DEPARTMENT OF MECHANICAL ENGINEERING

The Department of Mechanical Engineering offers a Bachelor of Science degree in Mechanical Engineering (ME). The program is currently accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org (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 increased specialization and depth through the selection of technical elective courses. 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 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 student outcomes. Attainment of these outcomes prepares graduates to enter the professional practice of engineering.

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. An ability to 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
3. An ability to communicate effectively with a range of audiences
4. An ability to 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
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

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.

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.
Engineering must complete the following semester credit hours, as well as the Core Curriculum requirements and General Engineering requirements:

A. Required foundation and general mechanical engineering courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>EE 2213</td>
<td>Electric Circuits and Electronics</td>
<td>3</td>
</tr>
<tr>
<td>EGR 2103</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>EGR 2513</td>
<td>Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>EGR 3323</td>
<td>Applied Engineering Analysis II</td>
<td>3</td>
</tr>
<tr>
<td>ME 1403</td>
<td>Engineering Practice and Graphics</td>
<td>3</td>
</tr>
<tr>
<td>ME 2173</td>
<td>Numerical Methods</td>
<td>3</td>
</tr>
<tr>
<td>ME 3113</td>
<td>Measurements and Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>ME 3241</td>
<td>Materials Engineering Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ME 3243</td>
<td>Materials Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ME 3263</td>
<td>Manufacturing Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ME 3293</td>
<td>Thermodynamics I</td>
<td>3</td>
</tr>
<tr>
<td>ME 3541</td>
<td>Dynamics and Controls Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ME 3543</td>
<td>Dynamic Systems and Control</td>
<td>3</td>
</tr>
<tr>
<td>ME 3663</td>
<td>Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>ME 3813</td>
<td>Mechanics of Solids</td>
<td>3</td>
</tr>
<tr>
<td>ME 3823</td>
<td>Machine Element Design I</td>
<td>3</td>
</tr>
<tr>
<td>ME 4293</td>
<td>Thermodynamics II</td>
<td>3</td>
</tr>
<tr>
<td>ME 4312</td>
<td>Thermal and Fluids Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>ME 4313</td>
<td>Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>ME 4543</td>
<td>Mechatronics</td>
<td>3</td>
</tr>
<tr>
<td>ME 4801</td>
<td>Manufacturing Practices Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>ME 4812</td>
<td>Senior Design I</td>
<td>2</td>
</tr>
<tr>
<td>ME 4813</td>
<td>Senior Design II</td>
<td>3</td>
</tr>
</tbody>
</table>

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 partially satisfy the requirements of a certificate in one of the following areas: 1) Aerospace Engineering; 2) Industrial and Manufacturing Engineering; or 3) Oil/Gas. For detailed requirements, see the Certificates section of the Mechanical Engineering program.

Aerospace Engineering

<table>
<thead>
<tr>
<th>Course</th>
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<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>ME 3323</td>
<td>Mechanical Vibration</td>
<td></td>
</tr>
<tr>
<td>ME 4183</td>
<td>Compressible Flow and Propulsion Systems</td>
<td></td>
</tr>
<tr>
<td>ME 4603</td>
<td>Finite Element Analysis</td>
<td></td>
</tr>
<tr>
<td>ME 4723</td>
<td>Reliability and Quality Control in Engineering Design</td>
<td></td>
</tr>
<tr>
<td>ME 4953</td>
<td>Special Studies in Mechanical Engineering (when topic is Aerodynamics)</td>
<td></td>
</tr>
<tr>
<td>ME 4953</td>
<td>Special Studies in Mechanical Engineering (when topic is Propulsion)</td>
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</tr>
<tr>
<td>ME 4953</td>
<td>Special Studies in Mechanical Engineering (when topic is Astrodynamics)</td>
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</table>

