Department of Mechanical Engineering

The Department of Mechanical Engineering offers a Bachelor of Science degree in Mechanical Engineering (ME). The program is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org. Individuals enrolling in this degree program are given the opportunity to develop a strong background in Engineering Science and to learn the analysis, design, and synthesis tools necessary to contribute in traditional and emerging areas of technology.

The department has excellent laboratory facilities where students receive hands-on instruction from faculty members. Computer-aided design (CAD) facilities, including state-of-the-art workstations, are routinely used. Some classes are taught by adjunct faculty from local industries, giving students the opportunity to interact with engineering professionals engaged in relevant engineering practice.

Because of the broad engineering training in this program, graduates may find employment in many industries, including companies or government agencies associated with aerospace, automotive, energy, petroleum, manufacturing, biomedical engineering, and research.

Bachelor of Science Degree in Mechanical Engineering

The Bachelor of Science degree in Mechanical Engineering offers students the opportunity to prepare for careers in traditional, new, and emerging technologies related to the practice of Mechanical Engineering, which is a versatile and broadly-based engineering discipline. Mathematics and basic sciences, such as physics and chemistry, form the foundation of mechanical engineering, which requires an understanding of diverse subject areas, such as solid and fluid mechanics, thermal sciences, mechanical design, structures, material selection, manufacturing processes and systems, mechanical systems and control, and instrumentation.

The Mechanical Engineering curriculum provides education and basic engineering training through the required coursework. Students may develop a degree of specialization and depth through the selection of technical elective courses. The design experience is integrated throughout the program. Development of open-ended, problem-solving skills is a part of many mechanical engineering courses. Design projects with formal report writing are included in many courses. In addition, a substantial portion of all technical elective courses is devoted to the design of systems and components. A capstone design sequence at the senior level provides an opportunity to apply and integrate the knowledge gained throughout the curriculum to the development of an instructor-approved project.

The laboratory requirements are designed to provide hands-on experience in basic measurement and instrumentation equipment and the application of classroom theory. Students may receive additional hands-on experiences by selecting technical elective courses with laboratory components.

Opportunities exist for students to participate in research and design projects. All students are eligible to participate in undergraduate research, through the independent study courses. Students also have an opportunity to participate in an approved co-op program and may receive up to 3 semester credit hours for their experience.

Program Educational Objectives

The Mechanical Engineering Program prepares students to attain the following program educational objectives after graduation:

1. Have engineering or other careers in industry, government, and/or will pursue advanced graduate or professional degrees.
2. Apply their engineering knowledge and skills to their professional careers.
3. Continue to advance their knowledge, communication and leadership skills using technology, continuing education, problem solving, and by serving technical or professional societies.
4. Apply their understanding of societal, environmental, and ethical issues to their professional activities.

Student Outcomes

Graduates of the UTSA Mechanical Engineering Program will demonstrate the following:

a. an ability to apply knowledge of mathematics, science, and engineering
b. an ability to design and conduct experiments, as well as to analyze and interpret data
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d. an ability to function on multidisciplinary teams
e. an ability to identify, formulate, and solve engineering problems
f. an understanding of professional and ethical responsibility
g. an ability to communicate effectively
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i. a recognition of the need for, and an ability to engage in life-long learning
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

The minimum number of semester credit hours required for this degree is 128, at least 39 of which must be at the upper-division level. All candidates for this degree must fulfill the Core Curriculum requirements, the General Engineering requirements, and the degree requirements, listed below. A minimum grade of “C-” or better is required for all mathematics, science, Engineering (EGR), and Mechanical Engineering (ME) courses in the curriculum.

Department of Mechanical Engineering
Core Curriculum Requirements (42 semester credit hours)

Students seeking the Bachelor of Science degree in Mechanical Engineering must fulfill the University Core Curriculum requirements in the same manner as other students. The courses listed below satisfy both major requirements and Core Curriculum requirements; however, if these courses are taken to satisfy both requirements, then students may need to take additional courses in order to meet the minimum number of semester credit hours required for the degree.

