***Twin Cities Campus***

# Aerospace Engineering and Mechanics M.S.

*Aerospace Engineering & Mechanics*

**College of Science and Engineering**

Link to a list of faculty for this program.

**Contact Information:**
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- Program Type: Master's
- Requirements for this program are current for Fall 2020
- Length of program in credits: 30
- This program does not require summer semesters for timely completion.
- Degree: Master of Science

Along with the program-specific requirements listed below, please read the General Information section of the catalog website for requirements that apply to all major fields.

The graduate program in Aerospace Engineering and Mechanics emphasizes engineering sciences that are basic to fluid mechanics, aerospace systems, and solid mechanics. Theoretical, analytical, experimental, and computational aspects of these fields are covered by the courses and research opportunities offered by the department.

## Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

## Prerequisites for Admission

The preferred undergraduate GPA for admittance to the program is 3.20.

A four-year BS degree in an engineering, basic science, or mathematics program is required.

Other requirements to be completed before admission:
Admission depends primarily on the applicant's undergraduate record and letters of recommendation.

**Special Application Requirements:**
GRE scores are not required but are strongly recommended for students applying for graduate fellowships. In all cases, these test scores are taken into account if provided. Students are admitted fall semester only. Only under unusual circumstances are students allowed to begin their studies at another time during the academic year.

The application deadline is December 15.

International applicants must submit score(s) from one of the following tests:

- TOEFL
  - Internet Based - Total Score: 79
  - Internet Based - Writing Score: 21
  - Internet Based - Reading Score: 19
- IELTS
  - Total Score: 6.5
- MELAB
  - Final score: 80

Key to test abbreviations(TOEFL, IELTS, MELAB).

For an online application or for more information about graduate education admissions, see the General Information section of the catalog website.

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## Program Requirements

**Plan A:** Plan A requires 14 major credits, 6 credits outside the major, and 10 thesis credits.The final exam is oral.

**Plan B:** Plan B requires 14 to 24 major credits and 6 to 16 credits outside the major.The final exam is oral.

**Plan C:** Plan C requires 14 to 24 major credits and 6 to 16 credits outside the major.The is no final exam.

This program may be completed with a minor.

Use of 4xxx courses toward program requirements is permitted under certain conditions with adviser approval.

A minimum GPA of 2.80 is required for students to remain in good standing.

All plans require a minimum of 14 major credits, of which 12 must be at the 5xxx or 8xxx level.

No more than 8 credits in 4xxx-level courses and no more than 8 credits (6 for Plan A) taken as S/N are allowed.

The minimum grade required for each course is B-.

Two semesters of seminar attendance are required.

**Required Courses (6 credits)**

Select one 2-course sequence in fluids, solids, or dynamics.

**Fluids**

AEM 8201 - Fluid Mechanics I (3.0 cr)
AEM 8202 - Fluid Mechanics II (3.0 cr)

*or* **Solids**

AEM 5501 - Continuum Mechanics (3.0 cr)
AEM 5503 - Theory of Elasticity (3.0 cr)

*or* **Dynamics**

AEM 5401 - Intermediate Dynamics (3.0 cr)
AEM 8411 - Advanced Dynamics (3.0 cr)

**Additional Major Courses (8-18 credits)**

Students select a minimum of 8 credits in consultation with advisor from the following to meet the required 14 credits in AEM courses. Plan B and Plan C students may take up to 18 credits from the list. One credit of AEM 8000 may be applied to degree requirements.

AEM 4305 - Spacecraft Attitude Dynamics and Control (3.0 cr)
AEM 4321 - Automatic Control Systems (3.0 cr)
AEM 5247 - Hypersonic Aerodynamics (3.0 cr)
AEM 5253 - Computational Fluid Mechanics (3.0 cr)
AEM 5321 - Modern Feedback Control (3.0 cr)
AEM 5333 - Design-to-Flight: Small Uninhabited Aerial Vehicles (3.0 cr)
AEM 5401 - Intermediate Dynamics (3.0 cr)
AEM 5451 - Optimal Estimation (3.0 cr)
AEM 5501 - Continuum Mechanics (3.0 cr)
AEM 5503 - Theory of Elasticity (3.0 cr)
AEM 5581 - Mechanics of Solids (3.0 cr)
AEM 5651 - Aeroelasticity (3.0 cr)
AEM 8000 - Seminar: Aerospace Engineering and Mechanics (1.0 cr)
AEM 8201 - Fluid Mechanics I (3.0 cr)
AEM 8202 - Fluid Mechanics II (3.0 cr)
AEM 8203 - Fluid Mechanics III (3.0 cr)
AEM 8207 - Hydrodynamic Stability (3.0 cr)
AEM 8211 - Theory of Turbulence I (3.0 cr)
AEM 8212 - Theory of Turbulence II (3.0 cr)
AEM 8213 - Turbulent Shear Flows (3.0 cr)
AEM 8221 - Rheological Fluid Mechanics (3.0 cr)
AEM 8231 - Molecular Gas Dynamics (3.0 cr)
AEM 8232 - Physical Gas Dynamics and Molecular Simulation (3.0 cr)
AEM 8241 - Perturbation Methods in Fluid Mechanics (3.0 cr)
AEM 8251 - Finite-Volume Methods in Computational Fluid Dynamics (3.0 cr)
AEM 8253 - Computational Methods in Fluid Mechanics (3.0 cr)
AEM 8261 - Nonlinear Waves in Mechanics (3.0 cr)
AEM 8271 - Experimental Methods in Fluid Mechanics (3.0 cr)

