MECHANICAL ENGINEERING

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Mechanical Engineering (ME) is a profession that applies the principles of mathematics, science and engineering for analysis, design, manufacturing, and maintenance of mechanical systems. Mechanical engineers research, develop, design and manufacture engines, machines, and other mechanical devices for the benefit of society. They work on power-producing machines such as automobile and jet engines. They also develop power-using machines such as air-conditioners, robots, machine tools and manufacturing equipment. Mechanical engineers are also at the forefront of newly developed technologies such as bioengineering, nanotechnology, environmental engineering and renewable energy.

Our mechanical engineering curriculum includes study in the following areas:

- Thermal sciences, including thermodynamics, fluid mechanics and heat transfer with applications in the efficient conversion of energy that allows the development of commercial power plants, environmentally friendly lawn mower engines, and cryogenic medical devices used to treat cancer.
- Mechanics and materials, including the analysis of machine elements, materials and dynamics to improve products such as artificial knees, automobile suspensions and space vehicles.
- Design and manufacturing, including application of manufacturing processes and integration of engineering fundamentals from the thermal science, mechanics and materials areas in analysis and synthesis of mechanisms and machinery.

The USD mechanical engineering curriculum is broad-based, hands-on and design-oriented. We emphasize a student-centered education in small classes with a liberal arts foundation. The mechanical engineering program prepares program graduates to work for small or large companies in most industries throughout Southern California, the United States and internationally. Graduates may work in most industries, including aerospace, automotive, bioengineering, environmental, product design and manufacturing industries. The program also prepares graduates for a career in government, to enter graduate school in environmental, product design and manufacturing industries. The program may work in most industries, including aerospace, automotive, bioengineering, nanoengineering, environmental engineering and renewable energy.

Educational Objectives
The mechanical engineering program seeks to develop graduates who are able to:

- Apply their mechanical engineering and broad academic backgrounds in their professional and personal endeavors
- Adapt to evolving job responsibilities
- Communicate effectively
- Contribute and provide leadership in a team environment.

To achieve these objectives, the ME program has been designed to ensure that graduates have achieved the following outcomes including an ability to:

- identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
- apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors
- communicate effectively with a range of audiences
- recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts
- function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives
- develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- acquire and apply new knowledge as needed, using appropriate learning strategies.

Mechanical Engineering Advisory Board
The Mechanical Engineering Advisory Board was established in 2005 with members representing current students, alumni, parents, higher education and local industries. The board, composed of representatives from companies such as Hamilton-Sunstrand, Asymtek, Hewlett-Packard, Trane and others, contributes to the on-going development of the mechanical engineering program, and provides mentorship and internship opportunities to our students.

Requirements for the Mechanical Engineering Major: 147 semester units
Preparation for the Major
The mathematics, science, and engineering courses listed below satisfy the core curriculum requirements in mathematics competency, scientific and technological inquiry, advanced writing, and the level 1 diversity, inclusion and social justice (DISJ) requirement.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 150</td>
<td>Calculus I</td>
<td>4</td>
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<tr>
<td>MATH 151</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 250</td>
<td>Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 310</td>
<td>Applied Mathematics for Science and Engineering I</td>
<td>3</td>
</tr>
<tr>
<td>ISYE 330</td>
<td>Engineering Probability and Statistics</td>
<td></td>
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<tr>
<td>or MATH 315</td>
<td>Applied Probability and Statistics</td>
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</tbody>
</table>
PHYS 270 & 270L Introduction to Mechanics and Mechanics Lab 4
PHYS 271 & 271L Introduction to Electricity and Magnetism and Introduction to Electricity and Magnetism Lab 4
CHEM 151 & 151L General Chemistry I and General Chemistry I Laboratory 4

Additional Math or Science 1 3-4

Engineering Core Requirements (22 units)
MENG 210 Statics 3
ENGR 101 Introduction to Engineering 3
ENGR 102 Introduction to Electromechanical System Design 3
ENGR 103 User-Centered Design 3
ENGR 121 Engineering Programming 3
or COMP 110 Computational Problem Solving 3
or COMP 150 Computer Programming I 3
MENG 260 Introduction to Thermal Sciences 3
ELEC 201 Electrical Circuits 4
ELEC 201L Electrical Circuits Lab 0

Engineering Professional Practice Requirements (12 units)
ECON 101 Principles of Microeconomics 3
or ECON 102 Principles of Macroeconomics 3
or ISYE 220 Engineering Economics 3
PHIL 342 Engineering Ethics 3
COMM 203 Public Speaking 2 3
ENGL 304 Advanced Composition 3

Total Units 67-68

1 The additional Math or Science course should be either MATH 311, or PHYS 272, or CHEM 152, or BIOL 240.
2 ROTC Students may substitute NAVS 201, MILS 301, or SDSU AS 300A for COMM 203 in the engineering program. These classes will not satisfy university core requirements.

Mechanical Engineering Requirements
These courses include units in mechanical engineering science, laboratory, and design. These courses are required by the major:

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<tr>
<th>Code</th>
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<tbody>
<tr>
<td>MENG 300</td>
<td>Applied Thermodynamics</td>
<td>3</td>
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<tr>
<td>MENG 311</td>
<td>Materials Science and Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ISYE 350</td>
<td>Manufacturing Processes</td>
<td>3</td>
</tr>
<tr>
<td>MENG 351</td>
<td>Machine Shop Practices</td>
<td>1</td>
</tr>
<tr>
<td>MENG 352</td>
<td>CAD Practices</td>
<td>1</td>
</tr>
<tr>
<td>MENG 360</td>
<td>Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>MENG 370</td>
<td>Mechanics of Materials</td>
<td>4</td>
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<tr>
<td>&amp; 370L</td>
<td>and Mechanics of Materials Laboratory</td>
<td></td>
</tr>
<tr>
<td>MENG 375</td>
<td>Dynamics</td>
<td>3</td>
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<tr>
<td>MENG 400</td>
<td>Heat Transfer</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 400L</td>
<td>and Heat Transfer Laboratory</td>
<td></td>
</tr>
<tr>
<td>MENG 430</td>
<td>Design of Machine Elements</td>
<td>3</td>
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<tr>
<td>MENG 491</td>
<td>Senior Design Project I</td>
<td>3</td>
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<tr>
<td>MENG 492</td>
<td>Senior Design Project II</td>
<td>3</td>
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<tr>
<td>Mechanical Engineering Simulation Elective 3 3</td>
<td>3</td>
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<tr>
<td>Mechanical Engineering Professional Elective 3 3</td>
<td>12</td>
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Students select one required simulation-based course and four additional mechanical engineering elective courses. A list of approved mechanical engineering electives is available from the chair of mechanical engineering.

Additional Requirements
All mechanical engineering majors must satisfy the core curriculum specified by the university and the Connect Career Readiness Program (https://www.sandiego.edu/engineering/resources/careers/connect).

Required Program of Study: Mechanical Engineering

First Year
Semester I Units
ENGR 101 Introduction to Engineering 3
MATH 150 Calculus I 4
CHEM 151 & 151L General Chemistry I 4
or ENGR 121, COMP 110, or COMP 150 Engineering Programming 3
or
ECON 101, 102, or ISYE 220 Principles of Microeconomics 3-4
or Principles of Macroeconomics 3-4
or Engineering Economics 3-4
or
CC Electives 6

Semester II Units
ENGR 102 or 103 Introduction to Electromechanical System Design 3
or ENGR 121, COMP 110, or COMP 150 Engineering Programming 3
or MATH 151 Calculus II 4
or CHEM 151 & 151L General Chemistry I 4
or ELEC 201 Electrical Circuits 4
or MATH 250 Calculus III 4
or MENG 210 Statics 3
or MENG 260 Introduction to Thermal Sciences 3

Sophomore Year
Semester I Units
ENGR 102 or 103 Introduction to Electromechanical System Design 3
or
MATH 310 Applied Mathematics for Science and Engineering I 3
or
PHYS 271 & 271L Introduction to Electricity and Magnetism 4
or
ECON 101, 102, or ISYE 220 Principles of Microeconomics 3-4
or Principles of Macroeconomics 3-4
or Engineering Economics 3-4
or
CC Electives 3

Semester II Units
ELEC 201 & 201L Electrical Circuits 4
or
MATH 250 Calculus III 4
or MENG 210 Statics 3
or MENG 260 Introduction to Thermal Sciences 3
MENG 210 | STATICS
Units: 3 Repeatability: No
Prerequisites: PHYS 270 and MATH 150
Equilibrium analysis of particles and rigid bodies using vector analysis of forces and moments in two and three dimensions; free body diagrams; friction; analysis of trusses; distributed forces; basics of shear and moment diagrams; centroids; and moments of inertia. Three hours lecture weekly. Fall and spring semesters.

MENG 260 | INTRODUCTION TO THERMAL SCIENCES
Units: 3 Repeatability: No
Prerequisites: MATH 151 and PHYS 270
Introduction to basic engineering thermodynamics, fluid mechanics, and heat transfer. Applications to engineering systems. Three hours lecture weekly. Fall and spring semesters.

MENG 260L | LABORATORY FOR MENG 260
Units: 1
A laboratory course to compliment the lecture material presented in ISYE 260. One three-hour laboratory weekly. Fall semester.

MENG 294 | SPECIAL TOPICS IN MECHANICAL ENGINEERING
Units: 1-4 Repeatability: Yes (Can be repeated for Credit)
Special topics seminar in areas of special interest to mechanical engineering. May be repeated for credit with a different topic.

MENG 299 | INDEPENDENT STUDY
Units: 1-3 Repeatability: Yes (Can be repeated for Credit)
Individual project in creative design and synthesis under the general supervision of a participating professor. Project proposal must be submitted and approved prior to enrollment. May be repeated for credit.

MENG 300 | APPLIED THERMODYNAMICS
Units: 3-4
Prerequisites: MENG 260
Further developments of concepts from classical thermodynamics. Application of laws of thermodynamics to gas and vapor power cycles, mixtures of gases and vapors, and refrigeration cycles. Moist air analysis and chemically reacting systems. Three hours lecture. Fall semester.

MENG 311 | MATERIALS SCIENCE AND ENGINEERING
Units: 3 Repeatability: Yes (Can be repeated for Credit)
Prerequisites: CHEM 151 and CHEM 151L and MATH 151
Basic concepts of material structure and its relation to properties; atomic structure; mechanical properties; engineering applications; introduction to semiconductor materials.
MENG 370 | MECHANICS OF MATERIALS  
Units: 3-4  
Prerequisites: MENG 210  
Corequisites: MENG 370L  
Analytical methods for determining stress and strain, torsion, bending of beams, shearing stress in beams, combined stresses, principal stresses, and deflection in beams. Three hours lecture weekly. Spring semester.

MENG 370L | MECHANICS OF MATERIALS LABORATORY  
Units: 1  
Corequisites: MENG 370  
Laboratory for MENG 370. Three-hour laboratory weekly. Spring semester.

MENG 375 | DYNAMICS  
Units: 3  
Repeatability: No  
Prerequisites: MENG 210  
Analysis of dynamics of particles and rigid bodies using vector methods in two and three dimensions. Topics include kinematics and kinetics of translational and rotational motion, energy and momentum methods. Three hours lecture weekly. Fall semester.

MENG 375L | MECHANICS OF MATERIALS LABORATORY  
Units: 1  
Corequisites: MENG 370  
Laboratory for MENG 375. Three-hour laboratory weekly. Fall semester.

MENG 380 | KINEMATICS AND DESIGN OF MACHINERY  
Units: 3  
Prerequisites: MENG 375  
Kinematics and dynamic analysis of machinery; mechanism synthesis techniques for function, motion, path generators; and design applications with linkages, cams, and gears. Three hours lecture weekly. Spring semester.

MENG 380L | KINEMATICS AND DESIGN OF MACHINERY LABORATORY  
Units: 1  
Core Attributes: Lab  
Corequisites: MENG 380  
Laboratory for MENG 380. Three laboratory weekly. Fall semester.

MENG 390 | HEAT TRANSFER  
Units: 3  
Prerequisites: MENG 360  
Corequisites: MENG 400L  
Heat transfer by conduction, convection, radiation, and combinations thereof. Introduction to heat exchanger analysis and design, along with other applications. Three hours lecture and three-hour laboratory weekly. Fall semester.

MENG 390L | HEAT TRANSFER LABORATORY  
Units: 1  
Core Attributes: Lab  
Corequisites: MENG 400  
Laboratory for MENG 390. Three laboratory weekly. Fall semester.

MENG 410 | ALTERNATIVE ENERGY SYSTEMS  
Units: 3  
Repeatability: Yes (Can be repeated for Credit)  
Prerequisites: MENG 300  
Thermodynamics of traditional fossil fuels and bio fuel combustion. Analysis of solar, wind, wave, and tidal power systems. Introduction to fuel cells and advanced battery technology. Discussion of the current technological limitation of each topic listed above. Three hours of lecture weekly.

MENG 420 | COMPUTER APPLICATIONS IN MECHANICAL ENGINEERING  
Units: 3  
Prerequisites: MATH 250 and MATH 310 and MENG 370 and MENG 352 and (ENGR 121 or COMP 150)  
Mechanical design and analysis using commercially available solid modeling, kinematics, and FEA computer software. Numerical methods and their applications using root solving, optimization, regression analysis, numerical differentiation and integration will be covered. An introduction to finite difference and finite element methods will also be presented. Two hours lecture and one three-hour laboratory weekly. Fall semester.

MENG 430 | DESIGN OF MACHINE ELEMENTS  
Units: 3-4  
Prerequisites: MENG 370  
Analysis and design of mechanical components against failures under steady and fatigue loads. Design applications of various machine elements, such as shafts, bearings, gears, springs, and fasteners. These are integrated into mini-design projects required of all students. Three hours lecture weekly. Spring semester.

MENG 445 | INTRODUCTION TO ROBOTICS  
Units: 3  
Prerequisites: MENG 375  
This course covers introductory materials related to the subject of robotics. The course is designed to encompass theories as well as practices, intended for both the user and the designer of a robotic system. Topics include modeling and analyses of the mechanics of robots, actuators, sensors, and vision systems.

MENG 460 | SYSTEM DYNAMICS AND VIBRATIONS  
Units: 3  
Prerequisites: MENG 375  
Analysis and design of dynamic systems in various engineering domains; modeling of mechanical and electrical systems, free and forced responses, time and frequency domain analysis, applications in isolation and control of mechanical vibrations, and vibration measuring instruments. Three hours lecture weekly. Spring semester.

MENG 460L | SYSTEM DYNAMICS AND VIBRATIONS LABORATORY  
Units: 1  
Prerequisites: MENG 460 (Can be taken Concurrently)  
Laboratory for MENG 460. Three-hour laboratory weekly. Spring semester.

MENG 462 | TOPICS IN FLUID MECHANICS  
Units: 3  
Repeatability: Yes (Can be repeated for Credit)  
Prerequisites: MENG 360  
Additional topics in fluid mechanics, including the differential description of fluid flow, its application to channel flow, pipe flow, and boundary layers, scaling of the equations, methods in computational fluid dynamics, and an introduction to turbulence. Three hours lecture weekly.

