

The University Senate of Michigan Technological University

Proposal 28-23

Establishment of a Associate of Science in Engineering

Submitted by: Department of Engineering Fundamentals

I. BACKGROUND:

This is a proposal for an Associate of Science in Engineering degree and will allow students eligibility for financial aid that is earmarked specifically for obtaining an associate's degree (e.g., [Michigan's Tuition Incentive Program](#) (TIP)). TIP provides tuition reimbursement for qualified Medicaid eligible students who enroll in an associate's degree (Phase I) and also during the student's bachelor's degree program (Phase II). Phase I can pay up to full tuition as long as the student is registered and taking enough courses that apply toward the associate's degree. Presently all TIP eligible Michigan Tech students are in bachelor's programs at Michigan Tech and opt into the only associate's degree available, Associate of Arts in Humanities. Since there is not a large overlap between this associate's degree and bachelor's in engineering degrees, TIP students who are simultaneously pursuing an engineering bachelor's degree often struggle to take classes that apply to both degrees. Therefore, many TIP students have to make a choice in their second year: take courses that are not part of the prereq sequence in their bachelor's degree to gain the tuition incentive or take their STEM required courses and pay for tuition they had planned to receive as part of their financial aid package.

Over the last three years we have averaged 295 students enrolled in the Associate in Humanities each fall. Of those 295, an average of 143 have been students also pursuing a bachelor of science degree in engineering. The three year averaged completion rate is 5 degrees awarded. This is an indication that a lot of students are not able to fully utilize the support offered by TIP.

The Associate of Science in Engineering degree is structured so all the required courses are also ones that are required for the student's engineering bachelor's degree. It would operate similarly as the Associate of Arts in Humanities, not as an advertised program but as one that is used by students in other majors.

Offering an Associate of Science in Engineering degree will benefit TIP eligible students because they will be able to complete their associate's degree while having courses that will count toward a bachelor's degree. This proposal has been discussed at length and received full support from Theresa Jacques from the Registrar's Office, Andrew Miles from Student Financial Services Center, and Maria Bergstrom the Associate Dean for Undergraduate Education in the College of Sciences and Arts.

II. BASIC PROGRAM INFORMATION

1. **Date Submitted:** Feb 24, 2023
2. **Primary Contact:** Amy Monte, aemonte@mtu.edu, Associate Teaching Professor, Academic Advisor, Associate Chair of BSE, Department of Engineering Fundamentals (aemonte@mtu.edu)

Additional Contacts: Mary Raber, Professor of Practice, Department Chair, Department of Engineering Fundamentals (mraber@mtu.edu) and Leonard Bohmann, Professor, Associate Dean for Academic Affairs, College of Engineering (lbohman@mtu.edu).

3. **Degree Type:** A.S.
4. **Program Title:** Associate of Science in Engineering
5. **Planned Implementation Date:** Fall 2023
6. **Program Location & Modality:** In residence on campus
7. **Target Student Population:** Students currently enrolled in an engineering bachelor's degree program and receiving TIP financial assistance.

This program will function much like the Associate of Arts in Humanities degree and will draw engineering students who would otherwise enroll in that program. This is not intended to be a source of new students and will not be advertised for recruiting. Rather, this program will be used to facilitate the TIP program for engineering majors. All students in this program will already be enrolled at Michigan Tech in one of the bachelor of science in engineering programs.

8. **General Description and Characteristics of the Program:** This is a two-year program similar to many engineering or pre-engineering associate's degrees offered at many other universities or community colleges. It offers the first two years of an engineering bachelor's degree. Unlike many of these programs, we will offer a much broader range of engineering courses allowing students to focus on particular engineering disciplines.
9. **Rationale:** This new associate's degree will allow engineering students to more fully utilize their TIP money (relieving some financial stress which should increase retention) and it will increase TIP engineering students' likelihood of completing their associate's degree. It will also benefit any student who decides to leave the university before completing their engineering bachelor's degree allowing them to earn an associate's degree as long as they meet the degree requirements.

10. Related Programs:

a. Michigan Tech.

This program is closely related to the first two years of the engineering bachelor's programs in the College of Engineering. It is unrelated in content to the one associate's degree that Michigan Tech currently offers, the Associate of Arts in Humanities (67 credits).

b. Other Michigan Institutions.

Michigan Universities

Three Michigan universities have associate's degrees in engineering; Ferris State University (FSU), Lake Superior State University (LSSU), and Northern Michigan University (NMU). These programs are similar to what is proposed here in that they allow students to seamlessly complete a bachelor's degree.