MAT 1214 may be used to satisfy the core requirement in Mathematics, as well as one of the General Engineering requirements. PHY 1943 and PHY 1963 may be used to satisfy the core requirement in Life and Physical Sciences, as well as two of the General Engineering requirements. EGR 1403 may be used to satisfy the core requirement in the Component Area Option.

Core Curriculum Component Area Requirements (http://catalog.utsa.edu/undergraduate/bachelorsdegeregulations/degreerequirements/corecurriculumcomponentarearequirements)

First Year Experience Requirement 3
Communication 6
Mathematics 3
Life and Physical Sciences 6
Language, Philosophy and Culture 3
Creative Arts 3
American History 6
Government-Political Science 6
Social and Behavioral Sciences 3
Component Area Option 3
Total Credit Hours 42

General Engineering Requirements

Students seeking the Bachelor of Science degree in Mechanical Engineering must complete the following 22 semester credit hours:

CHE 1103 General Chemistry I 3
EGR 2323 Applied Engineering Analysis I 3
MAT 1214 Calculus I 4
MAT 1224 Calculus II 4
or EGR 1324 Calculus II for Engineers
PHY 1943 & PHY 1951 Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory 4
PHY 1963 & PHY 1971 Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory 4

Total Credit Hours 22

Gateway Courses

Students pursuing the Bachelor of Science degree in Mechanical Engineering must successfully complete each of the following Gateway Courses with a grade of “C-” or better in no more than two attempts. A student who is unable to successfully complete these courses within two attempts, including dropping a course with a grade of “W” or taking an equivalent course at another institution, will be required to change his or her major.

EGR 2103 Statics
EGR 2323 Applied Engineering Analysis I
EGR 2513 Dynamics

Degree Requirements

Students seeking the Bachelor of Science degree in Mechanical Engineering must complete the following 42 semester credit hours, as well as the Core Curriculum requirements and General Engineering requirements:

A. Required foundation and general mechanical engineering courses:
EE 2213 Electric Circuits and Electronics 3
EGR 2103 Statics 3
EGR 2513 Dynamics 3
EGR 3323 Applied Engineering Analysis II 3
ME 1403 Engineering Practice and Graphics 3
ME 2173 Numerical Methods 3
ME 3113 Measurements and Instrumentation 3
ME 3244 Materials Engineering and Laboratory 4
ME 3263 Manufacturing Engineering 3
ME 3293 Thermodynamics I 3
ME 3543 Dynamic Systems and Control 3
ME 3663 Fluid Mechanics 3
ME 3813 Mechanics of Solids 3
ME 3823 Machine Element Design I 3
ME 4293 Thermodynamics II 3
ME 4313 Heat Transfer 3
ME 4543 Mechatronics 3
ME 4733 Mechanical Engineering Laboratory 3
ME 4803 Senior Design I 3
ME 4813 Senior Design II 3

B. Mechanical Engineering elective courses
Select 9 semester credit hours of Mechanical Engineering elective courses. Students are encouraged to choose courses from a specific group listed below. Students may also select courses to earn a Certificate in Oil/Gas.

Energy, Thermal and Fluid Systems
ME 4183 Compressible Flow and Propulsion Systems
ME 4323 Thermal Systems Design
ME 4343 Heating, Air Conditioning, and Refrigeration Design
ME 4593 Alternative Energy Sources
ME 4613 Power Plant System Design
ME 4623 Internal Combustion Engines

Manufacturing Engineering and Systems
ME 4563 Computer Integrated Manufacturing
ME 4573 Facilities Planning and Design
ME 4583 Enterprise Process Engineering

Design and Control of Mechanical Systems
ME 3323 Mechanical Vibration
ME 3513 Mechanism Design
### B.S. in Mechanical Engineering – Recommended Four-Year Academic Plan

#### First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>AIS 1203</td>
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<td>MAT 1214</td>
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<td>ME 1403</td>
<td>3</td>
</tr>
<tr>
<td>WRC 1013</td>
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<tr>
<td>MAT 1224</td>
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<td>PHY 1943</td>
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<td>POL 1013</td>
<td>3</td>
</tr>
<tr>
<td>WRC 1023</td>
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#### Second Year

