# The University Senate of Michigan Technological University

# Proposal 23-13

(Voting Units: Academic)

# "Proposal for a Minor in Aerospace Engineering"

(Department of Mechanical Engineering – Engineering Mechanics)

## 1. Introduction

The Department of Mechanical Engineering – Engineering Mechanics proposes to offer a minor program in Aerospace Engineering. Although Michigan Technological University already offers a minor in Aerospace Studies (administered by the Department of Air Force ROTC), the purpose and scope of the two minors is entirely different. Whereas the Aerospace Studies minor is focused on leadership as it is practiced in civilian and military institutions (e.g. national security policies, organization of military forces), the Aerospace Engineering minor emphasizes the scientific principles of flight and the design and performance of aerospace vehicles.

## 2. Rationale

Currently, there are three aerospace engineering programs available in the State of Michigan. The University of Michigan at Ann Arbor has an Aerospace Engineering degree program. Western Michigan University offers an Aeronautical Engineering program and Kettering University offers an "Aerospace Specialization" in engineering. Michigan Technological University offers no formal program, even at the certification or minor level. Therefore, there is an excellent opportunity to fill a gap that exists at Michigan Technological University that will help us to remain competitive among our peer institutions in the state.

Aerospace-related learning and research is very active at Michigan Tech, with student involvement via graduate and undergraduate research assistantships, The Aerospace Enterprise, and the SAE Aero Design Team. Annual research expenditures in Aerospace-related fields at Michigan Tech are difficult to estimate, however, NASA funding amounts to about 3% of the annual research grants at Michigan Tech, while the Department of Defense (including Air Force funding) amount to about 20%. The Aerospace Enterprise team is composed of over 50 students (up from 17 in 2002) and is participating in the Air Force Research Laboratory's prestigious University Nanosatellite flight competition review. The SAE Aero Design Team actively participates in national radio-controlled aircraft design competitions on an annual basis. Because of this aerospace engineering-related activity at Michigan Tech, it follows that we should offer a supplemental curriculum for students who are interested and involved in aerospace engineering projects on campus.

## 3. Details of Catalog Copy

3.1 **Title of Minor**: Aerospace Engineering

3.2 **Catalog Description**: This ME-EM Minor focuses on providing students a background for careers in aerospace engineering. The coursework includes topics related to structures, materials, gas dynamics, space science, and orbital mechanics. This minor is most suitable for undergraduate mechanical engineering majors. But this minor has been designed to accommodate other engineering majors, as well as students involved in the Aerospace Enterprise.

3.3 **List of Courses**: Students will be required to complete 16 credit hours, with a maximum of 3 credit hours earned at the 2000 level and a maximum of 3 credit hours at the 3000 level. Students must earn the remaining 10 credit hours at the 4000-level, including a minimum of 6 credit hours that are not required for their major degree program except as free electives. These courses are highlighted in the tables below. There are a select number of 5000-level course that can be taken as substitutions for the corresponding 4000-level course requirements, as indicated in the tables. Courses are planned to be offered in the semesters noted. Spring (odd AY) indicates courses taught in alternate years beginning with the 2013-2014 academic year, Spring (even AY) indicates courses taught in alternate years beginning with the 2014-2015 academic year. The listed prerequisites are those not listed for the minor.

Required Courses (9 credits maximum)

| Course | Credits | Title | Term | Prerequisites |
|---|---|---|---|---|
| MEEM 2150 | 3 | Mechanics of Materials | Fall, spring, summer | MEEM 2110 |
| | | **Or** | | |
| ENG 2120 | 4 | Statics-Strength of Materials* | Spring | MA 2160, PH 2100, ENG 1102 |
| MEEM 3210 | 3 | Fluid Mechanics | Fall, spring, summer | MEEM 2200, MEEM 2700 (C), and (MA 3520 or MA 3521 or MA 3530 or MA 3560) |
| | | **Or** | | |
| ENG 3200 | 4 | Thermodynamics/Fluid Mechanics* | Fall, spring | MA 2160 and CH 1112 or (CH 1150 and CH 1151) and PH 2100 and ENG 1102 |
| MEEM 4810 | 3 | Introduction Aerospace Engineering | Fall | (MEEM 2150 or ENG 2120) and (MEEM 3210 or ENG 3200) |

