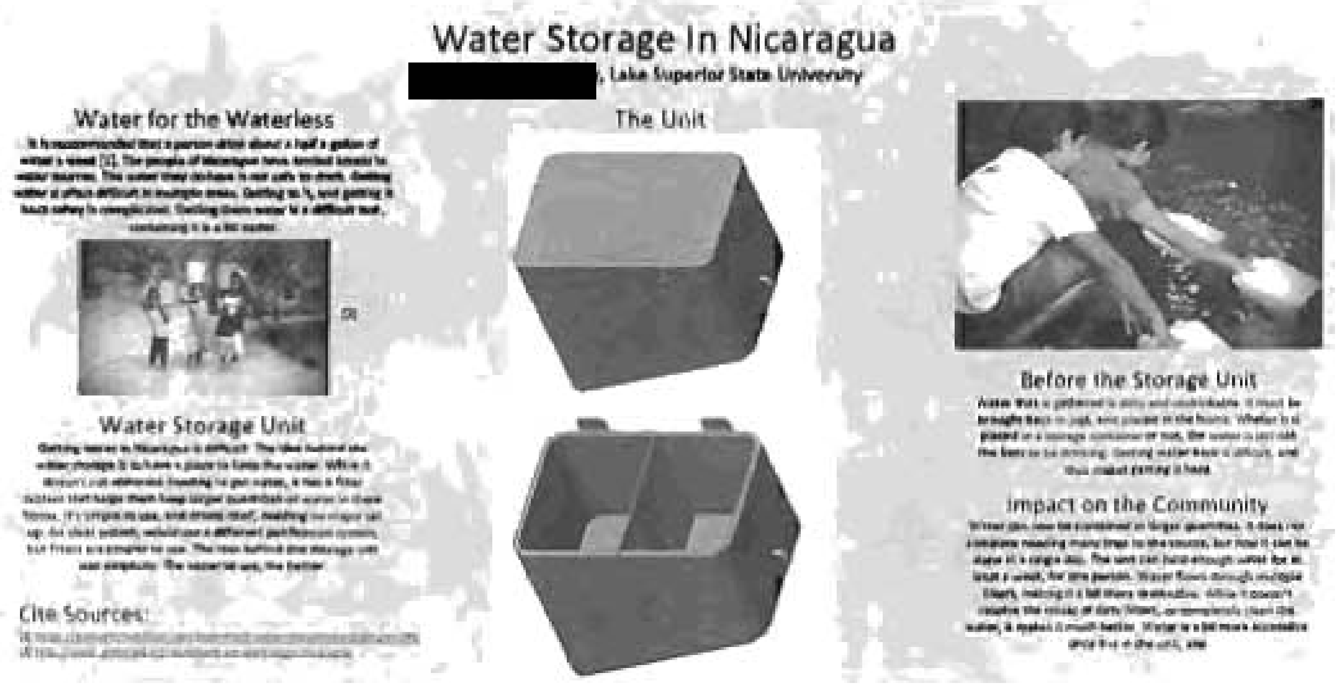
Sources:

[1] [illegible]

[2] [illegible]

[3] [illegible]

[4] [illegible]



Water Storage In Nicaragua

[redacted], Lake Superior State University

Water for the Waterless

Water Storage Unit

Cite Sources:

The Unit

Before the Storage Unit

Impact on the Community

Appendix Cover Sheet

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	Engineering and Technology
Document Title (if attached) or Filename (if emailed):	Four-Column Report
This documentation is relevant to Question number:	13
Briefly summarize the content of the file and its value as evidence supporting program review:	Evidence that Four-Column Report was completed.

Assessment: Program Four Column

Program (CoIS) - Electrical Engineering Technology AS

Program Notes: A recipient of the AS degree in Electrical Engineering Technology will possess the fundamental technical skills in engineering technology required to either work as an entry-level technician in industry, or to be in a position to complete a Bachelor?s degree in an engineering technology discipline with two remaining years of full-time study. These skills include testing and utilizing of electrical hardware, programming microprocessors, writing computer code, and using engineering software.
Assessment Contact: Dr. Paul Weber, Chair
Mission Statement: To produce sought-after engineers and technologists by providing a rigorous undergraduate learning experience characterized by close student-faculty interaction.

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
Electrical Systems - Students will have the ability to describe and analyze circuits and other electrical systems and explain their use. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Level 2 (Skills and Concepts) (Webb) **Institutional Learning:** ILO2 - Use of Evidence - Students will identify the need for, gather, and accurately process the appropriate type, quality, and quantity of evidence to answer a complex question or solve a complex problem.	**Direct - Exam/Quiz - within the course** - Students in EGET 110 (Applied Electricity) will apply analysis techniques to series and parallel resistor circuits. **Criteria Target:** An average of 70% or higher on student work on this objective. **Schedule/Notes:** EGET 110 is an alternate year course.	**Finding Reporting Year:** 2016-2017 **Goal met:** Yes Fall: Average of 77% on student work for this objective. (08/10/2017)	**Use of Result:** No concerns at this time. Reassess in Fall 2018. (08/10/2017)
	Direct - Exam/Quiz - within the course - Students in EGET 175 (Applied Electronics) will be able to explain the concept of RLC circuits. **Criteria Target:** An average of 70% or higher on student work on this objective. **Schedule/Notes:** EGET 175 is an alternate year course.	**Finding Reporting Year:** 2016-2017 **Goal met:** No Spring: Average of 64% on student work for this objective. (08/10/2017)	**Use of Result:** This topic is a good review from EGET 110. Students struggled with converting parallel-series to parallel correctly and struggled with phasors. A variety of actions are included in the course assessment summary including providing more on-line resources and identifying student engineers as tutors for the learning center. (08/10/2017)
	Direct - Exam/Quiz - within the	**Finding Reporting Year:** 2016-2017	**Use of Result:** No concerns at this

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
	course - Students in EGET 175 (Applied Electronics) will be able to describe the operation of DC and AC motors. **Criteria Target:** An average of 70% or higher on student work on this objective. **Schedule/Notes:** EGET 175 is an alternate year course.	**Goal met:** Yes Spring: Average of 83% on student work for this objective (08/10/2017)	time. Reassess in Spring 2019. (08/10/2017)
Technology - Students will be able to use computers, electronic instrumentation and coding to analyze, synthesize and solve problems in engineering. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Mid-Level (Analyzing/Applying) (Bloom) **Institutional Learning:** ILO3 - Analysis and Synthesis - Students will organize and synthesize evidence, ideas, or works of imagination to answer an open-ended question, draw a conclusion, achieve a goal, or create a substantial work of art.	**Direct - Exam/Quiz - within the course** - Students in EGET 110 (Applied Electricity) will use electronic instrumentation to analyze circuits. **Criteria Target:** An average of 70% or higher on student work on this objective. **Schedule/Notes:** EGET 110 is an alternate year course.	**Finding Reporting Year:** 2016-2017 **Goal met:** Yes Fall: Average of 70% on student work for this objective. (08/10/2017)	**Use of Result:** No major concerns at this time. There was some difficulty with complex calculations. (08/10/2017)
	Direct - Exam/Quiz - within the course - Students in EGEE 250 (Microcontroller Fundamentals) will be able to describe input/output hardware ports built into the 9S12, and the interfacing and programming of simple I/O devices. **Criteria Target:** An average of 70% or higher on student work on this objective.	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Fall: Average of 78% on student work for this objective. (08/10/2018)	**Use of Result:** No concerns at this time. (08/10/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** Yes Fall Average of 81% on student work for this objective. (08/10/2017)	**Use of Result:** No concerns at this time. Plan to introduce basic I/O prior to I/O communications. (08/10/2017)
	Direct - Exam/Quiz - within the course - Students in EGNR 265 ("C" Programming), will be able to write moderately involved computer programs in the C programming language to meet design specifications. **Criteria Target:** An average of 70% or higher on student work on this	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Fall: Average of 79% on student work for this objective (08/10/2018)	**Use of Result:** No concerns at this time. (08/10/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** Yes Fall: Average of 73% on student work for this objective Spring: Average of 75% on student work for this objective. (08/10/2017)	**Use of Result:** No concerns at this time. (08/10/2018)

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
	objective.		
Communication - Students will be able to apply written communication in technical environments. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Level 2 (Skills and Concepts) [Webb] **Institutional Learning:** ILO1 - Formal Communication - Students will develop and clearly express complex ideas in written and oral presentations.	**Direct - Homework, Writing Assignment** - Students in EGET175 [Applied Electronics] will develop written lab reports based on results from experiments. **Criteria Target:** An average of 70% or higher on student work on this objective. **Schedule/Notes:** EGET175 is an alternate year course.	**Finding Reporting Year:** 2016-2017 **Goal met:** Yes Spring: Average of 89% on student for this objective. (08/15/2017)	**Use of Result:** No concerns at this time. Need more direct means to measure outcome. Reassess in Spring 2019. (08/15/2017)
	Direct - Homework, Writing Assignment - Students in EGEE250 [Microcontroller Fundamentals] will be able write reports that consist of commented code, flowcharts, and executive summary. **Criteria Target:** An average of 70% or higher on student work on this objective.	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Fall: Average of 91% on student for this objective (08/15/2018)	**Use of Result:** No concerns at this time. Reassess in Fall 2018. (08/15/2018)

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering and Technology**
Document Title (if attached) or Filename (if emailed):	**Degree Audit**
This documentation is relevant to Question number:	**15**
Briefly summarize the content of the file and its value as evidence supporting program review:	

School of Engineering and Technology

AS Degree in Electrical Engineering Technology

(For Students Entering the Program in the 2016-2017 Academic Year)

Student Name: ____________________ Advisor Approval: ____________________ Date: ________

Student ID #: ____________________ Chair Approval: ____________________ Date: ________

Intended Month of Graduation: ____________________ Dean Approval: ____________________ Date: ________

All information below should be from the student's most recent transcript and/or transfer evaluation.