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<thead>
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<th>Fall</th>
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<tr>
<td>ME 4603</td>
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</tr>
<tr>
<td>ME 4963</td>
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<tr>
<td>ME 4643</td>
<td>3</td>
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<tr>
<td>ME 4653</td>
<td>3</td>
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<tr>
<td>ME 4683</td>
<td>3</td>
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</tbody>
</table>

#### Additional engineering elective courses

- EGR 4993 Honors Research ¹
- ME 4953 Special Studies in Mechanical Engineering ²

#### C. 3 semester credit hours of approved mathematics or basic science elective courses. A list of acceptable courses is available in Engineering Advising.

Total Credit Hours: 64

¹ With prior approval, these courses may be used as a technical elective.
² Graduate courses require approval. Forms are available from your academic advisor.

### Certificate in Oil/Gas

The Certificate in Oil/Gas is designed to prepare mechanical engineering degree-seeking students and non-degree-seeking students with mechanical engineering background with the fundamental engineering knowledge necessary for successful careers in Oil/Gas Industry.

It certifies to employers that students awarded the certificate have completed coursework essential to Oil/Gas industry.
Eligibility requirements:

- Meet the prerequisite courses for the certificate program (refer to course descriptions in the UTSA Undergraduate Catalog).

Students pursuing an Oil/Gas certificate must complete 15 semester credit hours as follows:

A. Required courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>ME 3113</td>
<td>Measurements and Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>ME 3823</td>
<td>Machine Design I</td>
<td>3</td>
</tr>
</tbody>
</table>

B. ME Electives. Three courses (9 semester credit hours) selected from the following list:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 3323</td>
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<td>ME 4323</td>
<td>Thermal Systems Design</td>
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<tr>
<td>ME 4373</td>
<td>Separation Processes</td>
</tr>
<tr>
<td>ME 4643</td>
<td>Pressure Vessel and Piping Design</td>
</tr>
<tr>
<td>ME 4653</td>
<td>Oil and Gas Engineering and Reservoir Geomechanics</td>
</tr>
<tr>
<td>ME 4683</td>
<td>Corrosion Engineering</td>
</tr>
</tbody>
</table>

Total Credit Hours 15

1 Those students who have transferred equivalent required and elective courses, as listed above, from other institutions may complete the certificate program by taking 15 semester credit hours of ME courses listed above.

To earn an Oil/Gas certificate, students must satisfy the following requirements:

1. Complete all the requirements of the certificate program.
2. Receive a grade of "C-" or better in each course used to satisfy the requirements of the certificate program.
3. Achieve at least a 2.5 grade point average (on a 4.0 scale) in all courses used to satisfy the requirements of the certificate program.

Undergraduates who are currently enrolled in the baccalaureate degree program in mechanical engineering or enrolled as non-degree-seeking students and who wish to earn an undergraduate Certificate in Oil/Gas are eligible to seek enrollment in the certificate program. An undergraduate wishing to enroll in the certificate program should contact the Mechanical Engineering Certificate Program Advisor and request permission to enter into the program. Approval is needed to enter into a certificate program and must be granted by the Certificate Program Advisor and the Dean of the College of Engineering.

Students not currently admitted to UTSA who wish to earn an undergraduate Certificate in Oil/Gas will be required to apply for admission to UTSA as non-degree-seeking, special students at the undergraduate level, and indicate in the application process their desire to pursue the requirements for an undergraduate Oil/Gas certificate program. Applicants will be required to meet University admission requirements for special students at the undergraduate level.

Students who are pursuing a certificate as non-degree-seeking students will not be eligible for financial aid or Veterans Administration educational benefits.

Graduate students may enroll in the undergraduate certificate programs, provided they meet the requirements for enrollment in a graduate certificate program.

