# AEROSPACE SCIENCE & ENGINEERING, BACHELOR OF SCIENCE

**College of Engineering**

Barbara S. Linke, Dr. –Ing. Habil, Vice Chairperson for Undergraduate Studies

## Mechanical & Aerospace Engineering Undergraduate Programs

The Department of Mechanical & Aerospace Engineering administers two undergraduate programs in the College of Engineering *(1)* Mechanical Engineering, *(2)* Aerospace Science & Engineering

For more information about our programs, please see Undergraduate Majors (http://mae.ucdavis.edu/undergraduate/undergraduate-majors/).

### Mission

The Department of Mechanical & Aerospace Engineering is committed to educating future engineers so that they may contribute to the economic growth and well-being of the state, the nation, and the world, and to the advancement of knowledge in the mechanical and aerospace sciences.

### Objectives

The objectives of the Mechanical Engineering and Aerospace Science & Engineering programs are to produce graduates who do one or more of the following: a. Practice mechanical engineering and/or aerospace engineering in a broad range of agencies, industries, and institutes; b. Pursue graduate education; c. Participate in research and development, and other creative and innovative efforts in science, engineering, and technology; d. Pursue entrepreneurial endeavors.

## Division of Aerospace Science & Engineering

The Division of Aerospace Science & Engineering administers the Aerospace Science & Engineering Program within the Department of Mechanical & Aerospace Engineering.

### Aerospace Science & Engineering Undergraduate Program

The Aerospace Science & Engineering program is accredited by the Engineering Accreditation Commission of ABET (http://www.abet.org).

Aerospace Science & Engineering majors learn to apply the principles of the physical sciences and engineering to the design of aerospace vehicles. Specific objectives include the design, development and manufacture of aerospace vehicles and other transportation systems through the integration of disciplines associated with aerodynamics, propulsion, structures and guidance/control.

Our Bachelor of Science degree in Aerospace Science & Engineering provides a broad background and fundamental education in mathematics, the physical sciences, and the engineering sciences. These fundamentals, when complemented by the required technical courses, prepare students for employment in government or industry, while simultaneously establishing an excellent foundation for graduate studies.

#### Aerodynamics & Fluid Mechanics

This field of study is based on the fundamentals of fluid mechanics and applied aircraft aerodynamics. Areas of current research include computational fluid dynamics, turbulent boundary layer flows, aeroacoustics, rotorcraft aerodynamics, wind turbine aerodynamics, active flow control, subsonic wind tunnel measurement, vortex generators, fixed-wing tip vortices, parachute drag prediction and aircraft design and optimization. Many of these projects are sponsored by government agencies and leading industrial companies, such as NASA, the U.S. Army, Sandia National Laboratory, the National Science Foundation and Boeing. Computational research is conducted using UC Davis High Performance Computing (HPC), NASA HPC, DoD HPC and DoE HPC. Experimental studies are conducted in the UC Davis Wind Tunnel Facility.

**Relevant courses:** EAE 126 & EAE 127.

#### Suggested Advisors

J. P. Delplanque, C. P. van Dam, M. Hafez, S. Lee, N. Sarigul-Klijn, S. K. Robinson

#### Aerospace Control

This field of study includes control theory and its application to aerospace systems. Areas of current research include adaptive control, networked system control, hybrid system control, and controller design for unmanned aerial systems, spacecraft, and other machines. Many of these projects are sponsored by government agencies and leading industrial companies, such as NASA Ames Research Center, NASA Jet Propulsion Laboratory, the National Science Foundation and Boeing.

**Relevant course:** EAE 129.

#### Suggested Advisors

S. Joshi, Z. Kong, N. Sarigul-Klijn

#### Aerospace Propulsion

This field of study involves air-breathing jet engines and rocket propulsion. Areas of current research include turbomachinery, computational fluid dynamics, open rotor, jet noise, turbine cooling, innovative gas-turbine cycles, rocket engine feed systems and cooling tubes, propeller design and centrifugal compressors. Many of these projects are sponsored by government agencies and leading industrial companies, such as The Wright-Patterson Air Force Research Laboratory (AFRL), Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Aerojet Rocketdyne and the University of California. Computational research is conducted using UC Davis High Performance Computing (HPC), NASA HPC, DoD HPC and DoE HPC.

**Relevant courses**: EAE 138 & EAE 140.

#### Suggested Advisors

J. P. Delplanque, S. Lee, N. Sarigul-Klijn

#### Structures & Materials

This field of study analyzes the structures and materials used in aerospace engineering, expanding from traditional mechanics of materials in order to correctly understand the behavior of thin-walled structures under bending, torsion and axial loads. Composite materials are being used extensively in new airplanes and helicopters, space structures, as well as in wind energy, ships, transportation, infrastructure and biomedical joints. Current research in composite structures encompasses several areas of engineering, includes durability of

composites due to in service load (for example, thermo-hygro-mechanical fatigue, impact, etc.) and structural health monitoring methods.

**Relevant courses**: EAE 133, EAE 135 & MAE 237 (graduate level/technical elective).

**Suggested Advisors**
V. La Saponara

### Spacecraft Engineering

This field of study includes rocket propulsion, orbital mechanics, spacecraft design, human life-support in space, space environments, mission design and systems engineering. Current research in the MAE department includes spacecraft and habitat design, CubeSat design, human life-support systems and safety, space robotics, autonomous systems supported by machine learning, radiation protection, atmospheric entry and metallic additive manufacturing. A variety of federally-funded national laboratories fund this research, and research projects often result in internship and employment opportunities for students in organizations like NASA, Lawrence Livermore Lab, SpaceX, Blue Origin, Sierra Nevada, Lockheed Martin, Northrup Grumman, Aerospace Corp, Space Systems Loral and Boeing.

**Relevant courses:** EAE 140, EAE 142, EAE 143A, EAE 143B.

**Suggested Advisors**
S. Joshi, N. Sarigul-Klijn, S. K. Robinson

### Aeroelasticity & Vibrations

This field of study looks at aircraft structural dynamics and aeroelasticity. Areas of current research include aerospace structures, aeroelasticity, biomechanics, flow-induced vibrations, vibroacoustics and minimum weight design with aeroelastic and acoustic constraints. Research is also done on landing recovery systems, including winged, rotor, or parachute recovery system trades and scaled flight testing and the long-duration effects of space flight on the human spine. Aerospace engineers in this research area also work to develop advanced finite element methods to solve steep gradient problems of high temperature due to aerodynamic heating or shock loading, innovative power generation systems and environmental noise control methods. Many of these projects are sponsored by government agencies and leading industrial companies.

**Relevant course:** EAE 133, EAE 135.

**Suggested Advisors**
V. La Saponara, N. Sarigul-Klijn

Students are encouraged to adhere carefully to all prerequisite requirements. The instructor is authorized to drop students from a course for which stated prerequisites have not been completed.

Exclusive of General Education units, the minimum number of units required for the Aerospace Science & Engineering major is 160.

| Code | Title | Units |
|---|---|---|
| **Lower Division Required Courses** | | |
| *Mathematics* | | |
| MAT 021A | Calculus | 4 |
| MAT 021B | Calculus | 4 |
| MAT 021C | Calculus | 4 |
| MAT 021D | Vector Analysis | 4 |
| MAT 022A | Linear Algebra | 3 |
| MAT 022B | Differential Equations | 3 |
| *Physics* | | |
| PHY 009A | Classical Physics | 5 |
| PHY 009B | Classical Physics | 5 |
| PHY 009C | Classical Physics | 5 |
| *Chemistry* | | |
| CHE 002A | General Chemistry | 5 |
| or CHE 002AH | Honors General Chemistry | |
| CHE 002B | General Chemistry | 5 |
| or CHE 002BH | Honors General Chemistry | |
| *Engineering* | | |
| ENG 004 | Engineering Graphics in Design | 3 |
| ENG 017 | Circuits I | 4 |
| ENG 035 | Statics | 4 |
| ENG 045 | Properties of Materials | 4 |
| or ENG 045Y | Properties of Materials | |
| ENG 006 | Engineering Problem Solving | 4 |
| or EME 005 | Computer Programming for Engineering Applications | |
| Lower Division Composition/Writing; choose one; a grade of C- or better is required: | | 4 |
| COM 001 | Major Works of the Ancient World | |
| COM 002 | Major Works of the Medieval & Early Modern World | |
| COM 003 | Major Works of the Modern World | |
| COM 004 | Major Works of the Contemporary World | |
| ENL 003 | Introduction to Literature | |
| NAS 005 | Introduction to Native American Literature | |
| UWP 001 | Introduction to Academic Literacies (Recommended) | |
| UWP 001V | Introduction to Academic Literacies: Online (Recommended) | |
| UWP 001Y | Introduction to Academic Literacies (Recommended) | |
| Choose one: | | 4 |
| CMN 001 | Introduction to Public Speaking | |
| ENG 003 | Introduction to Engineering Design | |
| Lower Division Required Courses Subtotal | | 74 |
| **Upper Division Required Courses** | | |
| *Aerospace Science & Engineering* | | *28* |
| *Required Aerospace Courses* | | |
| EAE 129 | Stability & Control of Aerospace Vehicles | |
| EAE 133 | Finite Element Methods in Structures | |
| EAE 135 | Aerospace Structures | |
| EAE 138 | Aircraft Propulsion | |
| *Aerodynamics Elective, choose one:* | | |
| EAE 126 | Theoretical & Computational Aerodynamics | |
| or EAE 127 | Applied Aircraft Aerodynamics | |
| *Senior Design Capstone, choose one series:* | | |
| EAE 130A & EAE 130B | Aircraft Performance & Design and Aircraft Performance & Design (taken in consecutive quarters) | |

| | | |
|---|---|---|
| EAE 143A & EAE 143B | Space Vehicle Design and Space Mission Design (EAE 143B Pending Approval; taken in consecutive quarters) | |
| *Engineering* | | *22* |
| ENG 100 | Electronic Circuits & Systems | |
| ENG 102 | Dynamics | |
| ENG 103 | Fluid Mechanics | |
| ENG 104 | Mechanics of Materials | |
| ENG 105 | Thermodynamics | |
| ENG 190 | Professional Responsibilities of Engineers | |
| *Mechanical Engineering* | | *20* |
| EME 106 | Thermo-Fluid Dynamics | |
| EME 108 | Measurement Systems | |
| EME 109 | Experimental Methods for Thermal Fluids | |
| EME 165 | Heat Transfer | |
| EME 172 | Automatic Control of Engineering Systems | |
| *Applied Mathematics Elective* | | *4* |
| Choose one: | | |
| ENG 180 | Engineering Analysis | |
| or EME 115 | Introduction to Numerical Analysis & Methods | |
| or MAT 128A | Numerical Analysis | |
| or MAT 128C | Numerical Analysis in Differential Equations | |
| or ECS 130 | Scientific Computation | |
| *Technical Electives* | | *12* |
| Astronautics Electives; choose one: | | |
| EAE 140 | Rocket Propulsion | |
| EAE 142 | Orbital Mechanics | |
| EAE 143A | Space Vehicle Design | |
| EAE 143B | Space Mission Design (Pending Approval) | |
| Aeronautics Elective; choose one: | | |
| EAE 126 | Theoretical & Computational Aerodynamics | |
| EME 139 | Stability of Flexible Dynamic Systems | |
| From the above Astronautics Elective list if not used in satisfaction of other degree requirements. | | |
| Technical Elective; choose one: | | |
| From the above Aeronautics Elective list if not used in satisfaction of other degree requirements. | | |
| Up to 4 units may be selected from any upper division engineering course including any engineering 192 or 199 not used in satisfaction of other degree requirements. [1] | | |
| *Upper Division Composition Requirement* | | *0-4* |
| Choose one; grade of C- or better is required: | | |
| UWP 101 | Advanced Composition | |
| or UWP 101V | Advanced Composition | |
| or UWP 101Y | Advanced Composition | |
| UWP 102E | Writing in the Disciplines: Engineering | |
| UWP 104A | Writing in the Professions: Business Writing | |
| or UWP 104AY | Writing in the Professions: Business Writing | |
| UWP 104E | Writing in the Professions: Science | |
| UWP 104T | Writing in the Professions: Technical Writing | |
| **or** | | |
| Passing the Upper Division Composition Exam | | |
| Upper Division Required Courses Subtotal | | 86-90 |
| **Total Units** | | **160-164** |

[1] Courses that cannot be used are BIM 110L, ENG 160, ECS 188 or any 197T course.