

The University Senate of Michigan Technological University
Proposal 48-20
(Voting Units: Academic)

“Master of Science in Electrical and Computer Engineering”

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I. Introduction

The Department of Electrical and Computer Engineering proposes to create a new Master’s Degree in Electrical and Computer Engineering (MSECE) with the intent to shelve the two existing degrees, the Master of Science in Electrical Engineering (MSEE) and the Master of Science in Computer Engineering (MSCompEng). If this proposal is approved no new students will be admitted to either the MSEE or MSCompEng starting with the next recruiting cycle in Fall Semester, 2020. The proposals to shelve the MS degrees in Electrical Engineering and in Computer Engineers are being submitted in parallel with this proposal (see proposals [49-20](#) and [50-20](#)). The proposed program will meet the needs of engineers seeking training in all areas of electrical and computer engineering supported by the ECE Department while making the graduation requirements both simpler to understand and more flexible, and making the program easier to administer. The new degree will allow students to determine a flexible mix of coursework in electrical and computer engineering, engineering from related fields, physical sciences, and computer science to meet their educational and career goals, while fulfilling a demanding set of Graduate School and departmental requirements. The proposed program will use the resources already available in the ECE Department and in the University - no new resources are proposed here. The MSECE is expected to continue to attract domestic and international students to pursue graduate study in interdisciplinary areas of Electrical and Computer Engineering including electrical energy systems, robotics, signal and image processing, communications, embedded systems, electro-magnetics, and optics and photonics.

II. Proposal

1. General description and characteristics of program

The proposed program does not change the basic requirements for graduation, which is presently to obtain 30 credits beyond a BS degree in an approved program of study for students without a Michigan Tech BS. However, presently the MSEE and MSCompEng have graduation requirements that are different in the details. The proposal below outlines a program which is flexible enough to allow students to emphasize their interests within the architecture of a single degree program. This proposal maintains the ECE Department's historical emphasis of the connection between hardware, software, and the physical world.

The Graduate Learning Objective for the MSECE program are provided in Appendix B.

2. Rationale

The MSCompEng program has always been much smaller than the MSEE program. When the MSCompEng program was established the degree requirements were set to be distinct from the MSEE requirements as at that time these were essentially two fairly separate fields. Since then large areas of Electrical Engineering and Computer Engineering have converged and these two fields are often interdisciplinary. At our graduate program review in October, 2020 the external reviewers raised these issues and pointed out that many universities have combined their Graduate Degrees in this manner. Historically, the ECE field has at times been "stove piped" in the sense that narrow specialization was the norm for most graduate students. While it is still the case that some students will seek narrow specialization, a great deal of exciting research in ECE is interdisciplinary. One of our goals in restructuring the Master's Program is to better serve both constituencies, while making sure graduates have the depth and breadth in their education to have successful careers.

The proposed MSECE degree will offer the following advantages:

- There are no required core courses; each program can be tailored to meet the needs and interests of each student while still providing the necessary level of rigor associated with MS degrees.
- The proposed MSECE degree program will attract students from diverse undergraduate backgrounds, including but not limited to Electrical Engineering, Computer Engineering, Physics, and Mechanical Engineering.

3. Discussion of related programs within the institution and at other institutions

3.1. Related programs within the institution

Michigan Tech currently offers MS degrees in Electrical Engineering and in Computer Engineering. If this proposal is approved, we will shelve the existing degrees and offer only the MSECE. The MSECE degree will require 30 credits beyond a BS degree.

It is our intent to make the MSECE program flexible, and interdisciplinary, while maintaining rigor. We will continue our approach of accepting students with non-traditional backgrounds at the BS level and help them succeed in their graduate program. In particular, we have already accepted students with BS degrees in Mechanical Engineering, Physics, Computer Science, and Math into our program, and this proposed update should make the MSECE program even more attractive to interdisciplinary students and study.

3.2. Related programs at other institutions

A few examples of prestigious universities which now offer MSECE degrees include Boston University: <https://www.bu.edu/academics/eng/programs/electrical-engineering/ms-in-electrical-computer-engineering/>

Purdue:

<https://engineering.purdue.edu/ECE/Academics/Graduates/MASTERS/handbook#degrees>

Georgia Tech:

<http://catalog.gatech.edu/programs/electrical-computer-engineering-ms/>

There are many others, but this list should suffice to show that Michigan Tech will be in good company if this proposal is approved. All these universities emphasize new emerging areas of interdisciplinary study. Our program will initially cover a subset of supported by our faculty which includes:

- Robotics and autonomous navigation
- Communications networks and connected sensor networks,

- Power generation and distribution, power system protection, and renewable sources of electrical energy, microgrids, power operations, and cyber-physical security of the power and transportation infrastructure
- Sensing and processing, embedded systems, and networking

3.3 Projected enrollment and economic impact

The projected enrollment in the proposed MSECE program would likely initially be unchanged from the sum of the number of MSEE and MSCompEng students in the department. However, making the program more flexible and interdisciplinary, and expanding the acceptance of people from a broader set of disciplines will very likely expand enrollment. ECE is not presently running at capacity for our graduate program, and we would welcome the additional students.