Mechanical Engineering (ME) Courses

ME 1403. Engineering Practice and Graphics. (2-3) 3 Credit Hours. (TCCN = ENGR 1304)
Prerequisites: MAT 1093 and completion of or concurrent enrollment in WRC 1013. Introduction to engineering practice and engineering graphics: geometric constructions, multi-view drawing, dimensioning, sections, pictorials and auxiliary views. Computer-aided design, generation of mechanical drawings, and design projects. (Formerly ME 1402. Credit cannot be earned for both ME 1402 and ME 1403.)

ME 2173. Numerical Methods. (2-3) 3 Credit Hours.
Prerequisite: EGR 2323. Introduction to numerical algorithms to solve science and engineering problems. Construction and derivation of numerical algorithm as well as application limits. Various numerical approaches in finding roots of linear and non-linear functions, regression analysis, interpolation, curve fitting procedures, differentiation, integration, solutions of system of linear algebraic equations, solutions of ordinary differential equations and boundary value problems. Introduction to structured programming (MATLAB), including error estimation, and stability. (Formerly ME 3173. Credit cannot be earned for both ME 3173 and ME 2173.) Generally offered: Fall, Spring, Summer.

ME 3113. Measurements and Instrumentation. (2-3) 3 Credit Hours.

ME 3244. Materials Engineering and Laboratory. (3-3) 4 Credit Hours.
Prerequisites: CHE 1103 and EGR 2103. Fundamentals in atomic structure and microstructures, properties, and mechanical behavior of engineering materials, such as metals, polymers, and ceramics. Investigation of the mechanical properties of engineering materials, with emphasis on metals, sample preparation, and metallography. (Formerly ME 3241 and ME 3243. Credit cannot be earned for ME 3244 and ME 3241/ME 3243. Prior completion of ME 3241 and ME 3243 can be substituted for this course.) Generally offered: Fall, Spring, Summer.

ME 3263. Manufacturing Engineering. (3-1) 3 Credit Hours.
Prerequisites: EGR 2513 and ME 3244. An integrated coverage of mechanical properties of materials, tolerances, measurement and quality assurance, manufacturing processes, and manufacturing systems, fundamental definitions, design for manufacturing, and mathematical models, hands-on applications related to measurement and manufacturing processes. (Formerly titled "Materials Processing.") Generally offered: Fall, Spring, Summer.

ME 3293. Thermodynamics I. (3-0) 3 Credit Hours.
Prerequisites: EGR 2103 and MAT 1224. Heat, work, equations of state, thermodynamics systems, control volume, first and second laws of thermodynamics, applications of the laws of thermodynamics, reversible and irreversible processes, and introduction to basic thermodynamic cycles. (Same as CME 3103. Credit cannot be earned for both ME 3293 and CME 3103.) Generally offered: Fall, Spring, Summer.

ME 3323. Mechanical Vibration. (3-0) 3 Credit Hours.
Prerequisites: EGR 2323 and EGR 2513. Free and forced vibrations, single and multiple degree of freedom systems, damping, matrix methods, time-domain and frequency-domain. Applications in the transmission and control of vibration. Generally offered: Spring.
ME 3513. Mechanism Design. (3-0) 3 Credit Hours.
Prerequisites: EGR 2513 and ME 1403. Introduction to mechanisms, graphical and linear analytical methods for kinematic synthesis of mechanisms; design of cam follower; gearing fundamentals, ordinary and planetary gear trains; and computer-aided design projects.

ME 3543. Dynamic Systems and Control. (3-0) 3 Credit Hours.
Prerequisites: EE 2213, EGR 2513 and EGR 3323. Introduction to modeling and control of dynamic physical systems, analysis and design of control systems for mechanical, electrical, manufacturing, fluid, and thermal systems. (Formerly ME 4522 and ME 4523. Credit cannot be earned for more than one of the following: ME 3543, ME 4522, or ME 4523.) Generally offered: Fall, Spring, Summer.

ME 3663. Fluid Mechanics. (3-0) 3 Credit Hours.
Prerequisites: EGR 2323, EGR 2513, and completion of or concurrent enrollment in ME 3293. Fluid properties, fluid statics, integral and differential analysis of fluid flow, viscous laminar and turbulent flow in conduits, dimensional analysis, boundary layer concepts, drag and lift. Generally offered: Fall, Spring, Summer.

