MECHANICAL ENGINEERING, BACHELOR OF SCIENCE

College of Engineering

Valeria La Saponara, Ph.D., Vice Chairperson for Undergraduate Studies

The 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, 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 & Aerospace Science and 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.

Mechanical Engineering Undergraduate Program

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

The mechanical engineer uses basic science in the design and manufacture of complex engineering systems, requiring the application of physical and mechanical principles to the development of machines, energy conversion systems, materials, and equipment for guidance & control.

Work in this broad field of engineering requires a thorough knowledge of mathematics, physics, chemistry, material science, applied mechanics, thermodynamics, heat transfer, mass transfer, electricity, manufacturing processes, and economics.

The Mechanical Engineering program is designed to provide knowledge in mechanical engineering and associated applied sciences so that graduates may practice in a broad range of industries, pursue graduate studies, participate in research & development, and/or pursue entrepreneurial endeavors.

Areas of Interest

Students spend their third year in further study of fundamental courses, and in the fourth year they may tailor their studies to their interests by selecting courses in controls and systems analysis, fluid mechanics, heat transfer, mechanical design or thermodynamics. Students can either prepare for graduate study in mechanical engineering or obtain a broad background for entering engineering practice.

Students may select elective courses from among the areas of interest listed below.

Mechanical Design

The creation and improvement of products, processes, or systems that are mechanical in nature are the primary activities of a professional mechanical engineer. The development of a product from concept generation to detailed design, manufacturing process selection and planning, quality control and assurance, and life cycle considerations are areas of study and specialization in the area of mechanical design.

Solutions to such major social problems as environmental pollution, the lack of mass transportation, the lack of raw materials, and energy shortages, will depend heavily on the engineer’s ability to create new types of machinery and mechanical systems.

The engineer-designer must have a solid and relatively broad background in the basic physical and engineering sciences and have the ability to synthesize the information from such a background in creative problem solving. In addition to having technical competence, the designer must be able to consider the socioeconomic consequences of a design and its possible impact on the environment. Product safety, reliability, and economics are other considerations.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG 122</td>
<td>Introduction to Mechanical Vibrations</td>
<td>4</td>
</tr>
<tr>
<td>EMS 180</td>
<td>Materials in Engineering Design</td>
<td>4</td>
</tr>
<tr>
<td>EMS 182</td>
<td>Failure Analysis</td>
<td>4</td>
</tr>
<tr>
<td>EME 121</td>
<td>Engineering Applications of Dynamics</td>
<td>4</td>
</tr>
<tr>
<td>EME 134</td>
<td>Vehicle Stability</td>
<td>4</td>
</tr>
<tr>
<td>EME 139</td>
<td>Stability of Flexible Dynamic Systems</td>
<td>4</td>
</tr>
<tr>
<td>EME 150B</td>
<td>Mechanical Design</td>
<td>4</td>
</tr>
<tr>
<td>EME 151</td>
<td>Statistical Methods in Design &amp; Manufacturing</td>
<td>4</td>
</tr>
<tr>
<td>EME 152</td>
<td>Computer-Aided Mechanism Design</td>
<td>4</td>
</tr>
<tr>
<td>EME 154</td>
<td>Mechatronics</td>
<td>4</td>
</tr>
<tr>
<td>EME 161</td>
<td>Combustion &amp; the Environment</td>
<td>4</td>
</tr>
<tr>
<td>EME 163</td>
<td>Internal Combustion Engines &amp; Future Alternatives</td>
<td>4</td>
</tr>
<tr>
<td>EME 164</td>
<td>Introduction to Heating, Ventilation &amp; Air Conditioning Systems</td>
<td>4</td>
</tr>
<tr>
<td>EME 171</td>
<td>Analysis, Simulation &amp; Design of Mechatronic Systems</td>
<td>4</td>
</tr>
</tbody>
</table>

Suggested Advisors


Engineering & Biomedical Fluid Mechanics

This field of study is based on the fundamentals of fluid mechanics and their broad range of applications in the biomedical and engineering areas. Areas of current research include blood circulation and its potential role in the regulation of normal physiological function and in the development of disease; groundwater and atmospheric flows and their implications for pollutant transport and environmental concerns; aerodynamic flow around transportation vehicles and its impact on vehicle performance; flow in combustion engines and other energy
systems with considerations of efficiency and environmental impact; compressible flows in aircraft engine or gas turbine; and computational fluid dynamics. These areas are investigated both experimentally and computationally.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Suggested Restricted Electives</strong></td>
<td></td>
</tr>
<tr>
<td>EAE 126</td>
<td>Theoretical &amp; Computational Aerodynamics</td>
<td>4</td>
</tr>
<tr>
<td>EAE 127</td>
<td>Applied Aircraft Aerodynamics</td>
<td>4</td>
</tr>
<tr>
<td>EAE 138</td>
<td>Aircraft Propulsion</td>
<td>4</td>
</tr>
<tr>
<td>EME 161</td>
<td>Combustion &amp; the Environment</td>
<td>4</td>
</tr>
<tr>
<td>EME 163</td>
<td>Internal Combustion Engines &amp; Future Alternatives</td>
<td>4</td>
</tr>
<tr>
<td>EME 164</td>
<td>Introduction to Heating, Ventilation &amp; Air Conditioning Systems</td>
<td>4</td>
</tr>
</tbody>
</table>

**Suggested Advisors**

**Combustion & the Environment**
Combustion is widely used for energy generation, propulsion, heating, and waste disposal, as well as for many other applications. Mechanical engineers are often heavily involved with the design of combustion systems (internal combustion engines, gas turbines, furnaces, etc.) and deal with aspects of combustion ranging from increasing efficiencies to reducing pollutant emissions. This specialization is for those who would like to work in fields that use combustion, or that deal with pollution related to combustion. With the current increased emphasis on reducing pollutants while maintaining or increasing efficiency, the efforts of mechanical engineers in designing and improving combustion systems are becoming more important.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Suggested Technical Electives</strong></td>
<td></td>
</tr>
<tr>
<td>EME 161</td>
<td>Combustion &amp; the Environment</td>
<td>4</td>
</tr>
<tr>
<td>EME 163</td>
<td>Internal Combustion Engines &amp; Future Alternatives</td>
<td>4</td>
</tr>
</tbody>
</table>

**Suggested Advisors**
R.C. Aldredge, P.A. Erickson, B.D. Shaw

**Heat Transfer, Thermodynamics, & Energy Systems**
This specialization emphasizes the fundamentals of heat transfer and thermodynamics, and their application to the design of advanced engineering systems. The objective of the program is to introduce students to the fundamental processes of heat transfer and thermodynamics in complex engineering systems so that they are able to design more efficient, cost-effective, and reliable systems with less environmental pollution and impact. An understanding of heat transfer and thermodynamics is required for the design of efficient, cost-effective systems for power generation, propulsion, heat exchangers, industrial processes, refining, and chemical processing. This area of specialization is important to many industries—aerospace, defense, automotive—as well as to the thermal design of electronic and computer packages.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Suggested Restricted Electives</strong></td>
<td></td>
</tr>
<tr>
<td>EAE 138</td>
<td>Aircraft Propulsion</td>
<td>4</td>
</tr>
<tr>
<td>EME 161</td>
<td>Combustion &amp; the Environment</td>
<td>4</td>
</tr>
</tbody>
</table>

**Suggested Advisors**
R.C. Aldredge, P.A. Erickson, B.D. Shaw

**Manufacturing**
Manufacturing is concerned with the conversion of raw materials into finished products by a variety of processes, such as machining, forming, casting, and molding. Modern manufacturing technology is increasingly dependent upon integration with computer-aided design systems and precision computer controls. State-of-the-art laboratories offer the opportunity for hands-on experience with a wide spectrum of manufacturing equipment. Manufacturing engineers must have expertise in design, materials, controls, statistical methods, computer software, and microprocessor applications.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Suggested Restricted Electives</strong></td>
<td></td>
</tr>
<tr>
<td>EMS 180</td>
<td>Materials in Engineering Design</td>
<td>4</td>
</tr>
<tr>
<td>EME 150B</td>
<td>Mechanical Design</td>
<td>4</td>
</tr>
<tr>
<td>EME 151</td>
<td>Statistical Methods in Design &amp; Manufacturing</td>
<td>4</td>
</tr>
<tr>
<td>EME 154</td>
<td>Mechatronics</td>
<td>4</td>
</tr>
</tbody>
</table>

**Suggested Advisors**
H.H. Cheng, R.T. Farouki, B.S. Linke, D.A. Horsley, V. La Saponara, M. Soshi, B. Ravani

**System Dynamics & Control**
Engineers are increasingly concerned with the performance of integrated dynamics systems in which it is not possible to optimize component parts without considering the overall system.

System dynamics and control specialists are concerned with the modeling, analysis, and simulation of all types of dynamic systems and with the use of automatic control techniques to change the dynamic characteristics of systems in useful ways. The emphasis in this program is on the physical systems that are closely related to mechanical engineering, but the techniques for studying these systems apply to social, economic, and other dynamic systems.

Ongoing research includes projects on continuously variable transmissions, active and semi-active suspension systems, modeling and control of vehicle dynamics, electromechanical actuator design, electronically controlled steering, the analysis of fuel management systems, and the design of flight-control systems with humans in the loop.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Suggested Restricted Electives</strong></td>
<td></td>
</tr>
<tr>
<td>EAE 129</td>
<td>Stability &amp; Control of Aerospace Vehicles</td>
<td>4</td>
</tr>
<tr>
<td>EAE 142</td>
<td>Orbital Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>EAE 143A</td>
<td>Space Vehicle Design</td>
<td>4</td>
</tr>
<tr>
<td>EAE 143B</td>
<td>Space Mission Design</td>
<td>4</td>
</tr>
<tr>
<td>ENG 111</td>
<td>Electric Machinery Fundamentals</td>
<td>4</td>
</tr>
<tr>
<td>ENG 121</td>
<td>Fluid Power Actuators &amp; Systems</td>
<td>4</td>
</tr>
<tr>
<td>ENG 122</td>
<td>Introduction to Mechanical Vibrations</td>
<td>4</td>
</tr>
</tbody>
</table>
EME 121  Engineering Applications of Dynamics  4
EME 134  Vehicle Stability  4
EME 139  Stability of Flexible Dynamic Systems  4
EME 152  Computer-Aided Mechanism Design  4
EME 154  Mechatronics  4
EME 171  Analysis, Simulation & Design of Mechatronic Systems  4

Suggested Advisors

Ground Vehicle Systems
An important aspect of mechanical engineering is the design of more environmentally benign surface vehicles that provide efficient individual and public transportation. Innovations in the field require competence in vehicle dynamics, control of vehicle dynamics, power sources & power transmission, lightweight structures & systems, alternatively fueled power systems, including electrical drives & fuel cells, and mechanical systems.

Suggested Restricted Electives
ENG 122  Introduction to Mechanical Vibrations  4
EME 121  Engineering Applications of Dynamics  4
EME 134  Vehicle Stability  4
EME 139  Stability of Flexible Dynamic Systems  4
EME 152  Computer-Aided Mechanism Design  4
EME 171  Analysis, Simulation & Design of Mechatronic Systems  4

Suggested Advisors
F. Assadian, P.A. Erickson, M. Hill, X. Lin, J. Moore, J. Park, N. Sarigul-Klijn

Transportation Systems
As society recognizes the increasing importance of optimizing transportation systems to minimize environmental degradation and energy expenditure, engineers will need to consider major innovations in the way people and goods are moved. Such innovations will require competence in vehicle dynamics, propulsion and control, and an understanding of the problems caused by present-day modes of transportation. Vehicle control requires an understanding of sensors and actuators, and the integration of yet-to-be-proposed concepts into overall vehicular dynamics. Competence in these areas allows for the development of alternative propulsion concepts, such as electric, hybrid, and fuel cell.

Suggested Advisors
F. Assadian, P.A. Erickson, M. Hill, X. Lin, J. Moore, J. Park, 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 Mechanical Engineering major is 148.

Code  Title  Units
CMN 001  Introduction to Public Speaking  4
or ENG 003  Introduction to Engineering Design  4
or ENG 003Y  Introduction to Engineering Design  4

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

PHY 009A  Classical Physics  5
PHY 009B  Classical Physics  5
PHY 009C  Classical Physics  5

CHE 002A  General Chemistry  5
or CHE 002AH  Honors General Chemistry  5

CHE 002B  General Chemistry  5
or CHE 002BH  Honors General Chemistry  5

ENG 004  Engineering Graphics in Design  3
ENG 017  Circuits I  4
ENG 035  Statics  4
EME 050  Manufacturing Processes  4
EME 005  Computer Programming for Engineering Applications (Discontinued)  4
or ENG 006  Engineering Problem Solving  4
ENG 045  Properties of Materials  4
or ENG 045Y  Properties of Materials  4

Lower Division Composition/Writing; choose one; a grade of C- or better is required:

COM 001  Major Works of the Ancient World  4
COM 002  Major Works of the Medieval & Early Modern World  4
COM 003  Major Works of the Modern World  4
COM 004  Major Works of the Contemporary World  4
ENL 003  Introduction to Literature  4
or ENL 003V  Introduction to Literature  4
NAS 005  Introduction to Native American Literature  4
UWP 001  Introduction to Academic Literacies (Recommended)  4
UWP 001V  Introduction to Academic Literacies: Online (Recommended)  4
**Mechanical Engineering, Bachelor of Science**