4. Scheduling plans (Extension, Evening, Regular)

As with the existing two programs, the new combined MS ECE program will be offered both on campus and on line.

5. Curriculum design

The curriculum structure of the proposed MSECE program has three plans: the Coursework Plan, the Report Plan, and the Thesis Plan. All require 30 credits of graduate work beyond the BS degree. The proposed degree requirements are described below:

Coursework Plan: a total of 30 advisor approved credits consisting of the following components:

- A minimum of 18 credits of advisor approved 5000 level ECE, Computer Science, Biomedical Engineering, Math, Mechanical Engineering, or Physics.
- A maximum 12 credits of advisor approved 4000 level courses
- A maximum of 3 credits of co-op experience.
- Students must meet the Graduate School's requirements for degree completion.

Report Plan: a total of 30 advisor approved credits consisting of the following components:

- 24 credit minimum of coursework consisting of:
 - 12 credits minimum of advisor approved 5000 level or higher ECE, Computer Science, Biomedical Engineering, Math, Mechanical Engineering, or Physics (not including EE 5991)
 - 12 credits maximum of 4000 level if approved by the Graduate Academic Advisor.
- At least 2 and up to a maximum of 6 credits of EE5991 Project Research.
- A maximum of 3 credits of co-op experience.
- Students must meet the Graduate School's requirements for degree completion.

Thesis Plan: a total of 30 advisor approved credits consisting of the following components:

- 20 credit minimum of coursework consisting of:
 - 12 credits minimum of advisor approved 5000 level or higher ECE, Computer Science, Biomedical Engineering, Math, Mechanical Engineering, or Physics (not including EE 5990).
 - 9 credits maximum of 4000 level if approved by the Graduate Academic Advisor.
- At least 6 and up to a maximum of 10 credits of EE5990 Thesis Research.
- A maximum of 3 credits of co-op experience.
- Students must meet the Graduate School's requirements for degree completion.

There are no required courses in this program. However, the Graduate Academic Advisor and the departmental faculty will help the students tailor programs to fit their interests and needs. All course plans must be approved by the graduate program.

The credit requirements for the three plans are summarized in the table below.

	Coursework	Report	Thesis
5000 level EE, CS, BE, MA, MEEM, or PH	18 minimum	12 minimum	12 minimum
4000 level courses	12 maximum	12 maximum	9 maximum
Co-op credits (included in above)	3 maximum	3 maximum	3 maximum
Research credits	0	2-6	6-10

Degree Options:

Students may earn the degree of MSECE degree according to the plans described above: Coursework, Report, or Thesis.

6. New course descriptions

Since the department already offers graduate degrees in Electrical Engineering and in Computer Engineering, no new courses are necessary and none are proposed.

7. Library and other learning resources

No additional library or learning resources are required.

8. Computing Access Fee

Not applicable.

9. Faculty resumes

The curriculum vitae of the faculty members are given at:

<https://www.mtu.edu/ece/department/faculty/>

Graduate Faculty serving this program will be the same as the existing MS and Ph.D. degrees in the department of Electrical and Computer Engineering.

The University has implemented special certification requirements for faculty teaching on-line courses. This certification is completed by the appropriate faculty in advance of running an on-line course.

10. Description of available/needed equipment

The ECE Department at Michigan Technological University is well equipped with modern research laboratories. Since the department already offers MS degrees in Electrical Engineering and in Computer Engineering, and enrollment increases are expected to be modest and in the future, no additional equipment is required to implement this proposal.

11. Additional Resources Required

No additional resources are required. No new costs anticipated for this new graduate degree program. Degree name changes in printed materials, if applicable, will be phased in over time and the minor costs will be absorbed by the department.

12. Space

No additional space is required to accommodate the new graduate degree program.

13. Policies, regulations and rules

None besides curricular requirements outlined above.

14. Accreditation requirements

Michigan Tech is accredited by the Higher Learning Commission (HLC). As such this program will meet HLC criteria 3 and 4.

No disciplinary accreditation will be sought.

15. Internal status of the proposal

March 18, 2020: The ECE graduate studies committee approved the proposal and recommended it to the ECE department faculty for its consideration.

16. Planned implementation date

Fall semester 2020.

Appendix A: Financial documentation for MSECE

I. Relation to university strategic plan

a. Relation of program to the university's educational and research goals: This new Master program supports Goal 2.1 of the university strategic plan (*Integration of research, instruction, and innovation that achieves the University Student Learning Goals*). Specifically, “*strengthen existing programs and develop new offerings in emerging interdisciplinary areas.*”

b. Consistency with the university's resource allocation criteria: The proposed program intended to attract new graduate students to the university based on existing instruction and research resources.