ME 3813. Mechanics of Solids. (3-0) 3 Credit Hours.
Prerequisite: EGR 2103. Internal forces and deformations in solids, stress, strain and their relations, torsion, stresses and deflections in beams, and elastic behavior of columns. (Credit cannot be earned for both ME 3813 and BME 3223.) Generally offered: Fall, Spring, Summer.

ME 3823. Machine Element Design I. (3-0) 3 Credit Hours.
Prerequisites: ME 1403, ME 3244 (or ME 3241 and ME 3243 in previous catalogs), and ME 3813. Introduction to design of machine elements, pressurized cylinders, press and shrink fits, contact stress, static and fatigue theories of failure, shafts and shaft components, welded and bolted connections, mechanical springs, and computer-aided design projects. (Formerly ME 4423. Credit cannot be earned for both ME 3823 and ME 4423.) Generally offered: Fall, Spring, Summer.

ME 4173. High Performance Computing. (3-0) 3 Credit Hours.
Prerequisite: ME 2173. Introduction to UNIX (login, shell scripts, editors, file permissions), visualization (software tools, data formats), Parallel programming (numerical libraries, Message Passing Interface, Trilinos, GPGPU programming).

ME 4183. Compressible Flow and Propulsion Systems. (3-0) 3 Credit Hours.
Prerequisites: ME 3293 and ME 3663. Application of mass, energy, and force balance to compressible fluids, analysis of one-dimensional steady flow, isentropic flow, adiabatic flow, flow with heat addition, supersonic flow, and shock waves. Introduction to the analysis and design of air-breathing engines for aeronautical transportation. (Formerly EGR 4183. Credit cannot be earned for both ME 4183 and EGR 4183.).

ME 4243. Intermediate Materials Engineering. (3-0) 3 Credit Hours.
Prerequisites: ME 3244 (or ME 3241 and ME 3243 in previous catalogs) and ME 3813. Selected topics in fabrication and processing of materials; macroscopic and microscopic aspects of the mechanical behavior of metals, ceramics, polymers and composites; Failure mode analysis in materials; optimization of material selection in the design process.

ME 4293. Thermodynamics II. (3-0) 3 Credit Hours.
Prerequisite: ME 3293. Energy and availability analysis, reactive and nonreactive mixtures, moist air properties, psychometric systems and analysis, vapor and gas power cycles, refrigeration and heat-pump cycles, thermodynamic relations, and chemical equilibria. Generally offered: Fall, Spring.

ME 4313. Heat Transfer. (3-0) 3 Credit Hours.
Prerequisites: EGR 3323, ME 2173 and ME 3663. Generalized potential distribution and gradients, and heat transfer, including transient and steady state conduction, forced and free convection, radiation, and heat exchanger analysis. Generally offered: Fall, Spring, Summer.

ME 4323. Thermal Systems Design. (3-0) 3 Credit Hours.
Prerequisite: ME 4313. Application of basic thermodynamics, fluid mechanics, heat transfer, and computer methods to the design of heat exchangers, coils, fans, pumps, and thermal energy systems.

ME 4343. Heating, Air Conditioning, and Refrigeration Design. (3-0) 3 Credit Hours.
Prerequisites: ME 4293 and ME 4313. Moist air properties, human comfort, solar radiation, heating loads, design selection, construction, and operation of air conditioning equipment, and duct design.

ME 4373. Separation Processes. (3-0) 3 Credit Hours.
Prerequisites: ME 4293 and ME 4313. Rate- and equilibrium-controlled separation, mass transfer, phase equilibrium, absorption, distillation, extraction, adsorption and membranes.

ME 4433. Machine Element Design II. (3-0) 3 Credit Hours.
Prerequisite: ME 3823. Design of spur, helical, bevel and worm gears; journal and rolling bearings; design of couplings, clutches, brakes, and flywheels; and computer-aided design project.