**UWP 001Y**  
Introduction to Academic Literacies  
(Recommended)

**Lower Division Required Courses Subtotal**  
78

**Upper Division Required Courses**

**Engineering**
- **ENG 100**  
Electronic Circuits & Systems  
3
- **ENG 102**  
Dynamics  
4
- **ENG 103**  
Fluid Mechanics  
4
- **ENG 104**  
Mechanics of Materials  
4
- **ENG 105**  
Thermodynamics  
4
- **ENG 190**  
Professional Responsibilities of Engineers  
3

**Mechanical Engineering**
- **EME 106**  
Thermo-Fluid Dynamics  
4
- **EME 108**  
Measurement Systems  
4
- **EME 109**  
Experimental Methods for Thermal Fluids  
4
- **EME 150A**  
Mechanical Design  
4
- **EME 165**  
Heat Transfer  
4
- **EME 172**  
Automatic Control of Engineering Systems  
4

**Choose a series:**  
8
- **EME 185A**  
Mechanical Engineering Systems Design Project  
and Mechanical Engineering Systems Design Project (taken in consecutive quarters)
- **EME 185B**  
Mechanical Engineering Systems Design Project  
and Mechanical Engineering Systems Design Project (taken in consecutive quarters)
- **EAE 130A**  
Aircraft Performance & Design  
and Aircraft Performance & Design (taken in consecutive quarters)
- **EAE 130B**  
Aircraft Performance & Design  
and Aircraft Performance & Design (taken in consecutive quarters)
- **EAE 143A**  
Space Vehicle Design  
and Space Mission Design (taken in consecutive quarters)
- **EAE 143B**  
Space Vehicle Design  
and Space Mission Design (taken in consecutive quarters)

**Applied Mathematics Electives**

**Choose one:**  
4
- **ECH 140**  
Mathematical Methods in Biochemical & Chemical Engineering
- **ECI 114**  
Probabilistic Systems Analysis for Civil & Environmental Engineers
- **ECS 130**  
Scientific Computation
- **ENG 180**  
Engineering Analysis
- **MAT 118A**  
Partial Differential Equations: Elementary Methods
- **MAT 128A**  
Numerical Analysis
- **MAT 128B**  
Numerical Analysis in Solution of Equations
- **EME 115**  
Introduction to Numerical Analysis & Methods
- **EME 151**  
Statistical Methods in Design & Manufacturing
- **STA 130A**  
Mathematical Statistics: Brief Course
- **STA 131A**  
Introduction to Probability Theory

**System Dynamics/Mechanical Design Electives**

**Choose one:**  
4
- **ENG 122**  
Introduction to Mechanical Vibrations
- **EME 121**  
Engineering Applications of Dynamics
- **EME 139**  
Stability of Flexible Dynamic Systems
- **EME 150B**  
Mechanical Design
- **EME 154**  
Mechatronics
- **EME 171**  
Analysis, Simulation & Design of Mechatronic Systems

**Restricted Electives**

**Choose two:**  
8
- **EAE 129**  
Stability & Control of Aerospace Vehicles
- **EAE 138**  
Aircraft Propulsion
- **EAE 140**  
Rocket Propulsion
- **EAE 142**  
Orbital Mechanics
- **EAE 143A**  
Space Vehicle Design
- **EAE 143B**  
Space Mission Design
- **ENG 188**  
Science & Technology of Sustainable Power Generation
- **EMS 180**  
Materials in Engineering Design
- **EMS 182**  
Failure Analysis
- **EAE 134**  
Vehicle Stability
- **EAE 152**  
Computer-Aided Mechanism Design
- **EAE 161**  
Combustion & the Environment
- **EAE 163**  
Internal Combustion Engines & Future Alternatives
- **EAE 164**  
Introduction to Heating, Ventilation & Air Conditioning Systems

**Upper Division Composition Requirement**

**Choose one; a grade of C- or better is required:**  
0-4
- **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 104AV**  
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

**Passing the Upper Division Composition Exam**

**Upper Division Required Courses Subtotal**  
70-74

**Total Units**  
148-152

---

1 Students may also choose from EAE 130A, EAE 130B, EME 121, EME 139, EME 150B, EME 151, EME 154, EME 171, ENG 122 if these courses are not used in satisfaction of other degree requirements.