**Minor credit cannot be granted for ME majors for these two courses*

Core Elective Courses (at least 4 credits)

| Course | Credits | Title | Term | Prerequisites |
|---|---|---|---|---|
| ENT 4950 | 2 | Enterprise Project Work V** | Fall, spring, summer | (BE 3500(C), and BE 3600 and BE 3750 or MEEM 4180) or (CE 3620 or CE 3810 and CE 3331) or CM 4855 (C) or (CS 4710 or CS 4711 or CS 4712) or (EE 3173 or EE 3305) and EE 3173 or EE 3130 or EE 4431 or (MEEM 3000(C) and MEEM 3900) or (MY 3110 and MY 3200 and MY 3210 and MY 3300 and MY 3410) |
| ENT 4960 | 2 | Enterprise Project Work VI** | Fall, spring, summer | ENT 4950 |
| ENT 4961 | 1 | Enterprise Project Work VII** | Fall, spring, summer | ENT 3950 and ENT 3960 and ENT 4950 and ENT 4960 |
| MEEM 4210 | 3 | Computational Fluids Engineering | Fall | MEEM 3230 (C) |
| MEEM 4720 | 3 | Space Mechanics | Fall | MEEM 2700 |
| MEEM 4230 | 3 | Compressible Flow/Gas Dynamics | Spring | MEEM 3210 or ENG 3200 |
| MY 4155 | 3 | Composite Materials | Spring | MY2100 |

*** Requires minor advisor approval of project*

5000-level substitutes for core elective courses

| Course | Credits | Title | Term | Prerequisites |
|---|---|---|---|---|
| MEEM 5170 | 3 | Finite Element and Variational Methods in Engineering | Fall | Graduate Level Restriction or instructor approval |
| MEEM 5180 | 3 | Mechanics of Composite Materials | Spring (odd AY) | Graduate Level Restriction or instructor approval |

Related Elective Courses (remaining credits)

| Course | Credits | Title | Term | Prerequisites |
|---|---|---|---|---|
| MEEM 4150 | 3 | Intermediate Mechanics of Materials | Fall | MEEM 2150 |
| MEEM 4170 | 3 | Failure of Materials in Mechanics | Spring | MEEM 3501 |
| MEEM 4180 | 3 | Engineering Biomechanics | Fall | MEEM 2700 and MEEM 2150 |
| MEEM 4630 | 3 | Human Factors | Fall | Senior standing |
| MEEM 4650 | 3 | Quality Engineering | Fall | MA 3710 or MA 3720 |
| MEEM 4701 | 4 | Analytical and Experimental Model Analysis | Fall | MEEM 3000 and MEEM 3700 |
| MEEM 4704 | 3 | Acoustics and Noise Control | Spring | MA 3160 and MEEM 2700 |
| MEEM 4705 | 3 | Introduction to Robotics and Mechatronics | Fall | MEEM 4700(C) |
| MY 4800 | 3 | Material and Process Selection in Design | Spring | MY 2100 |

5000-level substitutes for Related Elective Courses

| Course | Credits | Title | Term | Prerequisites |
|---|---|---|---|---|
| MEEM 5150 | 3 | Advanced Mechanics of Materials | Spring | MEEM 2150 + senior standing |
| MEEM 5210 | 3 | Advanced Fluid Mechanics | Fall | MEEM 3210 + senior standing |
| MEEM 5230 | 3 | Advanced Heat Transfer | Spring | MEEM 3230 + senior standing |
| MEEM 5240 | 3 | Computational Fluid Dynamics | Spring (odd AY) | MEEM 5210 + senior standing |
| MEEM 5701 | 3 | Intermediate Dynamics | Fall | MEEM 2700 + senior standing |

**4. New Course Descriptions:**

**MEEM 4810 Introduction to Aerospace Engineering:** Introductory course on topics relevant to aerospace engineering and science. Topics include history, properties of the atmosphere, the solar system, atmospheric and space vehicles, mission design, and vehicle design and performance.
Credits: 3.0
Semesters Offered: Fall
Pre-Requisites: (MEEM 2150 or ENG 2120) and (MEEM 3210 or ENG 3200)

**5. Estimated Costs:** The new course proposed for this minor is already being proposed in response to student demand in the mechanical engineering major, so no additional direct costs are incurred specifically for this minor.

**6. Planned Implementation date:** Fall 2013

**Introduced to Senate: 27 March 2013**
**Approved by Senate: 10 April 2013**
**Approved by Administration: 19 April 2013**