Our study indicated that similar programs do not exist at other Michigan Universities. Michigan does not allow State universities who are located within a defined community college district to award associate's degrees. Michigan Tech and these three universities are the only ones that are not located in a community college district.

Michigan Community Colleges

There are 31 community colleges in Michigan, many that offer associate's degrees in engineering and/or engineering technology. Of these, 24 have signed onto the MITransfer Pathway for Mechanical Engineering. This is a statewide agreement for transferring an associate's degree to a Michigan university in order to complete a degree in Mechanical Engineering. While Michigan Tech participates in the agreement, most students will need 2.5 - 3 years depending on the community college to complete their bachelor's degree. It takes even longer for a student in a different engineering discipline because of the lack of courses at the community colleges (many have a statics course but few have an introduction to materials science course.) In the Upper Peninsula, both Gogebic Community College and Bay de Noc Community College offer an associate's degree in engineering.

11. Projected Enrollment: Students in this program would be shifting from the Associate of Arts in Humanities to the Associate of Science in Engineering. Overall the university will not be gaining additional students by adding this program.

We anticipate approximately 50 students per year will enroll in this program instead of the Humanities Associate's degree. After the transition we expect approximately 125-130 students at any given time. This number is expected to change relative to overall enrollment of students in Michigan Tech's engineering bachelor's degrees.

12. **Specialized Accreditation Requirements:** There are no specialized accreditation requirements for this degree.
13. **Professional Licensure Requirements:** There are no specialized professional licensure requirements for this degree.

III. CURRICULUM DETAILS

1. **Learning Goals:** This degree aims to prepare students to pursue a bachelor's degree in engineering. Upon successful completion of the Associate of Science in Engineering degree, students will be able to:
 - a. Utilize foundational math, science, and engineering principles to define a problem, identify needed information, and derive solutions
 - b. Apply systematic methods and utilize computational tools to solve engineering problems
 - c. Communicate information, results, and recommendations in written and graphic formats
 - d. Function effectively in a collaborative environment
 - e. Be prepared to pursue advanced studies in engineering or other fields
2. **Assessment Plan:** Assessment may involve slight modifications of current practices.
3. **Curriculum Design:** The proposed Associate of Science in Engineering degree requires 65 credits of coursework which can be completed in four semesters in residence if a student starts in Calculus 1. It may take longer for students starting in Precalculus or Algebra or completing less than 17 credits per semester. There are 36 credits of required courses and 29 credits of electives which are selected from several lists.
 - 65 total credits
 - 12 credits – general education Core (UN1015, UN1025, and 2nd year)
 - 24-26 credits – math and science
 - 12-14 credits – engineering
 - 13-17 credits – from an elective list of mostly STEM courses

These requirements are detailed in the tables below.

Required Courses			
Credits		Credits	
12	General Education Core	8	Science
3	UN1015 - Composition*	3	CH1150 - University Chemistry I*
3	UN1025 - Global Issues or 3000+ Modern Language*	1	CH1151 - University Chemistry Lab I*
3	CORE: Critical & Creative Thinking*	1	PH1100 - Physics by Inquiry I*
3	CORE: Social Resp & Ethical Reason*	3	PH2100 - Uni Physics I - Mechanics*
	CoCurricular (3 units)	6	Engineering
10	Math	3	ENG1101 - Engrg Analysis & Problem Solving
4	MA1160/1161 - Calc/Plus w/ Tech I*	3	ENG1102 - Engrg Modeling & Design
4	MA2160 - Calculus w/ Tech II	29	Electives
2	MA2320/2321 - Elem Linear Algebra	65	Total Credits

* 24 Credits General Education: 12 credits core, 4 credits math, and 8 credits science in two different subjects. In addition, 3 units of co-curricular are required.

The 29 elective credits are divided into 3 lists: 6-8 credits from the Math/Science Electives list, 6-8 credits from the Engineering Electives list, and 13-17 credits from the Selective Electives list.

Credits	Math/Science Electives
	Select 6-8 credits
3	BL1100 General Biology 1
3	CH1160 University Chem 2
1	CH1161 University Chem Lab 2
3	GE2000 Understanding the Earth
4	MA3160 Multivariable Calculus
2	MA3520 or MA3521 Elementary Differential Equations
3	MA3710 Engineering Statistics
3	or CEE3710 Uncertainty Analysis in Engineering
3	or BE2110 Stats Methods for Biomedical Engineering
1	PH1200 Physics by Inquiry 2
4	PH2200 Univ Physics 2

Credits	Engineering Electives
	Select 6-8 credits
1	BE2100 Undergraduate Biomedical Engineering Seminar or CEE1000 Civil Engineering or CEE1501 Experiences in Environmental Engineering or CM1000 Intro to Chemical Engineering or ENG1505 Intro to Systems Engineering or GE1100 Geological Engineering & Sciences Orientation or SU1000 Intro to Geospatial Engineering
3	BE2700 Biomedical Signals & Systems
3	CEE3501 Environmental Engineering Fundamentals
3	or CEE3503 Environmental Engineering
3	CM2110 Materials & Energy Balances
3	CM3230 Thermo for Chem Engineers
3	CS1121 Intro to Programing 1
3	or CS1111 Intro to C/C++
3	EE2111 Electric Circuits 1
3	or EE3010 Circuits & Instrumentation
3	GE2300 Mineral Science
3	GE3050 Structural Geology
3	MEEM2110 Statics
4	or ENG2120 Statics-Strength of Materials
3	MEEM2201 Introduction to Thermodynamics
4	or CEE3200 Thermo/Fluid Mechanics
3	MSE2100 Intro to Materials Science & Engineering 1
3	or BE2800 Biomaterials 1
3	MSE2110 Intro to Materials Science & Engineering 2
2	SU2000 Introduction to Surveying
4	SU2050 Geospatial Computations

The selective electives list contains courses required in the first two years of the bachelor of science in engineering degrees and is composed mostly of STEM courses.

Selective Electives: select 13-17 credits (not used above)¹			
Credits	Course	Credits	Course
3	ACC2000 Accounting Principles 1	1	GE1200 Intro to Data Sci for Earth Resource Applications
3	BE2400 Cellular & Molecular Biology	3	GE2000 Understanding the Earth
3	BE2700 Biomed Signals & Systems	3	GE2010 Intro to GIS
3	BL1100 General Biology 1	3	GE2020 Intro to Mining Engineering
4	BL2010/11 Anatomy & Phys 1/Lab	3	GE2300 Mineral Science
4	BL2020/21 Anatomy & Phys 2/Lab	3	GE2310 Intro to Petrology
3	BUS2200 Business Law	2	GE2320 Mining Methods & Systems
1	CEE1001 Sustainability & Civil Engineering Practice	3	GE3040 Fund of Applied Environmental Geophysics
3	CEE3332 Fund of Construction Eng	3	GE3050 Structural Geology
3	CEE3401 Transportation Engineering	3	MA3710 Engineering Statistics
3	CEE3501 Environmental Eng Fund	3	or CEE3710 Uncertainty Analysis in Eng
3	or CEE3503 Environmental Engineering	3	or BE2110 Stats Methods for Bio Eng
3	CEE3502 Environmental Monitoring and Measurement Analysis	4	MA3160 Multivariable Calc
1	CH1153 University Chem Recitation 1	2	MA3520/21 Elem Diff Equations
4	CH1160/61 University Chem 2/Lab 2	3	MEEM2110 Statics
3	CH2410 Organic Chem 1	4	or ENG2120 Statics-Strength of Materials
1	CH2411 Organic Chem Lab 1	3	MEEM2201 Intro to Thermo
3	CM2110 Materials & Energy Balances	4	or CEE3200 Thermo/Fluid Mechanics
3	CM2200 Intro Minerals & Materials	3	MEEM2150 Mechanics of Materials
3	CM3230 Thermo for Chem Engineers	3	MEEM2700 Dynamics
3	CS1121 Intro to Programing 1	2	MEEM2901 ME Practice 1
3	or CS1111 Intro to C/C++	3	MEEM2911 ME Practice 2
3	CS1122 Intro to Programing 2	3	MSE2100 Intro to Materials Sci & Eng 1
3	CS1142 Programming at the Hardware Software Interface	3	or BE2800 Biomaterials 1
3	CS2311 Discrete Structures	3	MSE2110 Intro to Mat Sci & Eng 2
3	CS2321 Data Structures	4	MSE3120 Mat Characterization 1
3	EE2111 Electric Circuits 1	1	PH1200 Physics by Inquiry 2
3	or EE3010 Circuits & Instrumentation	3	PH2200 University Physics 2
4	EE2112 Electric Circuits 2	3	PH2400 University Physics 4

4	EE2174 Digital Logic	3	SAT2711 Linux Fundamentals
3	EE2180 Intro to Robotics	2	SU2000 Introduction to Surveying
3	EE3120 Electric Energy Systems	4	SU2050 Geospatial Computations
3	ENG2505 Intro to Low Fidelity Sys	3	SU2220 Route and Eng Surveying
1	BE2100 Undergraduate Biomedical Engineering Seminar or CEE1000 Civil Engineering or CEE1501 Experiences in Environmental Engineering or CM1000 Intro to Chemical Engineering or ENG1505 Intro to Systems Engineering or GE1100 Geological Engineering & Sciences Orientation or SU1000 Intro to Geospatial Engineering		

1. Additional electives, with approval of the Associate of Science in Engineering Academic Advisor.

4. **New Course Descriptions:** The program does not require the addition of new courses. All courses are currently being offered as part of the student's bachelor of science degree.

5. **Model Schedule:** The model schedule below assumes students start in Calculus 1. For students starting in PreCalculus or Algebra, the schedule would need to be adjusted. An example schedule is given in the table below. Electives would be selected based on bachelor of science major requirements.

All courses are assumed to be full semester courses. MA2321 Elementary Linear Algebra is offered along with MA3521 Elementary Differential Equations as a track-A and track-B sequence. In addition, some co-curricular courses are offered as a track-A or track-B course.

Students could start this program in Fall or Spring semester.

Fall Year 1		Spring Year 1	
Course Number - Name	Credit	Course Number - Name	Credit
UN1015 - Composition	3	UN1025 - Global Issues or 3000+ Modern Language	3
MA1160/MA1161 - Calculus/Calculus Plus with Technology I	4	MA2160 - Calculus with Technology II	4
CH1150 - University Chemistry I	3	PH2100 - University Physics I - Mechanics	3
CH1151 - University Chemistry Lab I	1		
ENG1101 - Engineering Analysis and Problem Solving	3	ENG1102 - Engineering Modeling and Design	3
PH1100 - Physics by Inquiry I	1		
Selective Elective	1	Selective Elective	3
Co-curricular	(1)	Co-curricular	(1)
Total	16+1	Total	16+1

Fall Year 2		Spring Year 2	
Course Number - Name	Credit	Course Number - Name	Credit
CORE: Critical & Creative Thinking	3	CORE: Social Responsibility & Ethical Reasoning	3
<u>Electives</u>		MA2320/2321 - Elementary Linear Algebra	2
Math/Science Elective	3	<u>Electives</u>	
Engineering Elective	3	Math/Science Elective	3
Selective Elective	7	Engineering Elective	3
Co-curricular	(1)	Selective Elective	6
Total	16+1	Total	17

6. **Statement of Faculty Qualifications:** No additional faculty would be required since these students would already be enrolled at Michigan Tech in one of the bachelor of science in engineering programs. There will be an additional advising load which will be distributed within the Department of Engineering Fundamentals (EF) and College of Engineering. We estimate there will be 50 students who may need additional advising support. The advising home for this associate's degree will be the Department of Engineering Fundamentals. Students will meet with the EF advisor in cases where they are not meeting the credit requirements for TIP and to process their final associate's degree audit. For advising and requirements regarding their bachelor's degree, students will need to meet with their primary advisor.
7. **Program-Specific Policies, Regulations, and Rules:** Admissions standards for this program will be the same as admissions standards for all other programs in the College of Engineering. Students will be admitted into the associate's program based on their opting to participate in the TIP scholarship.

IV. RESOURCES NEEDED TO SUPPORT NEW PROGRAM

1. **Library and Other Learning Resources:** No additional library or other learning resources would be required since these students would already be enrolled at Michigan Tech in one of the bachelor of science in engineering programs.
2. **Suitability of Existing Space, Facilities, and Equipment:** No additional space, facilities, and equipment would be required since these students would already be enrolled at Michigan Tech in one of the bachelor of science in engineering programs.

3. **Program Costs:** The program will not have any additional costs or tuition generation since these students will already be in a bachelor of science in engineering program.

Establishment of an Associate of Science in Engineering

Appendix I: Criteria for Financial Evaluation

1. Relation to University Strategic Plan

a. Relation of program to the university's educational and research goals.

There are three key areas in the university's goals which are supported through this program (<https://www.mtu.edu/stratplan/principles/goals/>).

- **Education: Educational Program** - *"Develop and enhance pathways to completion of undergraduate and graduate programs."*
- **People: Quality of Life** - *"Increase diversity, and promote success of all students, ..."*
- **People: Community** - *"... support, recognize, and graduate bright, motivated, and adventurous students."*

The Associate of Science in Engineering degree, will promote these goals by:

1. Reducing financial stress by allowing students to more fully access the first two years of TIP scholarship. This promotes the *success of all students*.
2. Improving retention of low income students by reducing financial stress. This promotes *completion of undergraduate programs* and *promotes success of all students*.
3. Increasing the associate's degree completion rate by retaining students. This promotes *completion of undergraduate programs* and *supports, recognizes, and graduates bright, motivated, and adventurous students*.

b. Consistency with the university's resource allocation criteria.