Design and Control of Mechanical Systems

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 3323</td>
<td>Mechanical Vibration</td>
<td></td>
</tr>
<tr>
<td>ME 3513</td>
<td>Mechanism Design</td>
<td></td>
</tr>
<tr>
<td>ME 4553</td>
<td>Automotive Vehicle Dynamics</td>
<td></td>
</tr>
<tr>
<td>ME 4723</td>
<td>Reliability and Quality Control in Engineering Design</td>
<td></td>
</tr>
<tr>
<td>ME 4773</td>
<td>Robotics</td>
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</tbody>
</table>

Energy, Thermal and Fluid Systems

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
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</tr>
</tbody>
</table>
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

Industrial and Manufacturing Engineering
EGR 3713  Engineering Economic Analysis
ME 4503  Lean Manufacturing and Enterprise Engineering
ME 4563  Computer Integrated Manufacturing
ME 4573  Facilities Planning and Design
ME 4723  Reliability and Quality Control in Engineering Design
ME 4773  Robotics
ME 4953  Special Studies in Mechanical Engineering (when topic is Operations Research Quality)
ME 4953  Special Studies in Mechanical Engineering (when topic is Systems Modeling and Analysis)

Mechanics and Materials
ME 4243  Intermediate Materials Engineering
ME 4603  Finite Element Analysis
ME 4963  Mechanical Engineering Applications to Biomedical Systems

Oil and Gas
EGR 3713  Engineering Economic Analysis
ME 3323  Mechanical Vibration
ME 4232  Thermal Systems Design
ME 4373  Separation Processes
ME 4593  Alternative Energy Sources
ME 4603  Finite Element Analysis
ME 4643  Pressure Vessel and Piping Design
ME 4653  Oil and Gas Engineering and Reservoir Geomechanics
ME 4683  Corrosion Engineering

Additional engineering elective courses
EGR 3303  Engineering Co-op
EGR 4993  Honors Research
ME 4173  High Performance Computing
ME 4913  Independent Study
ME 4953  Special Studies in Mechanical Engineering

Graduate Courses in Mechanical Engineering
MAT 3103  Data Analysis and Interpretation
PHY 2103  Modern Physics
PHY 3203  Classical Mechanics I
STA 2303  Applied Probability and Statistics for Engineers
STA 3003  Applied Statistics

Total Credit Hours 73

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.

B.S. in Mechanical Engineering – Recommended Four-Year Academic Plan

First Year

Fall  Credit Hours
AIS 1203  Academic Inquiry and Scholarship (core) 3
CHE 1103  General Chemistry I 3
MAT 1214  Calculus I (core and major) 4
ME 1403  Engineering Practice and Graphics 3
WRC 1013  Freshman Composition I (core) 3
Credit Hours 16

Spring  Credit Hours
MAT 1224  Calculus II 4
PHY 1943  Physics for Scientists and Engineers I (core and major) 3
PHY 1951  Physics for Scientists and Engineers I Laboratory 1
POL 1013  Introduction to American Politics (core) 3
WRC 1023  Freshman Composition II (core) 3
American History core 3
Credit Hours 17

Second Year

Fall  Credit Hours
EGR 2103  Statics 3
EGR 2323  Applied Engineering Analysis I 3
PHY 1963  Physics for Scientists and Engineers II (core and major) 3
PHY 1971  Physics for Scientists and Engineers II Laboratory 1
EGR 1403  Technical Communication (or other core option) 3
Math/Science Elective 3
Credit Hours 16

Spring  Credit Hours
EE 2213  Electric Circuits and Electronics 3
EGR 2513  Dynamics 3
EGR 3323  Applied Engineering Analysis II 3
ME 3241  Materials Engineering Laboratory 1
ME 3243  Materials Engineering 3
ME 3293  Thermodynamics I 3
Credit Hours 16

C. 3 semester credit hours of approved mathematics or basic science elective courses, selected from the following list:

BIO 1233  Contemporary Biology I
BIO 1243  Contemporary Biology II
BIO 1404  Biosciences I
BIO 2003  Biology of Human Reproduction
CHE 1113  General Chemistry II
CHE 2063  Organic Chemistry I
ES 2013  Introduction to Environmental Science I
GEO 1123  Life Through Time
MAT 3013  Foundations of Mathematics
### Third Year