GENERAL EDUCATION REQUIREMENTS (24)

Communication Skills (9 credits required)

- COMM101 - 3 ______
- ENGL110 - 3 ______
- ENGL111 - 3 ______

Mathematics (Also listed as Dept. Requirement – 3 credits)

- MATH111 - 3 ______

Natural Sciences (Also listed as Dept. Requirement – 8 credits)

- CHEM108 - 3 ______
- CHEM109 - 1 ______
- PHYS221 - 4 ______

Additional General Education Requirement (4 credits)

- Humanities - 4 ______
- OR
- Social Science - 4 ______

DEPARTMENT REQUIREMENTS (48)

Electrical Engineering Technology Core (48 credits required)

- CHEM108 - 3 ______
- CHEM109 - 1 ______
- EGEE125 - 4 ______ (C or better required)
- EGEE250 - 4 ______
- EGET110 - 4 ______ (C or better required)
- EGET175 - 4 ______ (C or better required)
- EGME141 - 3 ______
- EGNR101 - 2 ______
- EGNR140 - 2 ______
- EGNR265 - 3 ______
- MATH111 - 3 ______ (C or better required)
- MATH112 - 4 ______
- MATH131 - 3 ______
- PHYS221 - 4 ______ (C or better required)
- PHYS222 - 4 ______

Free Electives (1 credit required)

________ - ___ ______ ________ - ___ ______ ________ - ___ ______

EGRS215 Introduction to Robotics I (2-credits) is recommended for those students intending to pursue a BS-EET degree.

Students must satisfy the following for graduation:

2.0 Overall GPA
2.0 Dept. GPA
62 Total Credits (minimum)
Residency (16 of final 20 credits)

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**Sample Syllabus – EGME141 Solid Modeling F2018**
This documentation is relevant to Question number:	**Question #15**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Sample syllabus for EGME141 Solid Modeling showing course requirements and learning objectives**

LAKE SUPERIOR
STATE UNIVERSITY

School of Engineering and Technology **Fall 2018**
EGME141-001 Solid Modeling (2, 2) **3 Credits**

Pre- or Corequisite: MATH102

Instructor & Meeting Times:
Mr. David Leach, CAS129, 635-2635, dleach@lssu.edu
Section 001: Lecture M/W 11:00AM-11:50AM, Lab A: 12:00PM-12:50PM CAS209-B

Office Hours:

Monday	Tuesday	Wednesday	Thursday	Friday
10-11AM, 3-4PM	9-10AM	9-10AM	9-10AM	

Required Texts: **Daily Course Handouts via Shared Folders and Moodle LMS**

Recommended Text: None

Course Description: This course covers an introduction to creating 3D computer models of mechanical parts and the creation of 2D drawings, with proper dimensioning, for the models. The course utilizes 3D solid modeling software to cover the above content. The current software is CREO/Pro Engineer version 2.0.

Course Objectives: At the conclusion of EGME141 students will be able to:

1. Create three-dimensional parts using CAD software with the following techniques:
    a) Sketching of basic shapes.
    b) Creation of datum lines and planes.
    c) Use of extrude and revolve.
    d) Creation of holes.
    e) Creation of pattern and mirror features.
    f) Use of blend and sweep methods.
    g) Use of shell methods.
2. Use the history tree to modify solid models and drawings.
3. Create and identify standard 2D views of a 3D model.
4. Apply dimensions and notes to models using 2D drawings.
5. Create assemblies using multiple parts.
6. Animate assembly models.

School of Engineering and Technology **Fall 2018**
EGME141-001 Solid Modeling (2, 2) **3 Credits**

Grading Scale and Policies:

Point Values:

Class Exercises (Attendance)	5 points each session	120 points
Lab Exercises	20 points each session	430 points
Drawing Assignments	50 points each week	650 points
Exams	100 points each	300 points
Final HCD Project		475 points

Total 1975 points

Grading:

98-100	A+	70-77	C
92-97	A	68-69	C-
90-91	A-	66-67	D+
88-89	B+	62-65	D
82-87	B	60-61	D-
80-81	B-	0-59	F
78-79	C+		

Course Policies:

1. Attending class, completing assignments on time, and keeping up with the class material is important for success in this course and in college. Generally, late or missed assignments **will not** be accepted except for legitimate **(pre-approved when possible)** reasons as determined by the instructor. Examples of legitimate reasons are: illness, death in family, job interview, etc.

   LSSU sanctioned travel related absences (athletics, conference presentations, conference attendance) are approved by the Provost. Instructors are expected to accommodate students in these situations. However, students are expected to make arrangements with the instructor before the travel occurs. Failure to do so may result in "F" grades being assigned for the missed work.

2. Students are expected to perform all assigned work themselves unless otherwise noted. Any form of cheating or plagiarism will be handled in accordance with the University policy on Academic Integrity: See Academic Policies

3. All course work will be submitted electronically to your Y drive EGME141 folder. Work must be placed in your Class, Lab, HW, Exam, and Project folders, respectively. Work will be reviewed by the instructor and a grade will be posted in Moodle, or handed out individually. Grades will be posted within 1 week of assignment completion, when possible.

4. Exams will be printed during the exam period, with a signed exam document and a screen shot of the solid model and history tree. Exams will also be saved in your Y drive Exam folder. If files are not saved to your Y drive folder, it will be assumed that you did not complete the work.

5. All 2D drawings must be printed in an 8.5" x 11" pdf format, where applicable. This is so appropriate feedback can be provided.

6. All courses at LSSU are required to provide the students with an educationally challenging culminating experience; typically referred to as a final exam. The final exam period for this course is scheduled on: **Wednesday, December 12, 10AM-12PM. CAS209-B**. Final projects will be presented during the final exam period.

7. General Electronic Device Policy: Tablet computers, cell phones, and personal laptops may be used during class to display lecture and lab hand-outs.

8. Cell Phone Policy: Cell phone usage other than for displaying hand-outs during class is not allowed, unless under emergency situations. No cell phones are allowed during exams.

University Policies and Statements:

Your syllabus may either contain the full statements of the policies shown below OR you may choose to provide students notification of the policies by directing them on the syllabus to the Provost's web page where these policies are also provided. See Academic Policies

Online and Blended Course Attendance Policy

Students in online or blended classes are required to log in to the Course Management System (e.g. Moodle) and complete at least one "Academic Related Activity" within the Add/Drop period.

The Americans with Disabilities Act & Accommodations

In compliance with Lake Superior State University policies and equal access laws, disability-related accommodations or services are available to students with documented disabilities.

If you are a student with a disability and you think you may require accommodations you must register with Accessibility Services (AS), which is located in the KJS Library, Room 233, (906) 635-2355 or x2355 on campus. AS staff will provide you with a letter of confirmation of your verified disability and authorize recommended accommodations. This authorization must be presented to your instructor before any accommodations can be made.

Students who desire such services should meet with instructors in a timely manner, preferably during the first week of class, to discuss individual disability related needs. Any student who feels that an accommodation is needed – based on the impact of a disability – should meet with instructors privately to discuss specific needs.

IPASS (Individual Plan for Academic Student Success)

If at mid-term your grades reflect that you are at risk for failing some or all of your classes, you will be contacted by a representative of IPASS. The IPASS program is designed to help you gain control over your learning through pro-active communication and goal-setting, the development of intentional learning skills and study habits, and personal accountability. Contact Academic Services or email ipass@lssu.edu if you would like to sign up early in the semester or if you have any questions or concerns.

HONOR PLEDGE

As a student of Lake Superior State University, you have pledged to support the Student Honor Code of the School of Engineering & Technology. You will refrain from any form of academic dishonesty or deception such as cheating, stealing, plagiarism or lying on takehome assignments, homework, computer programs, lab reports, quizzes, tests or exams which are Honor Code violations. Furthermore, you understand and accept the potential consequences of punishable behavior.

School of Engineering and Technology
EGME141-001 Solid Modeling (2, 2)

Fall 2018
3 Credits

Tentative EGME 141 Syllabus

Note: Weeks shown below are actual calendar weeks, not course weeks. There are 14 weeks of instruction in 15 calendar weeks due to holidays

Session Number	Week	Day	Topic	Reading Assignment	Assignment Due
Lec & Lab 1	1	M	Policies, Creo Introduction, Definitions, Basic Skills, Dimensioning	Handout 1	Class & Lab Exercises Due End of Period
Lec & Lab 2	1	W	Datums, Holes, Sketching, Extruding, References **HCD Intro / Empathy**.	Handout 2	Class & Lab Exercises Due End of Period
Lec & Lab 3	2	M	Datums, Holes, Sketching, Extruding, References, Constraints	Handout 3	HW1 Due at Midnight, Class & Lab Exercises Due End of Period
Lec & Lab 4	2	W	Datums, Holes, Extrude, Sketching, Constraints, History Tree. **Storytelling**.	Handout 4	Class & Lab Exercises Due End of Period
Lec & Lab 5	3	M	Centerlines, Datums, Holes, Pattern, Sketching, History Tree.	Handout 5	HW2 Due at Start of Period, Class & Lab Exercises Due End of Period
Lec & Lab 6	3	W	Datums, Revolve, Sketching, Constraints, Patterns, History Tree. **Personas**.	Handout 6	Class & Lab Exercises Due End of Period
Lec & Lab 7	4	M	Datums, Construction Lines, Sketching, Extrude, Constraints, Patterns, History Tree	Handout 7	HW3 Due at Start of Period, Class & Lab Exercises Due End of Period
Lec & Lab 8	4	W	Datums, Sketching, Revolve. Patterns. **Team Building**.	Handout 8	Class & Lab Exercises Due End of Period
Lec & Lab 9	5	M	Exam #1		HW4 Due at Midnight, Exam Due End of Period