ME 4503. Lean Manufacturing and Enterprise Engineering. (3-0) 3 Credit Hours.
Prerequisite: ME 3263. Concepts and applications of Lean Systems applied to manufacturing and non-manufacturing environments. Topics include lean fundamentals and various tools and methodologies for transformation of companies and organizations into globally competitive enterprises. Team project on Value Streaming Mapping analysis of processes in real settings is required.

ME 4543. Mechatronics. (2-3) 3 Credit Hours.
Prerequisite: ME 3113. Modeling and analysis of electrical (resistors, capacitors, inductors, diodes, transistors, operational amplifiers, combinational logic and sequential logic) and mechanical systems (spring mass damper), data acquisition and measurements, sensors, actuators, and micro-controller programming. A lab component with emphasis on building electrical circuits, data acquisition using LabVIEW, and integration of sensors, actuators, and micro-controller programming (Arduino) to create a mechatronics system. Generally offered: Fall, Spring.

ME 4553. Automotive Vehicle Dynamics. (3-0) 3 Credit Hours.
Prerequisites: EGR 2323 and EGR 2513. Dynamics and control of automotive systems, handling, tires, suspension, steering, and aerodynamic forces.

ME 4563. Computer Integrated Manufacturing. (3-0) 3 Credit Hours.
Prerequisite: ME 3263. Fundamental concepts and models related to computer-aided design, computer-aided process planning, computer-aided manufacturing, production planning and scheduling, and manufacturing execution systems. Laboratory work includes computer-aided applications and programming of automated production equipment.

ME 4573. Facilities Planning and Design. (3-0) 3 Credit Hours.
Prerequisite: ME 3263. Product, process, and schedule design, flow, space, and activity relationships, material handling, layout planning models and design algorithms, and warehouse operations.
ME 4583. Enterprise Process Engineering. (3-0) 3 Credit Hours.
Prerequisite: ME 3263. Fundamental concepts, methodologies, and tools for the design, engineering and continuous improvement of enterprises. Topics include Six Sigma for process design and improvement, lean manufacturing fundamentals, value-stream mapping, performance evaluation, and other contemporary enterprise process engineering approaches. Generally offered: Fall.

ME 4593. Alternative Energy Sources. (3-0) 3 Credit Hours.
Prerequisites: ME 4293 and ME 4313. Solar, nuclear, wind, hydrogen, and geothermal energy sources. Resources, production, utilization, economics, sustainability, and environmental considerations. (Formerly ME 3593. Credit cannot be earned for both ME 3593 and ME 4593.)

ME 4603. Finite Element Analysis. (3-0) 3 Credit Hours.
Prerequisites: EGR 3323, ME 2173 and ME 3823. Finite element method fundamentals, advanced geometric modeling of mechanical components and systems, and finite element modeling of components.

ME 4613. Power Plant System Design. (3-0) 3 Credit Hours.
Prerequisites: ME 4293 and ME 4313. Application of thermodynamics and fluid mechanics to the design of vapor and gas-turbine power plant systems including boilers, condensers, turbines, pumps, compressors, and cooling towers.

ME 4623. Internal Combustion Engines. (3-0) 3 Credit Hours.
Prerequisites: ME 4293 and ME 4313. Application of thermodynamic cycles in design, analysis, and modeling of internal combustion engines including spark-ignition and compression-ignition cycles, thermochemistry, fuels, combustion, emissions, and pollution.

ME 4643. Pressure Vessel and Piping Design. (3-0) 3 Credit Hours.
Prerequisites: ME 3663 and ME 3813. ASME Section XIII Boiler and Pressure Vessel code, inspection, maintenance, repair, and modification of pressure vessels. Piping design and construction.

ME 4653. Oil and Gas Engineering and Reservoir Geomechanics. (3-0) 3 Credit Hours.
Prerequisites: ME 3663 and ME 3813. Introduction to the oil and gas industry, Measurement; deformation mechanisms in rock; rock fracture description and analysis; wellbore stresses and failure; wellbore stability analysis; fault stability analysis; depletion-induced reservoir deformation; and hydraulic fracturing.

