MECHANICAL ENGINEERING, BACHELOR OF SCIENCE

College of Engineering

Barbara S. Linke, Dr.-Ing. habil., Vice Chairperson for Undergraduate Studies; term begins July 1, 2019

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.

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

Suggested Advisors

H.H. Cheng, R.T. Farouki, M.R. Hill, B.S. Linke, B. Ravani, J. Schofield, M. Soshi

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.

Code	Title	Units
Suggested Restricted Electives		
EAE 126	Theoretical & Computational Aerodynamics	4
EAE 127	Applied Aircraft Aerodynamics	4
EAE 138	Aircraft Propulsion	4
EME 161	Combustion & the Environment	4
EME 163	Internal Combustion Engines & Future Alternatives	4
EME 164	Introduction to Heating, Ventilation & Air Conditioning Systems	4

Suggested Advisors
R.C. Aldredge, J.P. Delplanque, M. Hafez, S. Lee, S.K. Robinson, B.D. Shaw, C.P. van Dam, A.S. Wexler

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.

Code	Title	Units
Suggested Technical Electives		
EME 161	Combustion & the Environment	4
EME 163	Internal Combustion Engines & Future Alternatives	4

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.

Code	Title	Units
Suggested Restricted Electives		
EAE 138	Aircraft Propulsion	4
EME 161	Combustion & the Environment	4
EME 163	Internal Combustion Engines & Future Alternatives	4
EME 164	Introduction to Heating, Ventilation & Air Conditioning Systems	4

Suggested Advisors
R.C. Aldredge, P.A. Erickson, J.K. Kissock, V. Narayanan, J.W. Park, 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.

Code	Title	Units
Suggested Restricted Electives		
EMS 180	Materials in Engineering Design	4
EME 150B	Mechanical Design	4
EME 151	Statistical Methods in Design & Manufacturing	4
EME 154	Mechatronics	4

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.

Code	Title	Units
Suggested Restricted Electives		
EAE 129	Stability & Control of Aerospace Vehicles	4
EAE 142	Orbital Mechanics	4
EAE 143A	Space Vehicle Design	4
ENG 111	Electric Machinery Fundamentals	4
ENG 121	Fluid Power Actuators & Systems	4
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 154	Mechatronics	4
EME 171	Analysis, Simulation & Design of Mechatronic Systems	4

Suggested Advisors
F. Assadian, D.A. Horsley, S. Joshi, Z. Kong, X. Lin, S. Nazari, J. Schofield, I. Soltani

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.

Code	Title	Units
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.

Code	Title	Units
Suggested Restricted Electives		
EAE 129	Stability & Control of Aerospace Vehicles	4
ENG 122	Introduction to Mechanical Vibrations	4
EME 134	Vehicle Stability	4
EME 150B	Mechanical Design	4
EME 161	Combustion & the Environment	4
EME 163	Internal Combustion Engines & Future Alternatives	4
EME 171	Analysis, Simulation & Design of Mechatronic Systems	4

Suggested Advisors
F. Assadian, P.A. Erickson, X. Lin, S. Nazari, J.W. Park, I. Soltani

Mechanical Engineering Program Requirements

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
Lower Division Required Courses		
CMN 001	Introduction to Public Speaking	4
or ENG 003	Introduction to Engineering Design	
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
EME 050	Manufacturing Processes	4
EME 005	Computer Programming for Engineering Applications	4
or ENG 006	Engineering Problem Solving	
ENG 045	Properties of Materials	4
or ENG 045Y	Properties of Materials	
Choose one; a grade of C- or better is required:		4
ENL 003	Introduction to Literature	
UWP 001	Introduction to Academic Literacies	
or UWP 001V	Introduction to Academic Literacies: Online	
or UWP 001Y	Introduction to Academic Literacies	
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	
NAS 005	Introduction to Native American Literature	
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 & EME 185B	Mechanical Engineering Systems Design Project and Mechanical Engineering Systems Design Project (taken in consecutive quarters)	
EAE 130A & EAE 130B	Aircraft Performance & Design and Aircraft Performance & 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 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: [1]		8
EAE 129	Stability & Control of Aerospace Vehicles	
EAE 138	Aircraft Propulsion	
EAE 140	Rocket Propulsion	
EAE 142	Orbital Mechanics	
ENG 188	Science & Technology of Sustainable Power Generation	
EMS 180	Materials in Engineering Design	
EMS 182	Failure Analysis	
EME 134	Vehicle Stability	
EME 152	Computer-Aided Mechanism Design	
EME 161	Combustion & the Environment	
EME 163	Internal Combustion Engines & Future Alternatives	
EME 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 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.