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AEM 8400 - Seminar: Aerospace Systems (1.0 cr)
AEM 8411 - Advanced Dynamics (3.0 cr)
AEM 8421 - Robust Multivariable Control Design (3.0 cr)
AEM 8423 - Convex Optimization Methods in Control (3.0 cr)
AEM 8426 - Optimization and System Sciences (3.0 cr)
AEM 8442 - Aerospace Positioning, Navigation and Timing (3.0 cr)
AEM 8451 - System Identification: Theory and Applications (3.0 cr)
AEM 8500 - Research Seminar in Mechanics of Materials (1.0 cr)
AEM 8523 - Elastodynamics (3.0 cr)
AEM 8525 - Elastic Stability of Materials (3.0 cr)
AEM 8531 - Fracture Mechanics (3.0 cr)
AEM 8533 - Theory of Plasticity (3.0 cr)
AEM 8541 - Mechanics of Crystalline Solids (3.0 cr)
AEM 8551 - Multiscale Methods for Bridging Length and Time Scales (3.0 cr)

**Outside Courses (6-16 credits)**

Students take a minimum of 6 credits from the following list. Plan B and Plan C students may take as many as 16 credits. Consult with advisor for course selection or additional course options.

BMEN 5321 - Microfluidics in Biology and Medicine (3.0 cr)
BMEN 8101 - Biomedical Digital Signal Processing (3.0 cr)
CEGE 8401 - Fundamentals of Finite Element Method (3.0 cr)
CEGE 8521 - The Atmospheric Boundary Layer (4.0 cr)
CHEM 8541 - Dynamics (4.0 cr)
CHEM 8565 - Chemical Reaction Dynamics (2.0 cr)
CSCI 4041 - Algorithms and Data Structures (4.0 cr)
CSCI 5304 - Computational Aspects of Matrix Theory (3.0 cr)
CSCI 5451 - Introduction to Parallel Computing: Architectures, Algorithms, and Programming (3.0 cr)
CSCI 5512 - Artificial Intelligence II (3.0 cr)
CSCI 5521 - Machine Learning Fundamentals (3.0 cr)
CSCI 5525 - Machine Learning: Analysis and Methods (3.0 cr)
CSCI 5551 - Introduction to Intelligent Robotic Systems (3.0 cr)
CSCI 5552 - Sensing and Estimation in Robotics (3.0 cr)
CSCI 8314 - Sparse Matrix Computations (3.0 cr)
EE 5231 - Linear Systems and Control (3.0 cr)
EE 5235 - Robust Control System Design (3.0 cr)
EE 5239 - Introduction to Nonlinear Optimization (3.0 cr)
EE 5531 - Probability and Stochastic Processes (3.0 cr)
EE 8215 - Nonlinear Systems (3.0 cr)
EE 5571 - Statistical Learning and Inference (3.0 cr)
MATH 4242 - Applied Linear Algebra (4.0 cr)
MATH 5587 - Elementary Partial Differential Equations I (4.0 cr)
MATH 5651 - Basic Theory of Probability and Statistics (4.0 cr)
MATH 8401 - Mathematical Modeling and Methods of Applied Mathematics (3.0 cr)
MATH 8402 - Mathematical Modeling and Methods of Applied Mathematics (3.0 cr)
MATH 8431 - Mathematical Fluid Mechanics (3.0 cr)
MATH 8441 - Numerical Analysis and Scientific Computing (3.0 cr)
MATH 8442 - Numerical Analysis and Scientific Computing (3.0 cr)
MATH 8445 - Numerical Analysis of Differential Equations (3.0 cr)
MATH 8446 - Numerical Analysis of Differential Equations (3.0 cr)
MATH 8601 - Real Analysis (3.0 cr)
ME 8285 - Control Systems for Intelligent Vehicle Applications (3.0 cr)
ME 8361 - Molecular Gas Dynamics (3.0 cr)
ME 8446 - Advanced Combustion (3.0 cr)

**Plan Options**

**Plan A (10 credits)**

Take 10 thesis credits
AEM 8777 - Thesis Credits: Master's (1.0 - 18.0 cr)

*-OR-*

**Plan B (3 credits)**

Take 3 credits of AEM 8880 and complete a final project. The 3 credits in AEM 8880 may be counted toward the required 14 credits in AEM courses.
AEM 8880 - Plan B Project (1.0 - 3.0 cr)

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Information current as of March 28, 2024

*-OR-*

**Plan C**

Plan C students do not have additional requirements.

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