II. Impact on university enrollment

a. Projected number of students in the program: Projected enrollment is stable at the initial phase, but we expect growth in the future. Since the ECE graduate program is not currently running at capacity this growth will be managed at least initially within existing human and physical resources.

b. Source of new students; in particular, will the students be drawn from existing programs, or will they be students who would otherwise not have come to MTU? Both. The graduate student body in ECE is presently majority international students. We anticipate this will be at least steady, however, making the program attractive to a bigger cross section of people with non-traditional science and engineering backgrounds will likely grow both the US citizen and international enrollment.

c. What is the likely correlation between demand for the new program and existing enrollment patterns at MTU? This program emphasizes preparing students to meet the demands of interdisciplinary expertise in the job market. This will likely attract students from non-ECE backgrounds into the ECE department and thus diversify the existing enrollment patterns at the departmental level.

d. What is the current enrollment in the unit? Fall 2019: 133 graduate students.

III. Impact on resources required by department in which the program is housed

a. Faculty lines: This program will be supported by existing faculty lines.

b. Faculty and student labs, including ongoing maintenance: Existing research labs are adequate to support this program.

c. Advising: This will be supported by the existing Graduate Academic Advisor.

d. Assessment: The ECE graduate program committee will monitor and evaluate the enrollment and student performance of the new program on an annual basis.

IV. Impact on resources required by other units within the university

a. Other academic (e.g., Gen Ed) units with regard to faculty, labs and assessment. We do not expect any significant impact to other units although some of the existing classes may occasionally see an increase of enrollment by one or two students.

b. Information Technology, the Library, central administration and career planning with respect to the impact on the need for computing services, library resources, advising, record keeping, development of employer relations etc. There should be no significant impact on other units.

V. Assessment of the ability to obtain the necessary resources assuming requested funds are obtained. For high demand fields (e.g., business fields, etc.), will it be possible to fill allocated lines? Not applicable as we do not need additional resources.

VI. Past proposals

The ECE Department has not initiated any new Masters degree programs since the MSCompEng was approved in 2001.

VII. Departmental budget contribution

All figures are for 2019-2020.

a. What is the department's total general fund budget? The general fund base budget was \$2.1 million.

b. How much tuition does the department generate? This information should be provided for both the credit hours taught by the department and the number of credit hours taken by the department's majors.

For courses taught by the department [GA(1) : Undergraduate tuition was \$4,992,000 (~9344[GA(2) SCH times \$520 [GA(3) per credit hour) and graduate tuition was \$431,520 (~580[GA(4) SCH times \$744 per credit hour). Total tuition was \$5,423,520.

For courses taken by our majors and taught by other departments (estimated): 70 majors (primary majors only) times 32 credits per year times 0.6 (60% of credits taken outside the department) times \$520 per credit equals \$698,880.

[GA(1)for the 2018/2019 academic year, the latest year for which complete data is available

[GA(2)9344 sch compendium reports this sum of lower and upper. I don't know the price per sch but I'll bet its more that \$520.

Masters SCH was 1639 sch. For all instructional activity. I think the price per is closer to \$1000/sch.

[GA(3)

[GA(4)1069 sch at the masters level in

VIII. How do the benefits from this program compare to other alternatives that are currently under consideration or development?

The proposed MSECE degree will offer the following benefits:

1. The course sequence will be tailored to meet the needs of students depending on their individual area of interest.
2. The proposed MSECE degree program will attract students from diverse undergraduate backgrounds, including but not limited to electrical and computer engineering, other engineering disciplines, and physics.
3. A single MSECE program will be less time consuming to administer than a two single programs.

Appendix B: Graduate Learning Outcomes (GLOs)

The Graduate Learning Outcomes (GLOs) for the MSECE degree are described below.

At the time of graduation, MSECE students will have:

- GLO1. Demonstrated specialty-area knowledge
- GLO2. Developed an appreciation for the role of research and discovery in specific sub-disciplines.
- GLO3. Demonstrated effective written or oral communication skills
- GLO4. Demonstrated ethical and professional behaviors

Assessment Points for Measuring MS Graduate Learning Outcomes (GLO)

Table 1 presents the assessment points employed to obtain the data necessary to determine whether students achieve the MS GLOs.

Table 1. Master of Science GLOs and Assessment Points

Assessment Points	MS GLO Addressed	Notes
Form 5 : Thesis/report (thesis or report path)	GLO 1-4	Evaluation form used by thesis/report committee in evaluation of written work and oral presentation.
Form 6 : Thesis/report defense (thesis or report path)	GLO 1-4	Evaluation form used by thesis/report committee
Form 7 : Discipline specific courses (coursework path)	GLO 1-4	Evaluation form used by course instructor on specific assignments by ECE graduate committee each year

The first two forms (forms 5 and 6) are used for GLO assessment to be evaluated by the thesis or report committee. The committee will decide if the graduate students have taken appropriate courses that pertains to their research or topic of interest in the program. The third form is to assess coursework students.

Approved by the ECE Dept.: March 18, 2020
Approved by the College of Engineering: March 19, 2020
Approved by the Graduate School:
Approved by the Deans' Council:

Introduced to Senate:
Approved by Senate:
Approved by Administration: