

The University Senate of Michigan Technological University

Proposal 27-19 (Voting Units: Academic)

Proposal for Minor in Systems Engineering

1. **DATE:** February 22, 2019

2. **CONTACT, DEPARTMENT:** Jon Sticklen, Engineering Fundamentals, sticklen@mtu.edu

3. **INTRODUCTION:**

The proposed minor in Systems Engineering offered through the Department of Engineering Fundamentals in the College of Engineering, will offer Michigan Tech students the opportunity to learn concepts and competencies in systems thinking and in systems engineering that will complement work in their major field of study. The proposed minor will help to prepare students for careers in their chosen field augmented with systems thinking perspectives and the competency to develop low-fidelity dynamic systems models in the context of their chosen degree area. For students targeting graduate school experiences, the additional and documented experience with concepts and applications in systems thinking and modeling can be a strong marker for decision makers in graduate student acceptance offices.

4. **RATIONALE:**

The understanding and application of systems thinking approaches and the more concrete approaches of systems engineering are becoming more strongly sought after traits in possible new hires in industry. The need for broad understanding of how components of a complex system interact is critically needed as systems in everyday, and widespread use become more and more complicated. Without understanding the concept of emergent properties in general, and without the ability to anticipate the development of emergent properties based on low-fidelity modeling, changes in such systems as diverse as the US electric power grid and the supply chain of Apple Computer can be difficult, more costly than necessary, and even potentially dangerous.

For many undergraduate major programs, a Systems Engineering minor will be a leveraged augmentation both for those planning an immediate career in industry and for those planning to go to graduate school immediately after attaining a BS degree. This is particularly true for mechanical engineering, electrical engineering, and computer engineering. Likewise, forestry program students, and students focused on biological systems would be strongly served by this minor.

Thus, the Systems Engineering minor would be a valuable target for any student who is embarking in a career where complex systems play a role. The proposed minor is most likely to attract students from any engineering field and those in the Engineering Management area (School of Business).

5. DETAILS:

I. Title: Systems Engineering Minor

II. Description:

Students electing the Systems Engineering minor will learn concepts and competencies in systems thinking and systems engineering that will complement their major field of study. For students targeting graduate school, additional and documented experience with concepts and applications in systems thinking and modeling can be a strong marker for decision makers in graduate student acceptance offices.

Learning goals for the minor are:

- a) Analyze complex problems from a viewpoint of systems thinking,
- b) Construct appropriate low-fidelity systems models, and
- c) Use a dynamic systems model to make appropriate design decisions.

III. List of Courses:

Systems Engineering Minor (20 credits total)

Required courses (14 credits)

- ___ ENG 1505 (1) Introduction to Systems Engineering
- ___ ENG 2505 (3) Low Fidelity Systems Modeling
- ___ ENG 3505 (1) Modeling Laboratory for Sustainable Systems
- ___ ENG 4300 (3) Project Management
- ___ ENG 4505 (3) Systems Analysis, Modeling, and Design
- ___ ENG 4510 (3) Sustainable Futures I

Select 6 credits from one of the following groups (6 credits)

A. Environmental Engineering and Sustainability (6 credits)

CEE 3501 (3) Environmental Engineering Fundamentals	AND	CEE 4506 (3) Application of Sustainability Principles to Engineering Practice
OR		
CEE 3503 (3) Environmental Engineering		

B. Supply Chain, Logistics, Management (6 credits)

OSM 3150 (3) Introduction to Supply Chain Management	AND	OSM 3600 (3) Procurement and Supply Management
OR		
OSM 4700 (3) Logistics and Transportation Management		

C. Design, LEAN, and Six Sigma (6 credits)

MEEM 4650 (3) Quality Engineering	AND	HON 3300 (3) Innovation through Human Centered Design
OR		OR
OSM 4650 (3) Six Sigma Fundamentals		Select 3 credits from the following:
OR Take all 3 credits below:		ENT 3953 (1) Ignite: Ideate, Innovate, Create!
ENT 3959 (1) Fund of Six Sigma I		ENT 3958 (1) Ethics in Engineering Design and Implementation
ENT 3967 (1) Design for Six Sigma		ENT 3963 (1) Deliver: Explore, Develop, Execute!
ENT 3982 (1) Continuous Improvement Using LEAN Principles		ENT 3983 (1) The Culture of Continuous Improvement

IV. Pre-Requisite(s):

Required Courses

ENG 1505 (Prereqs: ENG 1001 or ENG 1101 or CS 1121 or CS1131)

ENG 2505 (Prereqs: ENG 1505(C) and MA 2160 and (ENG 1102 or CS 1121 or CS 1131))

ENG 3505 (Prereqs: ENG 1505(C) and MA 2160 and (ENG 1102 or CS 1121 or CS 1131))

ENG 4300 (Prereqs: BUS 2100 or CE 3710 or CEE 3710 or MA 2720 or MA 3710 or EE 3180 or BE 2100)

ENG 4505 (Prereqs: ENG 3505 and ENG 4510)

ENG 4510 (Prereqs: none)

Elective Courses

CEE 3501 (Prereqs: MA 2160 and CH 1112 or (CH 1150 and CH 1151))

CEE 3503 (Prereqs: MA 2160 and CH 1112 or (CH 1150 and CH 1151))

CEE 4506 (Prereqs: ENVE 3501 or ENVE 3503 or CEE 3501 or CEE 3503)

OSM 3150 (Prereqs: OSM 3000)

OSM 4700 (Prereqs: (MA 2710 or MA 2720 or MA 3710 or CE 3710 or CEE 3710) and (MA 1135 or MA 1160 or MA 1161))

OSM 3600 (Prereqs: none)

MEEM 4650 (Prereqs: MA 3710 or MA 3720 or MA 2710 or MA 2720)

OSM 4650 (Prereqs: MA 2710 or MA 2720 or MA 3710 or MA 3720 or BUS 2100 or CE 3710 or CEE 3710)

ENT 3959 (Prereqs: none)

ENT 3967 (Prereqs: none)

ENT 3982 (Prereqs: none)

HON 3300 (Prereqs: none)

ENT 3953 (Prereqs: none)

ENT 3958 (Prereqs: ENG 1101 or (ENG 1001 and ENG 1100))

ENT 3963 (Prereqs: none)

ENT 3983 (Prereqs: none)

6. ACADEMIC ADVISING:

The academic advisor for the Department of Engineering Fundamentals' BSE program will advise student who choose to enroll in this minor.

7. NEW COURSE DESCRIPTIONS:

No additional courses proposed for this minor.

8. ESTIMATED COSTS:

No additional costs will be associated with this minor at this time. All required and elective courses are currently being taught on a regular basis. There is existing capacity in all required courses.

9. LIBRARY RESOURCES:

No additional library resources are required to implement this minor.

10. PLANNED IMPLEMENTATION DATE:

Fall 2019