School of Engineering and Technology **Fall 2018**
EGME141-001 Solid Modeling (2, 2) **3 Credits**

Session Number	Week	Day	Week of	Topic	Reading Assignment	Assignment Due
Lec & Lab 10	5	M	9/27	Sketching, Revolve, Lettering Relations	Handout 10	Class & Lab Exercises Due End of Period
Lec & Lab 11	6	W	10/2	Sketching, Patterns, Mirror	Handout 11	HW5 Due at Start of Period, Class & Lab Exercises Due End of Period
Lec & Lab 12	6	R	10/4	Sketching, Shell, Rib **Brainstorming.**	Handout 12	Class & Lab Exercises Due End of Period
		T	**10/9**	**No Class – Attend Monday Classes**		
Lec & Lab 13	7	R	10/11	Blends, 2D Sweeps	Handout 13	HW6 Due at Start of Period, Class & Lab Exercises Due End of Period
Lec & Lab 14	8	T	10/16	Helical Sweeps, 3D Sweeps	Handout 14	Class & Lab Exercises Due End of Period
Lec & Lab 15	8	R	10/18	Sweep-Blends, Helical Sweeps, Sketching **Conceptual design.**	Handout 15	HW7 Due at Start of Period, Class & Lab Exercises Due End of Period
Lec & Lab 16	9	T	10/23	Blend, 3D Sweeps	Handout 16	Class & Lab Exercises Due End of Period
Lec & Lab 17	9	R	10/25	Exam #2		HW8 Due at Start of Period, Exam Due End of Period
Lec & Lab 18	10	T	10/30	Final Project, Multi-View Drawings & Dimensioning	Handout 18	Class & Lab Exercises Due End of Period
Lec & Lab19	10	R	11/1	Multi-View Drawings, Tolerancing, & Dimensioning **Final Design.**	Handout 19	HW9 Due at Start of Period, Class & Lab Exercises Due End of Period

Session Number	Week	Day	Week of	Topic	Reading Assignment	Assignment Due
Lec & Lab20	11	T	11/6	Multi-View Drawings, Section Views, & Dimensioning	Handout 20	Class & Lab Exercises Due End of Period
Lec & Lab21	11	R	11/8	Multi-View Drawings, Section Views, & Dimensioning **Prototype.**	Handout 21	HW10 Due at Start of Period, Class & Lab Exercises Due End of Period
Lec & Lab22	12	T	11/13	Multi-View Drawings, Section Views, & Dimensioning	Handout 22	Class & Lab Exercises Due End of Period
Lec & Lab23	12	R	11/15	Exam #3		HW11 Due at Start of Period, Exam Due End of Period
Lec & Lab24	13	T	11/20	Assemblies	Handout 24	Class & Lab Exercises Due End of Period
No Class		**R**	**11/22**	**Thanksgiving Break**		
Lec & Lab25	14	T	11/27	Assemblies	Handout 25	HW12 Due at Start of Period, Class & Lab Exercises Due End of Period
Lec & Lab26	14	R	11/29	Assemblies **Posters.**	Handout 26	Class & Lab Exercises Due End of Period
Lec & Lab27	15	T	12/4	Assemblies and/or Final Project	Handout 27	HW13 Due at Start of Period, Class & Lab Exercises Due End of Period
Lec & Lab28	15	R	12/6	Final Project, Assessment		
Exam Week	16			Final Project	**HCD Project Presentation and Poster session**	

Appendix Cover Sheet

Use a copy of this cover sheet for each document submitted. Evidence supporting the questions and narratives does *not* need to be electronically added to this Program Review form. One option is to use this cover sheet to add content to directly this Word document. A second option is to submit separate documents along with the form, also using this cover sheet for each document provided.

Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**Sample Course Assessment Summary EGME141 Solid Modeling, Spring 2018**
This documentation is relevant to Question number:	**Question #15**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Sample course assessment summary from EGME141 Solid Modeling, Spring 2018. Shows student self-assessment and faculty assessment of learning objectives, as well as action plans for improvement.**

LAKE SUPERIOR
STATE UNIVERSITY

EGME141 Solid Modeling (2,2) 3 Credits Spring 2018

COURSE ASSESSMENT SUMMARY

Offering Details

Lecture Times: M/W 2:00pm to 2:50pm Section 001	Lecturers: Masoud Zarepoor
Lab Times: M/W 3:00pm to 3:50pm Section 001	Lab Instructors: Masoud Zarepoor
Number of Students: 15	Evaluator: Masoud Zarepoor

Context within Curriculum

Student Population: ME, EE and MET(required)
Previous Courses Required: None
Subsequent Courses: EGME240, EGME350, EGME315, EGNR491, and EGNR495

Relationship to ABET Student Outcomes

TAC of ABET Student Outcomes	EAC of ABET Student Outcomes	
	a	•
	b	
	c	•
	d	
	e	
	f	
	g	•
	h	
	i	•
	j	
	k	•
= exposure (e.g., one graded assignment) = stress (e.g., one course objective) = focus (e.g., multiple objectives, course wide)	• = foundational – ready for further development – = developed – prepared for practical application –• = high – approaching that of a practicing engineer	

Context Within Curriculum

Student Population: freshmen ME, Manufacturing, and Electrical Engineering
Previous Courses None
Current Courses Required: None
Subsequent Courses: EGME240, EGME350, EGME315, EGNR491, and EGNR495

Student Grades

EGME141

F	D-	D	D+	C-	C	C+	B-	B	B+	A-	A	A+	GPA
									1	2	12		3.91

Analysis of Objectives

EGME141: Outcomes	Average Student Grade	Average Student Self Assessment	Average Faculty Subjective Assessmen
Objective 1 (use of CAD tools for 3D parts)	97%	98.6%	98%
Objective 2 (history tree)	100%	99.3 %	100%
Objective 3 (multi-view drawings)	93%	95 %	92%
Objective 4 (dimensioning)	93%	98.6 %	95%
Objective 5 (assemblies)	98.5%	95.7 %	95%
Objective 6 (animation)	100%	90.7 %	95%

1. ***Students will be able to create three-dimensional parts using CAD software with the following techniques.***
    1. ***Sketching of basic shapes.***
    2. ***Creation of datum lines and planes.***
    3. ***Use of extrude and revolve.***
    4. ***Creation of holes.***
    5. ***Creation of pattern and mirror features.***
    6. ***Use of blend and sweep methods.***
    7. ***Use of shell methods.***

Faculty Grades of Student Work 97%
Student Self Assessment: 98.6%

<u>Student Comments</u>

- I have 5 years' experience with a similar program
- Help is provided, easy to follow instructions
- Clear lectures with detailed examples and notes
- I gained sufficient knowledge in order to use all techniques
- I was taught how
- PowerPoints along with instructor aid was sufficient for learning how to complete the required tasks

Faculty Comments

Faculty grade based on class exercises from Labs 1-12.

2. *Students will be able to use the history tree to modify parts.*

Faculty Grades of Student Work 100%
Student Self Assessment: 99.3%

Student Comments

- I often go back to history tree to edit parts because lecture notes gave a clear understanding
- I can use this to edit one specific part and do with it as I please
- I was shown how
- Same as previous

Faculty Comments

Faculty grade based on class and lab exercises 6. Although this does not seem to be an appropriate objective, since it is very easy to modify the part using history tree, and they use it all the time in all classes.

3. *Students will be able to create and identify standard views of an object.*

Faculty Grades of Student Work 93%
Student Self Assessment: 95%

Student Comments

- I understand how to move objects and some created view
- I can create multiple views of a certain part
- I am ok, but could use more practice
- Same as previous

Faculty Comments

Faculty grade based on class exercises from Labs 18-22 (lectures corresponding to generate 2-D drawings of 3D parts)

4. ***Students will be able to dimension parts.***

Faculty Grades of Student Work 93%
Student Self Assessment: 98.6%

Student Comments

- I know how to create drawings and use dimensions tool
- I can edit parts however I need to
- Taught how
- Same as previous

Faculty Comments

Faculty grade based on class exercises from Labs 18-22

5. ***Students will be able to create assemblies.***

Faculty Grades of Student Work 98.5%
Student Self Assessment: 95.7%

Student Comments

- I understood how to assemble parts and apply the knowledge in final project
- I can make assemblies of multiple parts
- Was shown
- Same as previous

Faculty Comments

Faculty grade based on course final project.

6. ***The students will be able to create a simple animation of an assembly.***

Faculty Grades of Student Work 100%
Student Self Assessment: 90.7%

Student Comments

- Moderately new, not much experience
- I know how to assemble multiple parts to fit together and how to make the parts move
- I can create a moving animation of my assemblies if need be
- Was taught
- Same as previous, however limited practice on this task

Faculty Comments

Faculty grade based on lecture 26, which teaches the student how to create animation of an assembly.

7. **Do you feel comfortable in creating solid models with the CAD software? Explain your Response.**

Why or why not?

Student Self Assessment: ……………..… 97.1%

- I feel comfortable with creating solid models with CAD software. My high school offered CAD course so I had a basic idea of what I am doing
- I know how to do the things, but have limited experience with it
- I understand many of the tools and how to use them to create a designed part
- The software, once you get used to it, is a simple, easy to use program that is great for making models
- Yes, I feel like I can create solid models with CAD because I learned hands on how to do it
- Yes I do, with weekly practice and new problems I feel comfortable
- Class did a good job teaching this skill
- Yes, teacher was helpful with helping out if you didn't understand something
- I feel comfortable with making solid models because of the material I have learned in the class
- Have worked a lot with 3D CAD software. This class offered a lot of experience. This kind of thing really helps by being repetitive and doing a lot of small detail

Action Plans

From Previous Offering

- No comments. I think the current teaching class style works fine.