#### Fall
- **ME 2173** Numerical Methods 3
- **ME 3113** Measurements and Instrumentation 3
- **ME 3663** Fluid Mechanics 3
- **ME 3813** Mechanics of Solids 3
- **ME 4293** Thermodynamics II 3
- Language, Philosophy & Culture core 3

  **Credit Hours:** 18

#### Spring
- **ME 3263** Manufacturing Engineering 3
- **ME 3541** Dynamics and Controls Laboratory 1
- **ME 3543** Dynamic Systems and Control 3
- **ME 3823** Machine Element Design I 3
- **ME 4313** Heat Transfer 3
- Creative Arts core 3

  **Credit Hours:** 16

### Fourth Year

#### Fall
- **ME 4312** Thermal and Fluids Laboratory 2
- **ME 4543** Mechatronics 3
- **ME 4801** Manufacturing Practices Laboratory 1
- **ME 4812** Senior Design I 2
- **POL 1133 or POL 1213** or Civil Rights in Texas and America 3
- ME Technical elective 3

  **Credit Hours:** 15

#### Spring
- **ME 4813** Senior Design II 3
- ME Technical elective 3
- American History core 3
- Social and Behavioral Sciences core 3

  **Credit Hours:** 15

  **Total Credit Hours:** 128

### Certificate in Aerospace Engineering

The Certificate in Aerospace Engineering is designed to prepare degree-seeking students or degree holders in mechanical engineering or related fields with the fundamental engineering knowledge necessary for successful careers in the aerospace industry. It certifies to employers that students awarded the certificate have completed coursework essential to successful in entry-level positions in aerospace.

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

Students pursuing an Aerospace Engineering certificate must complete 15 semester credit hours as follows:

A. **Required courses:**
- **ME 3663** Fluid Mechanics 3

B. **ME electives.** A minimum of three courses (9 semester credit hours) selected from the following list:
- **ME 4183** Compressible Flow and Propulsion Systems 9
- **ME 4953** Special Studies in Mechanical Engineering (SS in Aerodynamics) 3

C. Additional electives. If only three courses are selected from list B, then an additional 3 semester credit hours must be completed from the following list:
- **ME 3323** Mechanical Vibration 3
- **ME 4603** Finite Element Analysis 3
- **ME 4723** Reliability and Quality Control in Engineering Design 3

**Total Credit Hours:** 15

### Certificate in Heating, Ventilation and Air-Conditioning

The Certificate in Heating, Ventilation and Air-Conditioning (HVAC) is designed to prepare degree-seeking students or degree holders in mechanical engineering or related fields with the fundamental engineering knowledge necessary for successful careers in the design, manufacture, selection, and/or installation of mechanical equipment which controls the built environment. It certifies to employers that students awarded the certificate have completed coursework essential to success in entry-level positions in HVAC related fields.

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

Students pursuing a HVAC certificate must complete 15 semester credit hours as follows:

A. **Required courses:**
- **ME 4313** Heat Transfer 3

B. **ME electives.** A minimum of three courses (9 semester credit hours) selected from the following list:
- **ME 4323** Thermal Systems Design 9
- **ME 4343** Heating, Air Conditioning, and Refrigeration Design 3
- **ME 4613** Power Plant System Design 3
- **ME 4953** Special Studies in Mechanical Engineering (SS in HVAC Controls) 3
- **ME 4953** Special Studies in Mechanical Engineering (SS in Refrigeration) 3
- **ME 4953** Special Studies in Mechanical Engineering (SS in Air Quality) 3

C. Additional electives. If only three courses are selected from list B, then an additional 3 semester credit hours must be completed from the following list:
- **ME 3323** Mechanical Vibration 3
- **ME 4603** Finite Element Analysis 3
- **ME 4723** Reliability and Quality Control in Engineering Design 3

**Total Credit Hours:** 15
Certificate in Industrial and Manufacturing Engineering

The Certificate in Industrial and Manufacturing Engineering is designed to prepare degree-seeking students or degree holders in mechanical engineering or related fields with the fundamental engineering knowledge necessary for successful careers in the manufacturing industry. It certifies to employers that students awarded the certificate have completed coursework essential to success in entry-level engineering positions in manufacturing.

Eligibility requirements:

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

Students pursuing an Industrial and Manufacturing Engineering certificate must complete 15 semester credit hours as follows:

A. Required courses: 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
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</thead>
<tbody>
<tr>
<td>ME 3263</td>
<td>Manufacturing Engineering</td>
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</tbody>
</table>

B. ME electives. A minimum of three courses (9 semester credit hours) selected from the following list: 9-12

<table>
<thead>
<tr>
<th>Course Code</th>
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</tr>
</thead>
<tbody>
<tr>
<td>ME 4503</td>
<td>Lean Manufacturing and Enterprise Engineering</td>
</tr>
<tr>
<td>ME 4563</td>
<td>Computer Integrated Manufacturing</td>
</tr>
<tr>
<td>ME 4573</td>
<td>Facilities Planning and Design</td>
</tr>
<tr>
<td>ME 4583</td>
<td>Enterprise Process Engineering</td>
</tr>
<tr>
<td>ME 4723</td>
<td>Reliability and Quality Control in Engineering Design</td>
</tr>
<tr>
<td>ME 4953</td>
<td>Special Studies in Mechanical Engineering (SS in Operations Research Quality)</td>
</tr>
</tbody>
</table>

C. Additional electives. If only three courses are selected from list B, then an additional 3 semester credit hours must be completed from the following list: 0-3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGR 3713</td>
<td>Engineering Economic Analysis</td>
</tr>
<tr>
<td>ME 4773</td>
<td>Robotics</td>
</tr>
<tr>
<td>ME 4953</td>
<td>Special Studies in Mechanical Engineering (SS in Systems Modeling and Analysis)</td>
</tr>
</tbody>
</table>

Total Credit Hours 15

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: 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 3823</td>
<td>Machine Element Design I</td>
</tr>
</tbody>
</table>

B. ME electives. A minimum of three courses (9 semester credit hours) selected from the following list: 9-12

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>ME 3323</td>
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<tr>
<td>ME 4323</td>
<td>Thermal Systems Design</td>
</tr>
<tr>
<td>ME 4373</td>
<td>Separation Processes</td>
</tr>
<tr>
<td>ME 4593</td>
<td>Alternative Energy Sources</td>
</tr>
<tr>
<td>ME 4603</td>
<td>Finite Element Analysis</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>

C. Additional electives. If only three courses are selected from list B, then an additional 3 semester credit hours must be completed from the following list: 0-3

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>EGR 3713</td>
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</tr>
<tr>
<td>ME 4603</td>
<td>Finite Element Analysis</td>
</tr>
</tbody>
</table>

Total Credit Hours 15

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 any certificate in the mechanical engineering program, 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 offered by the mechanical engineering program are eligible to enroll in the certificate program, provided they satisfy the course prerequisite requirements.

Students not currently admitted to UTSA who wish to earn an undergraduate certificate offered by the mechanical engineering program will be required to apply for admission to UTSA as special (non-degree-seeking) students at the undergraduate level, and indicate in the application process their desire to pursue the requirements for specific undergraduate 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 the certificate program.
During the last semester in the certificate program, students must submit an application for the Undergraduate Certificate to the Office of the Registrar.

**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 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.) Course Fees: LRE1 $20; STSE $30.

**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. Course Fees: LRE1 $20; STSE $30.

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

**ME 3241. Materials Engineering Laboratory.** (0-3) 1 Credit Hour.
Prerequisite: Concurrent enrollment in or completion of ME 3243. Investigation of the mechanical properties of engineering materials, with emphasis on metals, sample preparation, and metallography. (Formally ME 3244. Credit cannot be earned for both ME 3244 and ME 3241.) Differential Tuition: $55. Course Fee: L001 $30.

**ME 3243. Materials Engineering.** (3-0) 3 Credit Hours.
Prerequisites: CHE 1103, EGR 2103, and concurrent enrollment in or completion of ME 3241. Fundamentals in atomic structure, microstructures, properties, and mechanical behavior of engineering materials, such as metals, polymers, and ceramics. (Formerly ME 3244. Credit cannot be earned for both ME 3244 and ME 3243/ME 3241. Prior completion of ME 3244 can be substituted for ME 3243 and ME 3241.) Generally offered: Fall, Spring. Differential Tuition: $165.

**ME 3263. Manufacturing Engineering.** (3-0) 3 Credit Hours.
Prerequisites: EGR 2513, ME 3241 and ME 3243 (or ME 3244 in previous catalogs). Manufacturing processes, quality assurance, statistical methods, economic analysis, planning, and communication. (Formerly titled "Materials Processing." Generally offered: Fall, Spring, Summer. Differential Tuition: $165.

**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. (Credit cannot be earned for both ME 3293 and CME 3103.) Generally offered: Fall, Spring, Summer. Differential Tuition: $165.

**ME 3323. Mechanical Vibration.** (3-0) 3 Credit Hours.

**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. Differential Tuition: $165.

**ME 3541. Dynamics and Controls Laboratory.** (0-2) 1 Credit Hour.
Prerequisites: ME 3113 and concurrent enrollment in or completion of ME 3543. Investigation of the dynamics and control of physical systems. (Formerly ME 4733. Credit cannot be earned for both ME 4733 and ME 3541.) Differential Tuition: $55.

**ME 3543. Dynamic Systems and Control.** (3-0) 3 Credit Hours.
Prerequisites: EGR 2513 and EGR 3323, and concurrent enrollment in or completion of ME 3113. 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. Differential Tuition: $165.

**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. Differential Tuition: $165.

**ME 3813. Mechanics of Solids.** (3-0) 3 Credit Hours.
Prerequisites: EGR 2103 and MAT 1224. Internal forces and deformations in solids, stress, strain and their relations, tension, stresses and deflections in beams, and elastic behavior of columns. (Credit cannot be earned for both ME 3813 and CE 3103.) Generally offered: Fall, Spring, Summer. Differential Tuition: $165.

**ME 3823. Machine Element Design I.** (3-0) 3 Credit Hours.
Prerequisites: ME 1403, ME 3241 and ME 3243 (or ME 3244 in previous catalogs), and ME 3813. Introduction to design of machine elements, materials selection, static and fatigue failures, shafts, fasteners, springs, gears, bearings and design projects. (Formerly ME 4423. Credit cannot be earned for both ME 3823 and ME 4423.) Generally offered: Fall, Spring, Summer. Differential Tuition: $165.

**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). Differential Tuition: $165.

**ME 4183. Compressible Flow and Propulsion Systems.** (3-0) 3 Credit Hours.
Prerequisites: ME 3293 and ME 3663. Analysis of one-dimensional steady compressible flow, isentropic flow, compressible boundary layers, transition from subsonic to supersonic flow, Fanno and Rayleigh flow, supersonic nozzle design, normal and oblique shock waves, and expansion fans. (Formerly EGR 4183. Credit cannot be earned for both ME 4183 and EGR 4183.) Differential Tuition: $165.
ME 4243. Intermediate Materials Engineering. (3-0) 3 Credit Hours.  
Prerequisites: ME 3241 and ME 3243 (or ME 3244 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. Differential Tuition: $165.

ME 4293. Thermodynamics II. (3-0) 3 Credit Hours.  
Prerequisite: ME 3293. Energy and availability analysis, reactive and nonreactive mixtures, moist air properties, psychrometric systems and analysis, vapor and gas power cycles, refrigeration and heat-pump cycles, thermodynamic relations, and chemical equilibria. Generally offered: Fall, Spring. Differential Tuition: $165.