ME 4663. Corrosion Engineering. (3-0) 3 Credit Hours.
Prerequisite: ME 3244. Principles of electrochemistry, fundamentals of the environmental degradation of materials, corrosion thermodynamics and kinetics, corrosion phenomenology, and corrosion control and prevention.

ME 4723. Reliability and Quality Control in Engineering Design. (3-0) 3 Credit Hours.
Prerequisite: ME 3113. Introduction to statistical methods in reliability and probabilistic engineering design methodology, statistical quality control and inspection, life prediction and testing, and design optimization. Generally offered: Fall.

ME 4733. Mechanical Engineering Laboratory. (2-3) 3 Credit Hours.
Prerequisites: ME 3113, ME 3543, and ME 4293. Completion of or concurrent enrollment in ME 4313 is required. Transducers and signal conditioning, strain, force, acceleration, controls, vibration, rotating machinery, fluid flow, heat transfer, thermodynamics, internal combustion engines, and design of experiments. (Formerly ME 4702. Credit cannot be earned for ME 4702 and ME 4733. Prior completion of ME 4702 and ME 4802 can be substituted for this course.) Generally offered: Fall, Spring.

ME 4773. Robotics. (3-0) 3 Credit Hours.
Prerequisite: ME 2173. Kinematics, dynamics, planning and control of mobile robots and manipulators. Special topics may include legged robots, soft robots, climbing robots, advanced control methods, image processing, computer vision, estimation. A LEGO-based laboratory with emphasis on prototyping robotic systems for practical applications.

ME 4803. Senior Design I. (3-0) 3 Credit Hours.
Prerequisites: ME 3113, ME 3263, ME 3543, ME 3663, ME 3823, and ME 4293. Completion of or concurrent enrollment in ME 4313, ME 4543 and ME 4733 required. Design project proposals, computer-aided synthesis, analysis, and modeling of an open-ended problem development and presentation of conceptual designs. Industrial cooperation is encouraged. This course, as well as ME 4313, ME 4543, and ME 4733, must be completed with a grade of "C-" or better to serve as prerequisites for ME 4813. (Formerly ME 4811 and ME 4812. Credit cannot be earned for more than one of the following: ME 4803, ME 4811, or ME 4812.)

ME 4813. Senior Design II. (2-3) 3 Credit Hours.
Prerequisites: ME 4313, ME 4543, ME 4733, and ME 4803. Development of a working design of an instructor-approved design project using computer-aided synthesis, analysis, modeling, and optimization methods. Industrial cooperation encouraged. Considerations of safety, reliability, environmental, and economic constraints, and ethical and social impacts. Generally offered: Fall, Spring.

ME 4911. Independent Study. (0-0) 1 Credit Hour.
Prerequisite: Permission in writing (form available) from the instructor, the student’s advisor, the Department Chair, and Dean of the College. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours of independent study, regardless of discipline, will apply to a bachelor’s degree.

ME 4912. Independent Study. (0-0) 2 Credit Hours.
Prerequisite: Permission in writing (form available) from the instructor, the student’s advisor, the Department Chair, and Dean of the College. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours of independent study, regardless of discipline, will apply to a bachelor’s degree.

ME 4913. Independent Study. (0-0) 3 Credit Hours.
Prerequisite: Permission in writing (form available) from the instructor, the student’s advisor, the Department Chair, and Dean of the College. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours of independent study, regardless of discipline, will apply to a bachelor’s degree.

ME 4953. Special Studies in Mechanical Engineering. (3-0) 3 Credit Hours.
Prerequisite: Will depend on the topic. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when topics vary, but not more than 9 semester credit hours, regardless of discipline, will apply to a bachelor’s degree. Generally offered: Fall, Spring.

ME 4963. Mechanical Engineering Applications to Biomedical Systems. (3-0) 3 Credit Hours.
Prerequisites: EGR 2513, ME 3663 and ME 3813. Applications of dynamics, solid mechanics and fluid mechanics to biomedical systems. (Formerly titled “Bioengineering”).