Comments on Implementation

For Next Offering

- The used software for this class should be updated from Creo 3 to Creo 5 version.

PART 2: Degree-Level Review

Degree Program: **General Engineering (AS)**

Explain how the program works to address each of the following questions. For each question, respond with a narrative and supporting evidence.

Assessment (CC 4.B and CC 4.C)

13. Provide evidence that the degree-level program outcomes are clearly stated and are effectively assessed, including the "use of results." Attach the 4-Column Program Assessment Report.

14. Explain how results from degree assessments were used to improve the degree program. Include specific examples.

Program review and feedback from students using course assessment summary documents allow faculty to note changes and improvements from the prior assessment, as well as documenting future changes for the next course assessment. These details can be seen in the sample course assessment summary included in the following pages. Here are a few examples. In EGEE 210, oscilloscope usage was added on a lab practicum in order to better assess their actual ability with regard to a course learning outcome. Mentorship activities were added to EGNR 101. Projects specifications were posted sooner in order to give students more time to prepare in EGNR 265. In EGNR 340, more opportunities were added in each lesson for students to work on a hand-written exercise that was completed before moving on to writing MATLAB code to implement the algorithms of interest. This worked very well and was received well by students.

More detailed assessment reports are stored in CAS 203 for further reference.

Quality, Resources and Support (CC 3.A)

15. Explain how the program ensures that degree program-level and course-level learning outcomes are at an appropriate level. Attach evidence, including a degree audit for the program.

A recipient of the AS degree in General Engineering will possess the fundamental technical skills in engineering, spanning both mechanical and electrical applications, required to either work in an entry-level position in industry, or to be in a position to complete a Bachelor's degree in an engineering discipline with two remaining years of full-time study. These skills include mathematics, physics, numerical methods, statics and programming.

The objective identifies the requisite skills to follow either of the paths (industrial employment or continued academic study) identified as appropriate to AS recipients in this discipline. Accordingly, the accomplishment of the objective is dependent on the degree to which the respective skills identified are, in fact, acquired by the student. The goal of the assessment protocol herein described is to assure that the courses in place in the program curriculum are the right ones to deliver the skills identified, that the courses are effective in doing so, and that they are continuously improved to ensure a consistent, continuous and long-term viability in doing so.

Acquisition of the skills is effected through a two-year full-time curriculum of study at LSSU, as specified in appendix A, "plan of study". It will be apparent that all of the skills identified in the objective correspond to courses in that plan of study; specifically,

Skill		Course
Mathematics	is acquired from the course	MATH 151, 152, 251, 310
Physics	" " " "	PHYS 231, 232
Numerical Methods	" " " course	EGNR 340
Programming	" " " course	EGNR 265
Statics	" " " course	EGEM 220
Circuits	" " " course	EGEE 210

Although these mappings of courses on to skills are suggested solely on the basis of the course titles, further examination of any of the corresponding course-specific learning objectives will demonstrate the same. A sample syllabus with student learning outcomes can be viewed in the appendix attached to this document.

Having established that the set of courses comprising the GE AS curriculum does impart the set of skills called for by the objective, it remains then to establish that each identified course is effective in delivering its content, and undergoes continuous improvement. In other words, the remaining assessment of the program outcome objective reduces to assessment of the various constituent courses. All identified courses are regularly assessed according to the School's course assessment protocols, and continuously improved on the basis of these assessments, with new action plans established after each offering. A sample such course assessment summary can also be found in the appendix attached to this document.

See the following Appendix attachments:

- Degree Audit for GE-AS
- Sample Syllabus – EGEE 210 Circuit Analysis (S2018)
- Sample Course Assessment Summary – EGEE 210 Circuit Analysis (S2018)

Intellectual Inquiry (CC 3.B).

16. Explain what the program does to engage students in collecting, analyzing, and communicating information; mastering modes of inquiry or creative work; developing skills integral to the degree program. Attach examples of undergraduate research, projects, and creative work.

Some of the courses in the General Engineering (AS) plan of study have laboratory components as well as student projects. Laboratory experiences engage students in collecting and analyzing data, as well as reporting data in laboratory reports.

Appendix Cover Sheet

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**Sample Course Assessment Summary EGEE 210**
This documentation is relevant to Question number:	**Question #15**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Sample course assessment summary from EGEE210**

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ENGINEERING &
TECHNOLOGY

EGEE-210 Circuit Analysis (3,3)
Spring 2018

COURSE ASSESSMENT SUMMARY

Offering Details

Lecture Times: MWF 11:00-11:50 Lecturer: D. Baumann

Lab Time: W 3:00-5:50, R 2:00-4:50 Lab Instructor: D. Baumann

Number of Students: 19

Context Within Curriculum

Student Population: sophomore-level EE and junior-level ME

Previous Courses Required: MATH-152, EGNR-101, EGNR-140
Current Courses Required: none

Subsequent Courses: EGEE-310-330-345 -370, EGRS-430-460

Student Grades

W	F	D-	D	D+	C-	C	C+	B-	B	B+	A-	A	A+	GPA
ME			EET	ME	CE	EE	ME	CE	CE	ME	EE	EE		2.39
					CE	ME		EE	ME	ME		ME		
					ME	ME								

Relationship to ABET Student Outcomes

ETAC of ABET Student Outcomes	EAC of ABET Student Outcomes		
	a	✓✓	mSc
	b	✓	▪
	c	✓	▪
	d	✓	▪
	e	✓	▪
	f		
	g	✓	▪
	h		
	i		
	j		
	k	✓	▪
✓ = exposure (e.g. one graded assignment) ✓✓ = stress (e.g. one course objective) ✓✓✓ = focus (e.g. multiple objectives, course wide)	▪ = foundational – ready for further development ▪▪ = developed – prepared for practical application ▪▪▪ = high – approaching that of a practicing engineer		

Summary of Course Assessment

Meeting Course Objectives:

Objective	Student Self-Evaluation	Faculty Grades	Faculty Subjective
1 (Electrical Principles)	89	85	83
2 (Circuit Theorems)	87	71	75
3 (Dependent Sources)	75	79	76
4 (Transient Analysis)	77	75	75
5 (AC Circuits)	82	77	77
6 (AC Power)	78	78	78
7 (Laboratory)	90	76	82

Meeting ABET-EAC Student Outcomes:

Objective	Analysis of Student Work
	(1) Unacceptable (2) Below standard (3) Meets standard (4) Exemplary

Meeting ABET-ETAC Student Outcomes:

Objective	Analysis of Student Work
	(1) Unacceptable (2) Below standard (3) Meets standard (4) Exemplary

Course Objectives

Upon successful completion of the course, the student should be able to:

1. Explain and apply basic electrical principles to analyze linear DC circuits.
    a) Explain and apply the voltage-current relationships for resistors and sources.
    b) Explain the difference between supplied and dissipated power.
    c) Calculate the power supplied or dissipated by passive elements and sources.
    d) Explain and apply Kirchhoff's Voltage and Current Laws.
    e) Explain and apply circuit equivalency (series, parallel) and source transformations.
2. Apply circuit theorems to calculate voltage, current, and power in linear DC circuits.
    a) Use voltage and current division.
    b) Use mesh analysis.
    c) Use nodal analysis.
    d) Use superposition.
    e) Use Thevenin and Norton equivalent circuits.
3. Analyze linear DC circuits containing dependent sources.
    a) Analyze circuits containing dependent voltage and/or current sources.
    b) Explain the operation of the ideal op-amp.
    c) Analyze circuits containing ideal op-amps.
4. Calculate the transient response of linear RC and RL circuits with switches and DC sources.
    a) Identify step, exponential, sinusoidal and composite waveforms.
    b) Understand the basic principles of capacitors and inductors.
    c) Explain and calculate the time constant of RC and RL circuits.
    d) Calculate the initial and final conditions of RC and RL circuits.
    e) Formulate and graph the transient response of RC and RL circuits.
5. Analyze the sinusoidal steady-state response of linear AC circuits.
    a) Define and calculate the frequency, period and phase of sinusoidal waveforms.
    b) Explain and calculate the average and effective (rms) values of sinusoidal waveforms.
    c) Express sinusoidal waveforms as phasors and vice versa.
    d) Describe the voltage-current relationships of passive elements by their impedances.
    e) Use circuit theorems to calculate voltage and current phasors in circuits containing complex impedances.
6. Analyze sinusoidal steady-state power delivery in electric power circuits.
    a) Explain and calculate complex, average, reactive and apparent power.
    b) Analyze the transmission of power in the single-phase circuits.
    c) Describe the operation of ideal transformers and their use in transmission of power.
    d) Explain the basic concept of three-phase circuits.
7. Construct, test, and simulate simple electrical circuits.
    a) Use lab instrumentation to wire circuits containing resistors, capacitors and inductors.
    b) Use a digital multi-meter to measure voltage, current and resistance.
    c) Use a signal generator to produce a specified voltage waveform.
    d) Use an oscilloscope to measure amplitude, frequency and phase of periodic signals.
    e) Use electrical circuit simulation software to simulate electric circuits.
    f) Compare theoretical calculations, circuit simulations and measured results.
    g) Use a soldering iron to connect electrical components together.