ME 4312. Thermal and Fluids Laboratory. (0-4) 2 Credit Hours.  
Prerequisites: ME 3113, ME 4293, and concurrent enrollment in or completion of ME 4313. Investigation of thermal and fluid physical systems, and design of experiments. (Formerly ME 4733. Credit cannot be earned for both ME 4733 and ME 4312.) Differential Tuition: $110.

ME 4313. Heat Transfer. (3-0) 3 Credit Hours.  

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. Differential Tuition: $165.

ME 4343. Heating, Air Conditioning, and Refrigeration Design. (3-0) 3 Credit Hours.  
Prerequisite: ME 4293. Moist air properties, human comfort, solar radiation, heating loads, design selection, construction, and operation of air conditioning equipment, and duct design. Differential Tuition: $165.

ME 4373. Separation Processes. (3-0) 3 Credit Hours.  
Prerequisite: ME 4293. Rate- and equilibrium-controlled separation, mass transfer, phase equilibrium, distillation, and extraction. Differential Tuition: $165.

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. Differential Tuition: $165.

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. Differential Tuition: $165. Course Fee: L001 $30.

ME 4553. Automotive Vehicle Dynamics. (3-0) 3 Credit Hours.  
Prerequisites: EGR 2233 and EGR 2513. Dynamics and control of automotive systems, handling, tires, suspension, steering, and aerodynamic forces. Differential Tuition: $165.

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. Differential Tuition: $165.

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. Differential Tuition: $165.

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. Differential Tuition: $165.

ME 4593. Alternative Energy Sources. (3-0) 3 Credit Hours.  
Prerequisites: ME 3293 and ME 3663. 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.) Differential Tuition: $165.

ME 4603. Finite Element Analysis. (3-0) 3 Credit Hours.  

ME 4613. Power Plant System Design. (3-0) 3 Credit Hours.  
Prerequisite: ME 4293. 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. Differential Tuition: $165.

ME 4623. Internal Combustion Engines. (3-0) 3 Credit Hours.  

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. Differential Tuition: $165.

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. Differential Tuition: $165.
ME 4683. Corrosion Engineering. (3-0) 3 Credit Hours.
Prerequisites: ME 3241 and ME 3243 (or ME 3244 in previous catalogs).
Principles of electrochemistry, fundamentals of the environmental
degradation of materials, corrosion thermodynamics and kinetics,
corrosion phenomenology, and corrosion control and prevention.
Differential Tuition: $165.

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

ME 4773. Robotics. (3-0) 3 Credit Hours.
Prerequisites: EGR 2513 and 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. Differential Tuition: $165.

ME 4801. Manufacturing Practices Laboratory. (0-2) 1 Credit Hour.
Prerequisites: Concurrent enrollment in, or completion of, ME 3263 and
ME 4812. Use of measurement tools, saw, drill, mill, lathe, and welder.
Differential Tuition: $55.

ME 4812. Senior Design I. (2-0) 2 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 (or
ME 3513 in previous catalogs), ME 4801, and ME 4312 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, ME 4801, and ME 3541, must be completed with a grade
of "C-" or better to serve as prerequisites for ME 4813. (Formerly ME 4811
and ME 4803. Credit cannot be earned for more than one of the following:
ME 4812, ME 4803, or ME 4811.) Differential Tuition: $110.

ME 4813. Senior Design II. (2-3) 3 Credit Hours.
Prerequisites: ME 4312, ME 4313, ME 4543, ME 4801, and ME
4812. 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,

ME 4911. Independent Study. (0-0) 1 Credit Hour.
Prerequisite: Permission in writing (form available) from the instructor,
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. Differential Tuition: $55.

ME 4913. Independent Study. (0-0) 3 Credit Hours.
Prerequisite: Permission in writing (form available) from the instructor,
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. Differential Tuition: $165.

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. Differential Tuition: $165.

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.) Differential Tuition: $165.