No additional resources would be required since these students would already be enrolled and taking classes at Michigan Tech in one of the bachelor of science in engineering programs.

2. Impact on University Enrollment

a. Projected number of students in the program.

We anticipate approximately 50 students per year to be drawn from the Associate of Arts in Humanities program. After the transition we expect approximately 125-130 students at any given time.

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?

This program will function much like the Associate of Arts in Humanities degree and will draw engineering students who would otherwise enroll in that program. This is not intended to be a source of new students and will not be advertised for recruiting. Rather, this program will be used to facilitate the TIP program for engineering majors. All students in this program will already be enrolled at Michigan Tech in one of the bachelor of science in engineering programs.

c. What is the likely correlation between demand for the new program and existing enrollment patterns at MTU?

Students in this program will no longer be enrolled in the Associate of Arts in Humanities. Since engineering students in the Associate of Arts in Humanities program very rarely complete that degree, the impact will be an improved rate of completion of associate’s degrees for the university as a whole.

d. What is the current enrollment in the unit?

The department offers the Bachelor of Science in Engineering (BSE) degree, a Minor in Systems Engineering, and a non-degree seeking program for students who are exploring their engineering major, General Engineering. In addition, the department houses the first-year engineering program, providing the first two engineering courses for all engineering majors in the College of Engineering. As of Fall 2022, the enrollments are:

	Fall 2022	Spring 2023
	(# of Students)	(# of Students)
BS in Engineering	13	16
Minor in Systems Engineering	15	16
General Engineering	161	110
First-Year Engineering Courses (ENG1101 & ENG1102)	1020	784

3. Impact on Resources Required by the Department in Which the Program is housed.

This would include, but not be limited to:

a. Faculty lines.

No additional faculty lines will be needed.

b. Faculty and student labs, including ongoing maintenance.

No additional lab space will be needed.

c. Advising.

An initial addition of approximately 150 students, dropping to about 125 - 130 as it is expected that engineering students will be in this program for a shorter

period of time than they are in the Humanities associate's degree given the closer alignment of this program with their subsequent bachelor's degree.

d. Assessment.

Assessment may involve slight modifications of current practices.

4. Impact on Resources Required By Other Units Within the University. This analysis would include, but not necessarily be limited to, the impacts on:

- a. Other academic (e.g., Gen Ed) units with regard to faculty, labs and assessment. (NOTE: The current Student to Faculty ratio for the university as a whole is approximately 12:1 per Institutional Analysis.)**

The program will shift the advising load from the Humanities Department to the Engineering Fundamentals Department. It is envisioned that the university's overall advising load will decrease due to the better alignment between the associate's degree and the subsequent bachelor's degree.

- 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.**

No additional resources are required.

5. Assessment of the ability to obtain the necessary resources assuming requested funds are obtained

- a. For high demand fields (e.g., business fields, etc.), will it be possible to fill allocated lines**

No lines or funds are needed for this program.

6. Past proposals. Has the department initiated any other new degree programs in the last five years? If so:

No new degree programs have been proposed.

7. Departmental Budget contribution

The data below is from 2019-2020.

- a. What is the department's total general fund budget?**

S&W:	\$	963,747.49
Fringe:	\$	439,098.44
SSE:	\$	35,000.00
Total:	\$	1,437,845.93

- 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.**

Tuition generated based on majors: \$ 4,176,505.50

- for tuition generated by credit hours taught by Engineering Fundamentals

Tuition based on SCH: \$ 2,472,644.40

- for tuition generated by the number of credit hours taken by Engineering Fundamentals enrolled students

- 8. How do the benefits from this program compare to other alternatives that are currently under consideration or development. Will approval and allocation of resources to this program preclude the development of other programs?**

The primary alternative to compare this to is the present situation where the vast majority of the TIP eligible engineering students who enroll in the Associate of Arts in Humanities, stay in the program for two or three years, and almost never complete the program.

It is expected that the approval of this program will:

- Increase the retention rate of the low income students enrolled in this program by allowing them to more fully utilize their TIP benefits, reducing their financial stress.
- Free up Financial Aid resources when TIP eligible students are able to more fully use their benefits.
- Increase the number of associate's degrees awarded from about 5 per year to about 40-45 per year.
- Benefit students who decide to leave the university before completing their engineering bachelor's degree allowing them to earn an associate's degree as long as they meet the degree requirements.

The approval of this program will not preclude the development of other programs, including other associate's degree programs. The program will have a small positive financial impact on the university by the increase in tuition assistance from the TIP program.