General Comments

Student Comments

- Well organized course, very easy learning.
- I don't think my test scores showed what I learned.
- Egee-260 was very helpful.
- Signal processing.
- Diff eq helped with some aspects.
- I understood the material much clearer this time thanks to having physical note taking and various example problems to demonstrate. Most errors a result of personal mistakes and not the material taught.
- If possible, use a wider range of numbers in examples (i.e. don't use the same values for every component in examples).
- I think PHYS 232 is sufficient enough for ME students to get EE experience.
- I only wish that I had more time for tests/shorter tests. If I had this, I believe that I would have done better significantly.
- I wish I would have taken this course sooner. After being in this course I was able to construct a modulating actuator using an Arekino micro controller. I was not only able to understand the circuit requirements but construct & test the circuit before final assembly. Though it is not complex, I was not able to follow the process through before this course. Taking this has made me question going for a ME rather than EE.
- You should go over the homework more often. {oral - Y8-N1}
- I like non-flipped format. {oral - 1 prefers flipped, 13 prefer non-flipped}
- You stand in front of the board while writing which makes it hard to see. {oral}
- Did you like having 6 tests? {oral - Y12-N1}
- Did you like having daily homework? {Y13-N1}

Faculty Comments

- The format of the lecture was 36 (planned) lectures, nearly daily homework of two or three problems, and 6 in-class tests. The format of the laboratory was 12 regular lab sessions, 1 practicum practice session, and 1 practicum session.
- One lecture was missed due to snow. Still all material was covered although coverage of three-phase power and transformers were each reduced by one lecture.
- Having six midterm tests is good in some ways (more focus, less for students to "remember", easier for assessment) and bad in others (taking away from lecture time). Since the students seem to like it, I will continue the practice.
- With so many students, grading daily homework was time consuming even though I only graded one of the (usually) three assigned problems. Since the students seem to like it, I will continue the practice.
- The course is stable, and no major changes need to be made.

Analysis of Objectives

1. Explain and apply basic electrical principles to analyze linear DC circuits.

Student Self Assessment: ……………… 89%
Faculty Grades of Student Work ……… 85%
Faculty Subjective Assessment ………… 83%

Student Comments

- Thanks to a clearer visualization flow through various components to determine proper node currents.
- It was taught well.
- I had knowledge of basic DC analysis before taking this class and it was reinforced with this class.
- Notes were logical and organized.

Faculty Comments

- The faculty grade above was determined by Test 1 in week two of the course and Question #1 on the final exam. By the end of the semester all of students could do this fairly well. Several students – more than usual – had difficulty with voltage polarity and current direction.

2. Apply circuit theorems to calculate voltage, current, and power in linear DC circuits.

Student Self Assessment: ……………… 87%
Faculty Grades of Student Work ……… 71%
Faculty Subjective Assessment ………… 75%

Student Comments

- It was taught well.
- I had knowledge of basic DC analysis before taking this class and it was reinforced with this class.
- I tend to run out of time on this topic.

Faculty Comments

- The faculty grade above was determined by Test 2 in week five of the course and Questions #2 and #3 on the final exam. The students struggled with systematically labeling signals, applying physical properties to relate them, and solving for their values.

3. Analyze linear DC circuits containing dependent sources.

Student Self Assessment: ……………… 75%
Faculty Grades of Student Work ……… 79%
Faculty Subjective Assessment ………… 76%

Student Comments

- Topic was only briefly taught, discussed, and practiced.
- Still a little bit iffy. Could have done a bit more practice on it.
- This was a new topic for me, but I understand the method for solving it fairly well.
- I understand the topic but I tend to run out of time.

Faculty Comments

- The faculty grade above was determined by Questions #1 and #2 on Test 3 in week seven of the course. The coverage of this is somewhat brief. More time would be beneficial, but what would be removed to make room?

4. Calculate the transient response of linear RC and RL circuits with switches and DC sources.

Student Self Assessment:	77%
Faculty Grades of Student Work	75%
Faculty Subjective Assessment	75%

Student Comments

- A lot of this points well to signal processing....taught very well.
- I can pretty well understand the equations used to display the responses of inductors and capacitors.

Faculty Comments

- The faculty grade above was determined by Test 4 in week nine of the course and Question #4 on the final exam. Having MATH-310 as a co-requisite course would be beneficial, although perhaps impractical.

5. Analyze the sinusoidal steady-state response of linear AC circuits.

Student Self Assessment:	82%
Faculty Grades of Student Work	77%
Faculty Subjective Assessment	77%

Student Comments

- Taught well and practiced thoroughly.
- It was taught mostly well.
- I understand how to use the methods from DC analysis and apply them to AC circuits.
- Lab helped me visualize.

Faculty Comments

- The faculty grade above was determined by Test 5 in week twelve of the course and Question #5 on the final exam. This semester I planned and gave an entire lecture on trigonometry and another entire lecture on complex numbers. This seemed to help many of the students to perform sinusoidal analysis better. Yet, sadly, some students never understood the difference between a phasor and the sinusoid which it represents.

6. Analyze sinusoidal steady-state power delivery in electric power circuits.

Student Self Assessment: ……………..…. 78%
Faculty Grades of Student Work ……... 78%
Faculty Subjective Assessment ………... 78%

Student Comments

- This material was gone through too fast in my opinion.
- A better understanding of calculations for peak, phase, amplitude, etc….
- It was taught well.
- The ideas of complex and reactive power seem a little hazy to me.
- Equations in notes were organized well.

Faculty Comments

- The faculty grade above was determined by Test 6 in week fourteen of the course and Questions #6 on the final exam. As usual, this material was a bit rushed at the end of the semester due to missed lecture sessions.

7. Construct, test, and simulate simple electrical circuits.

Student Self Assessment: ……………..…. 90%
Faculty Grades of Student Work ……... 76%
Faculty Subjective Assessment ………... 82%

Student Comments

- Lecture phasors were helpful.
- Sometimes if my hand calculations do not match my simulation or measured values I have a hard time figuring out which one's wrong.
- Practiced and executed on multiple occasions.
- The lab helped a lot with circuits.
- I enjoyed the lab portion of the class very much and am confident in my ability to do so.
- I feel I understand how but I tend to make mistakes.

Faculty Comments

- The faculty grade was determined by the Lab Practicum. Because I deducted points for not reporting results with the correct number of significant figures, the grade under represents the students' true capabilities.

Analysis of Pre-Requisite Courses

1. Did MATH-152 Calculus II provide adequate preparation?

Student Comments

- Yes. (9)
- Plenty of math.
- Math 152 was VERY important for the class.
- Yes, integration is necessary to have mastered.
- Yes, basic integration is all you need so technically business calc or calc 1 is all you would need.
- Calculus was definitely necessary for this class and Taylor series were also used, although I did not take math 152 here.
- Yes, that is adequate.
- Never had any issues with the math of this course.
- MATH-152 prepared us very well. {oral – unanimous}

Faculty Comments

- MATH-152 should definitely remain a prerequisite for this class.

2. Did EGNR-140 Linear Algebra and MATLAB provide adequate preparation?

Student Comments

- Not needed.
- NO.
- Nope.
- Yes. (2)
- No. (2)
- Not really needed. (2)
- Not necessary, but helpful.
- Yes, knowledge of complex numbers were necessary.
- Yes, but we did not use any of the information we learned in 140.
- Yes, using formulas with x unknown is important in the course.
- Linear algebra was used many times in mesh and nodal analysis.
- I don't remember using much of this class.
- Yes, though it seems unnecessary.
- Never used Matlab & only used matrix style algebra on 1 or 2 questions for hw 4 or 5. So no → 140 did not prepare me for circuit analysis.
- Only the imaginary numbers and systems of equations helped. {oral}

Faculty Comments

- Now that EGNR-140 covers complex numbers it is definitely beneficial. The coverage of solving a system of equations is also helpful.

3. *Did EGNR-101 Introduction to Engineering provide adequate preparation?*

Student Comments

- Yes. (8)
- I went through a EGNR 101 at my community college and it was very different from LSSU but did not make an impact on this course.
- No based on material but EGNR 101 should be still taken before circuits.
- Not really needed.
- Not needed.
- Not entirely necessary, but helpful.
- Not really. The only other circuits preparation I received before this class was high school physics.
- Yes, but did not need much of the information. Not necessary as a prerequisite.
- Not really.
- No → I have no idea how this course prepped me for circuits.
- Not necessary. {oral}

Faculty Comments

- The students appear to have been equally divided. I'm not sure why EGNR-101 is a prerequisite for this class. Perhaps it is ensure that students taking this class are really "in the program"?

Action Plans

From Previous Offering

- Be sure to have oscilloscope usage on the lab practicum. {Done}

  This made the lab practicum more meaningful.
- Perhaps reduce material from Chapter 5 (Waveforms) from four lectures to two lectures in order to leave more time for coverage of transient analysis and/or AC power and/or transformers? Test signals could be skipped and only sinusoids and periodic signals could be retained. {Not Done}

  This idea didn't work out at all. The four lectures were necessary.

For Next Offering

- Expand review of trigonometry and complex numbers from one lecture to two lectures.
- Plan on not covering single-phase power flow (section 16.4).

Appendix Cover Sheet

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	Engineering & Technology
Document Title (if attached) or Filename (if emailed):	Sample Syllabus – EGEE 210
This documentation is relevant to Question number:	Question #15
Briefly summarize the content of the file and its value as evidence supporting program review:	Sample syllabus for EGEE 210

LAKE SUPERIOR
STATE UNIVERSITY

EGEE-210 (3,3) Circuit Analysis Spring 2018

Prerequisites:

MATH-152, EGNR-140, and (EGNR-101 or EGNR-103 or CSCI-103)

Instructor:

Dr. David Baumann		Office:	CAS-204A
Phone:	635-2142	Email:	dbaumann@lssu.edu

Office Hours:

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY

Office hours are subject to change, which will be posted on my office door. I have an open door policy so anytime you have a question please come and see me.

Required Text:

The Analysis and Design of Linear Circuits, 7th Edition, by Roland E. Thomas and Albert J. Rosa, 2009, John Wiley & Sons Inc., ISBN: 978-1-118-06558-7

Recommended Texts:

A Guide to Writing as an Engineer, 4th Edition, by David F. Beer and David A. McMurrey, 2014, John Wiley & Sons, Inc., ISBN: 978-1-118-72261-9. ***Used in EGNR-101***

Course Description:

This course is an introduction to the analysis of linear circuits. Topics include: basic circuit elements and their terminal relations, Kirchhoff's laws, nodal analysis, mesh analysis, superposition theorem, Thevenin and Norton equivalent circuits, DC transient analysis of RC and RL circuits, phasors, sinusoidal steady-state response of RLC circuits and single-phase and three-phase AC power analysis.