MENG 465 | INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS  
Units: 3  
Prerequisites: MENG 360  
Topics in fluid mechanics, including the differential description of fluid flow, its application to channel flow, pipe flow, and boundary layers, scaling of the equations, methods in computational fluid dynamics, and an introduction to turbulence.

MENG 470 | FINITE ELEMENT ANALYSIS  
Units: 3  
Repeatability: No  
Prerequisites: MATH 310 and MENG 351 and MENG 370  
Finite element based solutions to engineering problems with an emphasis on elastostatic problems in structural mechanics. The power and pitfalls associated with the finite element method highlighted through practical modeling assignments. Modeling and practical applications using commercial finite element codes. Three hours lecture weekly.
MENG 491 | SENIOR DESIGN PROJECT I
Units: 3 Repeatability: No
Prerequisites: (MENG 311 or ENGR 311) and ENGL 304 and MENG 351 and MENG 352 (Can be taken Concurrently) and MENG 400 (Can be taken Concurrently) and MENG 400L (Can be taken Concurrently) and MENG 430 (Can be taken Concurrently) and COMM 203 (Can be taken Concurrently)
Mechanical engineering capstone design experience in a simulated industrial environment. Students work in teams, in collaboration with an engineering faculty and/or an engineering professional from industry, on an open-ended design project. This involves designing, construction, testing, and evaluation as well as consideration of issues related to ethics, economics, safety and professional practice. Two-hour lecture and four-hour laboratory weekly.

MENG 491W | SENIOR DESIGN PROJECT I
Units: 4 Repeatability: No
Core Attributes: Writing-Pre F17 CORE
Prerequisites: COMM 203 and ENGR 311 and MENG 351 and MENG 352 and MENG 400 (Can be taken Concurrently) and MENG 430 (Can be taken Concurrently)
This course prepares students to approach an engineering design project in a small team. Topics include project selection, research methods on chosen project, a review of the design process, including concept generation, concept selection, construction, testing, and evaluation, as well written and oral presentation skills. Three-hour lecture recitation and one three-hour laboratory weekly. Fall semester.

MENG 492 | SENIOR DESIGN PROJECT II
Units: 3 Repeatability: No
Core Attributes: Advanced Integration
Prerequisites: MENG 491W or MENG 491
Mechanical engineering capstone design experience in a simulated industrial environment that applies and integrates engineering and nonengineering topics. Students work in teams, in collaboration with an engineering faculty and/or an engineering professional from industry, on an open-ended design project. This involves designing, construction, testing and evaluation as well as consideration of issues related to ethics, economics, safety and professional practice. The course also includes documentation of design project including written reports and oral presentations to multiple audiences.

MENG 494 | SPECIAL TOPICS IN MECHANICAL ENGINEERING
Units: 1-4 Repeatability: Yes (Can be repeated for Credit)
Special topics seminar in areas of special interest to current engineering practice in Mechanical Engineering. May be repeated for credit.

MENG 496 | UNDERGRADUATE RESEARCH
Units: 0.5-3 Repeatability: Yes (Can be repeated for Credit)
Faculty-directed undergraduate research in mechanical engineering. Problem proposal must be submitted and approved prior to enrollment. Written report required. Upper division standing in the EE major. Prior approval by the department chair is required. May be repeated for credit.

MENG 498 | INTERNSHIP/CO-OP EXPERIENCE
Units: 1-3 Repeatability: Yes (Can be repeated for Credit)
Directed upper division level internship/co-operative experience in engineering research, design, development, manufacturing, or the engineering activity. Written report required. Credit not applicable to minimum program graduation requirement. Placement contingent upon approval of participating organization. May be repeated for credit.

MENG 499 | INDEPENDENT STUDY
Units: 1-3 Repeatability: Yes (Can be repeated for Credit)
Individual design or research project under the general supervision of participating professor. Project proposal must be submitted and approved prior to enrollment. May be repeated for credit.