***Twin Cities Campus***

# Aerospace Engineering and Mechanics B.A.E.M.

*Aerospace Engineering & Mechanics*

**College of Science and Engineering**

- Program Type: Baccalaureate
- Requirements for this program are current for Spring 2019
- Required credits to graduate with this degree: 122
- Required credits within the major: 102
- Degree: Bachelor of Aerospace Engineering and Mechanics

The mission of the bachelor of aerospace engineering and mechanics (B.A.E.M.) program is to produce graduates who are prepared to enter and sustain the practice of aerospace engineering and related fields, or to pursue advanced studies. This mission is consistent with the mission of the University in learning and teaching, and with the mission of the College of Science and Engineering: to provide a rigorous and stimulating education for its undergraduate majors and to provide programs of instruction in engineering that meet nationally accepted standards for practice of the profession of engineering.

Aerospace engineering is a multidisciplinary field that encompasses many areas of science and engineering and plays a major role in the technological advancement of society. As a constantly changing profession, aerospace engineering is concerned with a wide range of problems and the latest technologies. An aerospace engineer must have a comprehensive fundamental education in mathematics, physical sciences, and engineering sciences. The four-year program leading to the B.A.E.M. provides this broad background. The program is accredited by the Engineering Accreditation Commission of ABET.

## Program Delivery

This program is available:

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

## Admission Requirements

Students must complete 8 courses before admission to the program.

Freshman and transfer students students are usually admitted to pre-major status before admission to this major

For information about University of Minnesota admission requirements, visit the Office of Admissions website.

**Required prerequisites**

**Mathematics Core**

MATH 1371 - CSE Calculus I [MATH] (4.0 cr)
*or* MATH 1271 - Calculus I [MATH] (4.0 cr)
*or* MATH 1571H - Honors Calculus I [MATH] (4.0 cr)
MATH 1372 - CSE Calculus II (4.0 cr)
*or* MATH 1272 - Calculus II (4.0 cr)
*or* MATH 1572H - Honors Calculus II (4.0 cr)
MATH 2263 - Multivariable Calculus (4.0 cr)
*or* MATH 2374 - CSE Multivariable Calculus and Vector Analysis (4.0 cr)
*or* MATH 2573H - Honors Calculus III (4.0 cr)

**Physics Core**

PHYS 1301W - Introductory Physics for Science and Engineering I [PHYS, WI] (4.0 cr)
*or* PHYS 1401V - Honors Physics I [PHYS, WI] (4.0 cr)
*or* PHYS 1501V *{Inactive}*[PHYS, WI] (4.0 cr)
PHYS 1302W - Introductory Physics for Science and Engineering II [PHYS, WI] (4.0 cr)
*or* PHYS 1402V - Honors Physics II [PHYS, WI] (4.0 cr)
*or* PHYS 1502V *{Inactive}*[PHYS, WI] (4.0 cr)

**Chemistry Core**

CHEM 1061 - Chemical Principles I [PHYS] (3.0 cr)
CHEM 1065 - Chemical Principles I Laboratory [PHYS] (1.0 cr)
*or* CHEM 1071H - Honors Chemistry I [PHYS] (3.0 cr)
CHEM 1075H - Honors Chemistry I Laboratory [PHYS] (1.0 cr)

**Statics Core**

AEM 2011 - Statics (3.0 cr)

© 2005 by the Regents of the University of Minnesota
The University of Minnesota is an equal opportunity educator and employer.
Information current as of March 28, 2024

## General Requirements

All students are required to complete general University and college requirements including writing and liberal education courses. For more information about University-wide requirements, see the liberal education requirements.Required courses for the major or minor in which a student receives a D grade (with or without plus or minus) do not count toward the major or minor (including transfer courses).

## Program Requirements

All freshmen in the College of Science and Engineering must complete CSE 1001: First-Year Experience.

**AEM Core**

AEM 2012 - Dynamics (3.0 cr)
AEM 2301 - Mechanics of Flight (3.0 cr)
AEM 3031 - Deformable Body Mechanics (3.0 cr)
AEM 4201 - Fluid Mechanics (4.0 cr)
AEM 3103 - Computer Methods in Aerospace Engineering (3.0 cr)
AEM 4202 - Aerodynamics (4.0 cr)
AEM 4301 - Orbital Mechanics (3.0 cr)
AEM 4501 - Aerospace Structures (3.0 cr)
AEM 4601 - Instrumentation Laboratory (3.0 cr)
AEM 4331 - Aerospace Vehicle Design (4.0 cr)
AEM 4602W - Aeromechanics Laboratory [WI] (4.0 cr)
AEM 4203 - Aerospace Propulsion (4.0 cr)
AEM 4303W - Flight Dynamics and Control [WI] (3.0 cr)

**Math, Science, and Engineering**

EE 3005 - Fundamentals of Electrical Engineering (4.0 cr)
EE 3006 - Fundamentals of Electrical Engineering Laboratory (1.0 cr)
ME 3324 - Introduction to Thermal Science (3.0 cr)
*or* ME 3333 - Heat Transfer (3.0 cr)
CSCI 1113 - Introduction to C/C++ Programming for Scientists and Engineers (4.0 cr)
*or* CSCI 1133H - Honors Introduction to Computing and Programming Concepts (4.0 cr)
MATS 2001 - Introduction to the Science of Engineering Materials (3.0 cr)
*or* MATS 3011 - Introduction to Materials Science and Engineering (3.0 cr)
PHYS 2503 - Physics III: Intro to Waves, Optics, and Special Relativity (4.0 cr)
*or* PHYS 2303 - Physics III: Physics of Matter (4.0 cr)
*or* PHYS 2503H - Honors Physics III (4.0 cr)
MATH 2373 - CSE Linear Algebra and Differential Equations (4.0 cr)
*or* MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
*or* MATH 2574H - Honors Calculus IV (4.0 cr)

**Technical Electives**

One technical elective course may be 2xxx or above, while the other two must be 4xxx or above. Only one course may be an independent study course or a global seminar. Courses like BAE 4744, IOFT 4101, most IE courses, and courses from the School of Management cannot be used to fulfill this requirement.
Take 3 or more course(s) totaling 9 or more credit(s) from the following:

**Lower Level Technical Electives**

Other 2xxx and 3xxx level Math, Science, or Engineering courses may also count with permission. CHEM 1062 and 1066 are exceptions to the 2xxx or above lower level requirement.
Take 0 - 4 credit(s) from the following:
•AST 2001 - Fundamental Astrophysics (4.0 cr)
•STAT 3021 - Introduction to Probability and Statistics (3.0 cr)
•IE 3521 - Statistics, Quality, and Reliability (4.0 cr)
•BBE 2201 - Renewable Energy and the Environment [TS] (3.0 cr)
•BIOC 3021 - Biochemistry (3.0 cr)
•CSCI 2021 - Machine Architecture and Organization (4.0 cr)
•MATH 2283 *{Inactive}*(3.0 cr)
•ME 2011 - Introduction to Engineering (4.0 cr)
•ME 3331 - Thermodynamics (3.0 cr)
•STAT 3011 - Introduction to Statistical Analysis [MATH] (4.0 cr)
•CSCI 2011 - Discrete Structures of Computer Science (4.0 cr)
•CSCI 2033 - Elementary Computational Linear Algebra (4.0 cr)
•CHEM 1066 - Chemical Principles II Laboratory [PHYS] (1.0 cr)

© 2005 by the Regents of the University of Minnesota
The University of Minnesota is an equal opportunity educator and employer.
Information current as of March 28, 2024

CHEM 1062 - Chemical Principles II [PHYS] (3.0 cr)

**•Fluids Technical Electives**

A faculty advisor is required for AEM 4295. Honors students may choose to take AEM 5247 or 5253.
Take 0 or more course(s) from the following:
•AEM 4290 - Special Topics in Fluid Mechanics (1.0 - 3.0 cr)
•AEM 4247 - Hypersonic Aerodynamics (3.0 cr)
*or* AEM 5247 - Hypersonic Aerodynamics (3.0 cr)
•AEM 4253 - Computational Fluid Mechanics (3.0 cr)
*or* AEM 5253 - Computational Fluid Mechanics (3.0 cr)

**•Aerospace Systems Technical Electives**

A faculty advisor is required for AEM 4495. Honors students may choose to take AEM 5247 or 5253.
Take 0 or more course(s) from the following:
•AEM 4305 - Spacecraft Attitude Dynamics and Control (3.0 cr)
•AEM 4321 - Automatic Control Systems (3.0 cr)
•AEM 4490 - Special Topics in Aerospace Systems (1.0 - 3.0 cr)
•AEM 5401 - Intermediate Dynamics (3.0 cr)
•AEM 5451 - Optimal Estimation (3.0 cr)
•AEM 5651 - Aeroelasticity (3.0 cr)

**•Build Courses**

Only one course may be used as a technical elective.
Take 0 - 1 course(s) from the following:
•AEM 4333 - Aerospace Design: Special Projects (3.0 cr)
•AEM 5333 - Design-to-Flight: Small Uninhabited Aerial Vehicles (3.0 cr)

**•Structures and Solids Technical Electives**

A faculty advisor is required for AEM 4595. Honors students may choose to take AEM 5581.
Take 0 or more course(s) from the following:
•AEM 4502 - Computational Structural Analysis (3.0 cr)
•AEM 4511 - Mechanics of Composite Materials (3.0 cr)
•AEM 4590 - Special Topics in Solid Mechanics and Materials (1.0 - 3.0 cr)
•AEM 5501 - Continuum Mechanics (3.0 cr)
•AEM 5503 - Theory of Elasticity (3.0 cr)
•AEM 4581 - Mechanics of Solids (3.0 cr)
*or* AEM 5581 - Mechanics of Solids (3.0 cr)

**•Honors Thesis Technical Elective**

Using AEM 4894H as a technical elective requires completion of your honors thesis in order to complete your degree.
Take 0 or more course(s) from the following:
•AEM 4894 - Directed Studies: Senior Honors Thesis (3.0 cr)

**•Other Possible Technical Electives**

Any mathematics, science, or engineering course of technical nature that is not listed below may be used as technical electives by permission. Contact the AEM Director of Undergraduate Studies.
Take 0 or more course(s) from the following:
•AST 4001 - Astrophysics I (4.0 cr)
•AST 5022 - Relativity, Cosmology, and the Universe (4.0 cr)
•BIOL 4003 - Genetics (3.0 cr)
•CSCI 4611 - Programming Interactive Computer Graphics and Games (3.0 cr)
•CSCI 5551 - Introduction to Intelligent Robotic Systems (3.0 cr)
•EE 4233 - State Space Control System Design (3.0 cr)
•IE 5111 - Systems Engineering I (2.0 cr)
•MATH 4152 - Elementary Mathematical Logic (3.0 cr)
•MATH 4242 - Applied Linear Algebra (4.0 cr)
•MATH 4428 - Mathematical Modeling (4.0 cr)
•MATH 4512 - Differential Equations with Applications (3.0 cr)
•MATH 4567 - Applied Fourier Analysis (4.0 cr)
•MATH 4603 - Advanced Calculus I (4.0 cr)
•MATH 5583 - Complex Analysis (4.0 cr)
•MATH 5587 - Elementary Partial Differential Equations I (4.0 cr)
•ME 5286 - Robotics (4.0 cr)
•ME 5341 - Case Studies in Thermal Engineering and Design (4.0 cr)
•ME 5351 - Computational Heat Transfer (4.0 cr)
•ME 5446 - Introduction to Combustion (4.0 cr)
•MOT 4010 *{Inactive}*[GP] (3.0 cr)
•PHYS 4051 - Methods of Experimental Physics I (5.0 cr)
•PHYS 4001 - Analytical Mechanics (4.0 cr)
•CSCI 4061 - Introduction to Operating Systems (4.0 cr)
•CSCI 4041 - Algorithms and Data Structures (4.0 cr)
•CSCI 5143 - Real-Time and Embedded Systems (3.0 cr)

© 2005 by the Regents of the University of Minnesota
The University of Minnesota is an equal opportunity educator and employer.

- CSCI 5521 - Machine Learning Fundamentals (3.0 cr)
- ME 4231 - Motion Control Laboratory (4.0 cr)
- MATH 5485 - Introduction to Numerical Methods I (4.0 cr)
- PHYS 4611 - Introduction to Space Physics (3.0 cr)
- LAAS 5050 - Integrated Topics in Land & Atmospheric Science (3.0 cr)
- MATS 4594 - Directed Research in Materials Science (1.0 - 3.0 cr)

**Upper Division Writing Intensive within the Major**

Students are required to take one upper division writing intensive course within the major. If that requirement has not been satisfied within the core major requirements, students must choose one course from the following list. Some of these courses may also fulfill other major requirements.

Take 0 - 1 course(s) from the following:

- AEM 4303W - Flight Dynamics and Control [WI] (3.0 cr)
- AEM 4602W - Aeromechanics Laboratory [WI] (4.0 cr)

© 2005 by the Regents of the University of Minnesota
The University of Minnesota is an equal opportunity educator and employer.