Course Goals:

The student should be able to:

1. Understand basic electrical relationships between voltage, current, resistance, power for various signal types and for basic circuit elements.
2. Evaluate the input/output relationships of basic electric circuits, both AC and DC.
3. Evaluate circuits containing operational amplifiers and linearly dependent sources.
4. Evaluate elementary three-phase circuits.
5. Set up experiments and analyze bread-boarded circuits using standard lab equipment.

Course Objectives:

At the conclusion of EGEE-210, the successful student will be able to:

1. Explain and apply basic electrical principles to analyze linear DC circuits.
    a) Explain and apply the voltage-current relationships for resistors and sources.
    b) Explain the difference between supplied and dissipated power.
    c) Calculate the power supplied or dissipated by passive elements and sources.
    d) Explain and apply Kirchhoff's Voltage and Current Laws.
    e) Explain and apply circuit equivalency (series, parallel) and source transformations.
2. Apply circuit theorems to calculate voltage, current, and power in linear DC circuits.
    a) Use voltage and current division.
    b) Use mesh analysis.
    c) Use nodal analysis.
    d) Use superposition.
    e) Use Thevenin and Norton equivalent circuits.
3. Analyze linear DC circuits containing dependent sources.
    a) Analyze circuits containing dependent voltage and/or current sources.
    b) Explain the operation of the ideal op-amp.
    c) Analyze circuits containing ideal op-amps.
4. Calculate the transient response of linear RC and RL circuits with switches and DC sources.
    a) Identify step, exponential, sinusoidal and composite waveforms.
    b) Understand the basic principles of capacitors and inductors.
    c) Explain and calculate the time constant of RC and RL circuits.
    d) Calculate the initial and final conditions of RC and RL circuits.
    e) Formulate and graph the transient response of RC and RL circuits.
5. Analyze the sinusoidal steady-state response of linear AC circuits.
    a) Define and calculate the frequency, period and phase of sinusoidal waveforms.
    b) Explain and calculate the average and effective (rms) values of sinusoidal waveforms.
    c) Express sinusoidal waveforms as phasors and vice versa.
    d) Describe the voltage-current relationships of passive elements by their impedances.
    e) Use circuit theorems to calculate voltage and current phasors in circuits containing complex impedances.
6. Analyze sinusoidal steady-state power delivery in electric power circuits.
    a) Explain and calculate complex, average, reactive and apparent power.
    b) Analyze the transmission of power in the single-phase circuits.
    c) Describe the operation of ideal transformers and their use in transmission of power.
    d) Explain the basic concept of three-phase circuits.
7. Construct, test, and simulate simple electrical circuits.
    a) Use lab instrumentation to wire circuits containing resistors, capacitors and inductors.
    b) Use a digital multi-meter to measure voltage, current and resistance.
    c) Use a signal generator to produce a specified voltage waveform.
    d) Use an oscilloscope to measure amplitude, frequency and phase of periodic signals.
    e) Use electrical circuit simulation software to simulate electric circuits.
    f) Compare theoretical calculations, circuit simulations and measured results.
    g) Use a soldering iron to connect electrical components together.

Grading:

Homework	10%	90% 93% 97%	A- A A+
Tests	40%	80% 83% 87%	B- B B+
Final Exam	30%	70% 73% 77%	C- C C+
Labs	15%	60% 63% 67%	D- D D+
Lab Practical	5%	below 60%	F
	100%		

Graded Items:

Homework:

Homework is assigned each class period and is due at the start of the following class period (i.e. homework for lecture #1 is due at the start of lecture #2). It is your responsibility to communicate that you understand the problem and the solution to it. Late homework will not be accepted unless prior arrangements have been made.

It often helpful to work in study groups when doing homework problems to discuss the material. Homework is for your benefit (to ensure you understand the material), therefore, it is essential that you work the problems until you understand the topic. You must write-up the homework by yourself.

Tests and Final Exam:

The tests and the final exam will be closed book and closed notes. However a single-page equation sheet of your own making and without worked problems may be used. Approved calculators (see Corse Policies) may be used during exams.

Labs:

Some laboratory exercises may include a graded, pre-lab component. This pre-lab will include preliminary calculations, and detailed plans for testing that will occur during the lab exercise. The thought and planning that is invested into the pre-lab will enhance the understanding and results obtained during lab. Some labs will require memos discussing the lab.

Course Policies:

Attendance: Attendance will be taken at each lecture and laboratory session. It is important that students attend class regularly in order to do well in the course. Perfect attendance will result in a 1% (out of 100%) increase in your final grade. Any absence beyond three will result in a 1% (out of 100%) decrease in your final grade. Two tardies will count as one absence.

Submitted Work: All calculations must be performed in a clear and logical manner such that the instructor can follow the steps. The procedure used to determine the solution is more important than the final answer. Failure to show your work in a clear and logical manner will result in a significant or total loss of points.

Lecture Grade: A minimum of 60% is required in the lecture portion of the course, regardless of the laboratory grade, in order to pass the course.

Laboratory Grade: A minimum of 60% is required in the laboratory portion of the course, regardless of the lecture grade, in order to pass the course.

Calculators: Only those calculators which are permitted for the Fundamentals of Engineering exam (Casio *fx-115*, TI *30X*, TI *36X*, HP *33s*, or HP *35s*) may be used during exams and quizzes. No exceptions will be made. Other calculators may be used in the laboratory, but you are strongly encouraged to use one of these calculators there as well.

Disturbances: All portable electronic devices (cell phones, MP3 players, PDAs, etc.) must be turned off or put on silent mode for all class and lab sessions. If the device is on and interrupts class, the student may be asked to leave the class for the day which would count as an absence.

Policy Change: The instructor reserves the right to modify the course outline and policies mentioned in this syllabus at any time during the semester. All modifications will be discussed with the students.

University Policies and Statements:

Policies, including those below, are posted on the Provost's website www.lssu.edu/provost/forms:

- Academic Integrity Policy
- Online and Blended Course Attendance Policy
- The Americans with Disabilities Act & Accommodations
- IPASS (Individual Plan for Academic Student Success)
- Policy on Student Absences

Honor Pledge

As a student of Lake Superior State University, you have pledged to support the Student Honor Code of the School of Engineering & Technology. You will refrain from any form of academic dishonesty or deception such as cheating, stealing, plagiarism or lying on take-home assignments, homework, computer programs, lab reports, quizzes, tests or exams which are Honor Code violations. Furthermore, you understand and accept the potential consequences of punishable behavior.

Lecture Schedule

SESSION	TOPIC	SECTION	HOMEWORK
1	Introduction, Circuit Variables	1.1, 1.2, 1.3	1.5, 1.19, 1.22
2	Circuit Elements, Kirchhoff's Laws	2.1, 2.2, 2.3	2.26, 2.27, 2.30, 2.32
3	Equivalent Circuits	2.4	2.36, 2.41, 2.46, 2.47
4	Voltage and Current Division, Circuit Reduction	2.5, 2.6	2.54, 2.56
5	**Test #1**		
6	Nodal Analysis	3.1	3.4, 3.5, 3.12
7	Mesh Loop Analysis	3.2	3.13, 3.14
8	Superposition	3.3	3.28, 3.28, 3.38
9	Thevenin and Norton Equivalent Circuits	3.4	3.47, 3.48, 3.52
10	Maximum Power Transfer, Interface Circuits	3.5, 3.6	3.71, 3.72
11	**Test #2**		
12	Linear Dependent Sources, Circuits with Dependent Sources	4.1, 4.2	4.7a, 4.8
13	Operational Amplifiers	4.3	
14	Analysis of Op-Amp Circuits	4.4	4.25, 4.28, 4.39
15	Impulse, Step, and Ramp Waveforms	5.1, 5.2	5.2, 5.4
16	Exponential and Sinusoidal Waveforms	5.3, 5.4	5.14, 5.16, 5.22
17	Composite Waveforms	5.5	5.28, 5.30
18	Waveform Descriptors	5.6	5.40, 5.42
19	**Test #3**		
20	Capacitors	6.1, 6.4a	6.2, 6.4. 6.6, 6.8
21	Inductors	6.2, 6.4b	6.10, 6.14
22	RC and RL Circuits	7.1	
23	First-Order Circuit Step Response	7.2, 7.3	7.8, 7.10, 7.16
24	**Test #4**		
25	Review of Trigonometry and Complex Numbers		
26	Sinusoids and Phasors	8.1	8.2, 8.4
27	Phasor Circuit Analysis	8.2	8.16, 8.18
28	Basic AC Circuit Analysis with Phasors	8.3	8.26, 8.36
29	AC Circuit Theorems with Phasors	8.4	
30	General AC Circuit Analysis with Phasors	8.5	8.40, 8.42, 8.54
31	AC Energy and Power	8.6	8.78
32	**Test #5**		
33	Average and Reactive Power	16.1	16.2
34	Complex Power	16.2	16.4
35	Single-Phase Circuit Analysis	16.3	16.12
36	Single-Phase Power Flow	16.4	16.21, 16.22
37	Three-Phase Circuit Analysis	16.5	16.31, 16.32
38	Three-Phase Power	16.6	16.42
39	Ideal Transformer	15	15.2
40	Transformer Circuit Analysis	15	15.12
41	**Test #6**		
42	Evaluation and Assessment		

Laboratory Schedule

Lab	ACTIVITY
1	Introduction to Lab Equipment
2	Basic Circuit Measurements
3	Series and Parallel Circuits
4	Circuit Simulation Software (OrCAD or LTSpice)
5	Linearity and Superposition
6	Thevenin and Norton Equivalent Circuits; Maximum Power Transfer
7	Soldering & Oscilloscope Operation
8	Operational Amplifiers
9	RC & RL Circuit Step Response
10	AC Circuits
11	Basic Filter Circuits
12	AC Power Analysis
13	**Lab Practical**
14	Basic Transformers

Appendix Cover Sheet

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering and Technology**
Document Title (if attached) or **Filename (if emailed):**	**Four-Column Report**
This documentation is relevant to Question number:	**13**
Briefly summarize the content of the file and its value as evidence supporting program review:	**Evidence that Four-Column Report was completed.**

Assessment: Program Four Column

Program (CoIS) - General Engineering AS

Assessment Contact: Dr. Paul Weber

Mission Statement: A recipient of the AS degree in General Engineering will possess the fundamental technical skills in engineering, spanning mechanical, electrical and computer-related subject areas, required to be in a position to complete a Bachelor?s degree in an engineering discipline with two remaining years of full-time study. These skills include computing, numerical methods, electrical circuit analysis, and mechanical force analysis.

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
Engineering System Analysis - Students will be able to analyze electrical and/or mechanical systems by applying math, science, and/or engineering equations and techniques. **Goal Status:** *Active* **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Mid-Level (Analyzing/Applying) (Bloom) **Institutional Learning:** ILO2 - Use of Evidence - Students will identify the need for, gather, and accurately process the appropriate type, quality, and quantity of evidence to answer a complex question or solve a complex problem. **Assessment Year:** AY16-17, AY17 18, AY18-19	**Direct - Exam/Quiz - within the course** - Students in EGEE210 [Circuit Analysis] will apply analysis techniques to series and parallel resistor circuits as measured by a final exam problem on that topic. **Criteria Target:** an average grade of 70% or higher	**Finding Reporting Year:** 2016-2017 **Goal met:** No Fall 2016: 65% Spring 2017: 82% (09/03/2018)	**Use of Result:** One semester's group did not meet the target whereas the other did. Each was taught by different instructors. The two should come up with an action plan and the results should be monitored in 2017-2018. (09/03/2018)
		Finding Reporting Year: 2017-2018 **Goal met:** No Fall 2017: 62% Spring 2018: 87% (09/03/2018)	**Use of Result:** There is some concern at this time since the fall class again did not meet the target. Moving from 2 exams to 3 exams may give students more feedback and help them improve. Continue to evaluate in Fall 2018 (09/03/2018)
Communication - Students will be able to communicate in a technical environment. **Goal Status:** Active **Goal Category:** Student Learning	**Direct - Portfolio Review** - Students in EGNR101 [Introduction to Engineering] will compose a technical log of their final project as demonstrated in a team logbook	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Fall 2017 78% (08/30/2018)	**Use of Result:** No concern at this time. Continue to evaluate in Fall 2018 (08/30/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** Yes	**Use of Result:** No concern at this

Student Learning Outcomes	*Assessment Criteria & Procedures*	*Assessment Results*	*Use of Results*
Goal Level (Bloom/Webb): Level 2 (Skills and Concepts) (Webb) **Institutional Learning:** ILO1 - Formal Communication - Students will develop and clearly express complex ideas in written and oral presentations. **Assessment Year:** AY16-17, AY17-18, AY18-19	**Criteria Target:** An average of 70% or higher on student work **High Impact Program Practices 1:** First-year Seminar and Experiences **High Impact Program Practices 2:** Collaborative Assignments, Projects	Fall 2016: 80% (01/01/2017)	time. Continue to evaluate in Fall 2017. (01/01/2017)
Use of Technical Tools - Students will be able to us technical tools to solve engineering problems. **Goal Status:** Active **Goal Category:** Student Learning **Goal Level (Bloom/Webb):** Mid-Level (Analyzing/Applying) (Bloom) **Institutional Learning:** ILO3 - Analysis and Synthesis - Students will organize and synthesize evidence, ideas, or works of imagination to answer an open-ended question, draw a conclusion, achieve a goal, or create a substantial work of art. **Assessment Year:** AY16-17, AY17-18, AY18-19	**Direct - Exam/Quiz - within the course** - Performance Indicator: ability to solve a recursive problem by writing a program in a structured programming language, implementing the recursion in an iterative loop on an exam question from Numerical Methods for Engineers (EGNR-340). **Criteria Target:** an average evaluation of 3.0 out of 4 on the performance indicator for at least one of the semesters with no performance indicator below 2.0	**Finding Reporting Year:** 2017-2018 **Goal met:** Yes Fall 2017: 3.1 Spring 2018: 2.0 (08/30/2018)	**Use of Result:** Target met overall for the year. No concern at this time. Continue to evaluate in Fall 2018. (08/30/2018)
		Finding Reporting Year: 2016-2017 **Goal met:** Yes Fall 2016: 2.3 Spring 2017: 3.0 (08/30/2017)	**Use of Result:** Target met overall for the year. No concern at this time. Continue to evaluate in Fall 2017. (08/30/2017)

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**Engineering and Technology**
Document Title (if attached) or Filename (if emailed):	**Degree Audit**
This documentation is relevant to Question number:	**15**
Briefly summarize the content of the file and its value as evidence supporting program review:	

School of Engineering and Technology

ASSOCIATE DEGREE IN GENERAL ENGINEERING

(For Incoming Freshman Starting Fall 2015 or later)

Student Name: ____________________ Overall GPA: ________ Department GPA: ________

Student ID #: ____________________ Advisor Approval: ____________________ Date: ________

Intended Month of Graduation: ____________________ Chair Approval: ____________________ Date: ________

All information below should be from the student's most recent transcript and/or transfer evaluation.

GENERAL EDUCATION REQUIREMENTS (21 CREDITS)

Communication Skills (9 credits)

ENGL110 - 3 ______

ENGL111 - 3 ______

COMM101, 201, or 225 – 3 credits ______

General Education Elective (12 credits required)

CHEM115 – 5 (*also used for dept requirements*) ______

______ - ______ ______

______ - ______ ______

Remaining 7 credits to be chosen from Humanities, Social Science or Diversity Electives

DEPARTMENT REQUIREMENTS (49 CREDITS)

CHEM115 - 5 ______

EGEE210 - 4 ______

EGEM220 - 3 ______

EGNR101 - 2 ______

EGNR140 - 2 ______

EGNR265 - 3 ______

EGNR340 - 1 ______

MATH151 - 4 ______

MATH152 - 4 ______

MATH251 - 4 ______

MATH310 - 3 ______

PHYS231 - 4 ______

PHYS232 - 4 ______

Designated Electives (6 credits required)
See advisor for approval

______ - ______ ______

______ - ______ ______

2.0 Overall GPA .... ☐ Yes ☐ No

2.0 Dept. GPA .... ☐ Yes ☐ No

65 Total Credits .... ☐ Yes ☐ No

Residency (16 of final 20) .... ☐ Yes ☐ No

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Academic Program Review

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Send email with supporting documentation to: TRACDAT@lssu.edu, with a cc to your dean, or submit as a hardcopy to your dean.

School:	**School of Engineering & Technology**
Document Title (if attached) or Filename (if emailed):	**EGNR265 Project 3 Example Student Work**
This documentation is relevant to Question number:	**16**
Briefly summarize the content of the file and its value as evidence supporting program review:	**This document showcases an example of student work of an undergraduate project within the A.S. General Engineering program where the student has developed a skill (coding in this case) that is integral to the program (no pun intended).**

EGNR265 Fall 2017

Programming Project #3
Runner Log Management

Student: __ **Date of Submission:** 12/7/17

Compiled on: ☑ CodeBlocks, ☐ other: ____________; **# of fns:** 17, **lines of code:** 967

See attached code listing for detailed comments.

Grade summary:

PART	INSTRUCTOR NOTES/VERIFICATION	POINTS	SCORE
Functional:		---	
Read file, Sort list, Build list	☑ proper file access ☑ create/populate node ☑ build linked list ☑ sorted chronologically	15	15
Display list, Search list	☑ display list (organized) ☑ search date range and string fields ☑ proper match/display of search	10	10
Add & edit events	☑ query (and verify) for new info ☑ proper node create/add/insert not leap century ☑ process to find 1 node ☑ proper update means of node/list	15	14
Run report	☑ process to find 1 person(runner) ☑ proper date range and report generation	10	10
Save list, Delete list	☑ save list to file (proper format) ☑ delete list (deallocate memory) — on exit of program	10	9
Quality of program	☑ > 10 functions good use of functions ☑ < 1000 lines 0 warnings 0 codecheck issues	15	15
Code Style	watch indenting in a few places	10	9
Comments	Very easy to read. good function headers	10	10
User friendly	nice feedback	5	5
Extra credit	Color in table (+1) instructions menu (+2) delete confirm (+1)	+	4
	Out of 100 points	**TOTAL**	101

```
/*---------------------------------------------------------------*/
/*Name:                                                          */
/*Class: EGNR265                                                 */
/*Project: project #3                                            */
/*Date: 12/6/2017                                                */
/*Purpose: runners log                                           */
/*Compiled on: Codeblocks                                        */
/*used files provided by Dr. Jones                               */
/*---------------------------------------------------------------*/

#define TERM_PC
//#define TERM_MAC
//#define TERM_LINUX
//#define TERM_UNKNOWN
#include "run_support.h"  // defining structure, constants for project 3

// define other constants, function prototypes, and libraries here
int input_confirm(int low,int high);
struct Event *create_list(struct Event *head_ptr,FILE *ptr);
FILE *load_file();
struct Event *sort_list(struct Event *head_ptr);
void print_list(struct Event *head_ptr);
int date_to_int(int day,int month, int year);
int count_list_nodes(struct Event *head_ptr);
struct Event *delete_linked_list(struct Event *head_ptr);
struct Event *add_event(struct Event *head_ptr);
struct Event ask_for_date(struct Event  athlete);
struct Event *find_edit_event(struct Event *head_ptr);
struct Event *edit_or_delete_event(struct Event *cur_ptr,
struct Event *prev_ptr,struct Event *head_ptr,int entry_num);
int runner_report(struct Event *head_ptr);
void print_event_norm(struct Event *cur_ptr);
void save_to_file(struct Event *head_ptr);
float input_confirm_float(float low,float high);
void instructions(void);

int main (int Argc, char **Argv)
{
  // main program - add variables here
  int cyear, cmonth, cday;
  struct Event *head_ptr = NULL;
  int enter=9,file_load_indicator=0,event_num=0;
  char yes_or_no;
  FILE *fptr;

  /* begin the main program */
  Set_Screen_Size(SCREENX,SCREENY);  // set console size - do NOT modify
  Set_Screen_Title(" -- Graham Runners Log -- ");  // modify


  do
  {
    Clear_Screen();
    event_num=count_list_nodes(head_ptr);

    //print main menu
    Set_Color(0x07);
    printf("\n\t Log Menu - First edition\n ");
    Get_Current_Day(&cyear, &cmonth, &cday);
    printf("\nToday is: ");
    Print_Dayofweek(Day_Of_Week(cyear, cmonth, cday)+1);
    printf(", ");
    Print_Month(cmonth);
    printf(" %d, %d\n\n", cday, cyear);
```

```
      {
        printf("file is corrupted!\n");
        fclose(ptr);
        exit(-1);
      }
      if (scan_check==EOF)
        break;


      cur_ptr=(struct Event *)malloc(sizeof(athlete));
      if(cur_ptr==NULL)
       {
         Set_Color(0x0C);
         printf("\nfailure in data allocation!\n");
         exit(-1);
       }

      //copy data to the node
      cur_ptr->date.d=athlete.date.d;
      cur_ptr->date.m=athlete.date.m;
      cur_ptr->date.y=athlete.date.y;
      cur_ptr->type=athlete.type;
      cur_ptr->distance=athlete.distance;
      cur_ptr->duration=athlete.duration;
      cur_ptr->comment=(char *)malloc(strlen(comment)+1);
      if(cur_ptr->comment==NULL)
       {
         Set_Color(0x0C);
         printf("\nfailure in data allocation!\n");
         exit(-1);
       }
      strcpy(cur_ptr->comment,comment);
      strcpy(cur_ptr->person,athlete.person);

      cur_ptr->next_ptr=NULL;

      if (head_ptr==NULL)//first iteration
      {
          head_ptr=cur_ptr;
      }
      else//other iterations besides first
      {
         tail_ptr->next_ptr=cur_ptr;
      }
      tail_ptr=cur_ptr;
    }

  fclose(ptr);//close file
  return(head_ptr);
}
// got most from lecture note   ######
//*sort_list()
//accepts the head pointer of a linked list and goes through
//a bubble sort to sort the list by chronological order
//returns head pointer
struct Event *sort_list(struct Event *head_ptr)
{
  //declare local variables
  int out,in,length1=0,count1=0;
  int first,second;
  struct Event *cur_ptr,*temp_ptr;
  struct Event **array1;

  length1=count_list_nodes(head_ptr);
```

Confirm data ! !

build forward

Bubble Sort

```
  }
 strcpy(cur_ptr->comment,comment);
 strcpy(cur_ptr->person,athlete.person);
 cur_ptr->next_ptr=NULL;
 //double checking the user
 print_list(cur_ptr);
 printf("Is the above correct? (Y/N): ");
 fflush(stdin);
    yes_or_no=getchar();
    fflush(stdin);
    yes_or_no=toupper(yes_or_no);
    if(yes_or_no=='Y')
      {
        temp_ptr=head_ptr;
        head_ptr=cur_ptr;
        cur_ptr->next_ptr=temp_ptr;
      }
    else
     {
       free(cur_ptr->comment);
       free(cur_ptr);
     }
 return(head_ptr);
}
//*find_edit_event()
//accepts head pointer of the linked list
//the user is asked for parameters to search for a specific event
//the user can edit or delete it
//returns the head pointer
struct Event *find_edit_event(struct Event *head_ptr)
{
 //declaring local variables
 struct Event athlete1,athlete2,*cur_ptr,*temp_ptr=NULL;
 int date1,date2,date3,temp,temp_y,entry_num=0;
 int entry_select,color_change=0;
 char find_str[MAX_STR_LEN],temp_str[MAX_STR_LEN],type[MAX_STR_LEN];

 //asking user for parameters of the srearch
 printf("\n\n Entered Find Event to edit\n");
 printf("Enter date range of event:\n");
 printf("Early date...\n");
 athlete1=ask_for_date(athlete1);
 printf("Later date...\n");
 athlete2=ask_for_date(athlete2);
 date1=date_to_int(athlete1.date.d,athlete1.date.m,athlete1.date.y);
 date2=date_to_int(athlete2.date.d,athlete2.date.m,athlete2.date.y);
 if (date1>date2)//if dates were imputed backwards
 {
   Set_Color(0x0E);
   printf("\n User entered a date that occured before the 'Early date'\n");
   printf("will set the earliest date to early date and the latest\n");
   printf("date to the 'later date'.\n");
   Set_Color(0x07);
   temp=date2;
   date2=date1;
   date1=temp;
 }
 printf("Please enter runner name (even if partial):");
 fflush(stdin);
 gets(find_str);

 strupr(find_str);
 cur_ptr=head_ptr;
 //start of printing matches
```

[illegible]

```
      cur_ptr->date.d=Athlete.date.d;
    }
    if (enter==2)//edit run type
    {
      printf("  Enter run type...\n");
      printf("   1. Long\n");
      printf("   2. Easy\n");
      printf("   3. Race\n");
      printf("   4. Tempo\n");
      printf("   5. Interval\n");
      printf("   6. Hills\n");
      printf("   7. Other\n");
      cur_ptr->type=input_confirm(1,7);
    }
    if (enter==3)//edit name
    {
      printf("\nenter runner name:");
      fflush(stdin);
      gets(new_name);
      strcpy(cur_ptr->person,new_name);
    }
    if (enter==4)//edit distance
    {
      printf("enter new distance in miles (0.10 to 100.00):");
      cur_ptr->distance=input_confirm_float(.1,100.0);
    }
    if (enter==5)//edit duration
    {
      printf("enter new duration in minutes (1.00 to 1440.00):");
      cur_ptr->duration=input_confirm_float(1.00,1440.0);
    }
    if (enter==6)//edit comment
    {
      printf("enter new comment:");
      fflush(stdin);
      gets(temp_comment);
      free(cur_ptr->comment);
      cur_ptr->comment=(char *)malloc(strlen(temp_comment)+1);
      strcpy(cur_ptr->comment,temp_comment);
    }
    if (enter==7)//delete node
    {
      printf("are you sure?(Y/N):");
      fflush(stdin);
      yes_or_no=getchar();
      fflush(stdin);
      yes_or_no=toupper(yes_or_no);
      if(yes_or_no=='Y')
       {
         if (prev_ptr!=NULL)
         {
           prev_ptr->next_ptr=cur_ptr->next_ptr;
           free(cur_ptr->comment);
           free(cur_ptr);
         }
         if(prev_ptr==NULL)
         {
           head_ptr=cur_ptr->next_ptr;
           free(cur_ptr->comment);
           free(cur_ptr);
         }
       }
       if(enter==0)//leave
       {
```

yes

```
        strcpy(type,"Easy");
      if(cur_ptr->type==3)
        strcpy(type,"Race");
      if(cur_ptr->type==4)
        strcpy(type,"Tempo");
      if(cur_ptr->type==5)
        strcpy(type,"Interval");
      if(cur_ptr->type==6)
        strcpy(type,"Hills");
      if(cur_ptr->type==7)
        strcpy(type,"Other");
      if((cur_ptr->type<1)&&(cur_ptr->type>7))
       {
        printf("\nCorrupt File! closing program");
        exit(-1);
       }

       if (cur_ptr->date.y>2000)
         temp_y=cur_ptr->date.y-2000;//to print the year value in 2 digits
       printf("%2.2d/%2.2d/%2.2d %-8.8s %-13.13s %5.2f %8.2f  %5.2f  %-17.17s\n",cur_ptr
       ->date.d,
             cur_ptr->date.m,temp_y,type,cur_ptr->person,
             cur_ptr->distance,cur_ptr->duration,
             ((cur_ptr->distance)/((cur_ptr->duration)/60)),cur_ptr->comment);
    }
    //save_to_file()
    //accepts head pointer of linked list
    // prints the data of each node into a record of a file
    //returns nothing
    void save_to_file(struct Event *head_ptr)
    {
      //declare local variables
      FILE *new_fptr;
      char file_name[MAX_STR_LEN];
      struct Event *cur_ptr;

      //ask for file name
      printf("Enter file name to save to:");
      fflush(stdin);
      gets(file_name);

      //open file
      new_fptr=fopen(file_name,"w");
      if (new_fptr==NULL)  //test to see if the file succesfully opened
        {
          Set_Color(0x0C);
          printf("error reading file");
          exit(-1);
        }
       Wait_For_Enter();
      cur_ptr=head_ptr;
      //print to file
      while (cur_ptr!=NULL)
      {
        fprintf(new_fptr,"%d,%d,%d;%s,%d,%.3f,%.3f,%s\n",cur_ptr->date.d,
               cur_ptr->date.m,cur_ptr->date.y,cur_ptr->person,cur_ptr->type
               ,cur_ptr->distance,cur_ptr->duration,cur_ptr->comment);
        cur_ptr=cur_ptr->next_ptr;

      }
      //close file
      fclose(new_fptr);

    }
```