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. 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.
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

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

General Engineering Requirements

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 1103</td>
<td>General Chemistry I</td>
</tr>
<tr>
<td>EGR 2323</td>
<td>Applied Engineering Analysis I</td>
</tr>
<tr>
<td>MAT 1214</td>
<td>Calculus I</td>
</tr>
<tr>
<td>MAT 1224</td>
<td>Calculus II</td>
</tr>
<tr>
<td>or EGR 1324</td>
<td>Calculus II for Engineers</td>
</tr>
<tr>
<td>PHY 1943</td>
<td>Physics for Scientists and Engineers I</td>
</tr>
<tr>
<td>&amp; PHY 1951</td>
<td>and Physics for Scientists and Engineers Laboratory</td>
</tr>
<tr>
<td>PHY 1963</td>
<td>Physics for Scientists and Engineers II</td>
</tr>
<tr>
<td>&amp; PHY 1971</td>
<td>and Physics for Scientists and Engineers Laboratory</td>
</tr>
</tbody>
</table>

Total Credit Hours: 42

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.

A. Required foundation and general mechanical engineering courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGR 2103</td>
<td>Statics</td>
</tr>
<tr>
<td>EGR 2323</td>
<td>Applied Engineering Analysis II</td>
</tr>
<tr>
<td>ME 1403</td>
<td>Engineering Practice and Graphics</td>
</tr>
<tr>
<td>ME 2173</td>
<td>Numerical Methods</td>
</tr>
<tr>
<td>ME 3113</td>
<td>Measurements and Instrumentation</td>
</tr>
<tr>
<td>ME 3241</td>
<td>Materials Engineering Laboratory</td>
</tr>
<tr>
<td>ME 3243</td>
<td>Materials Engineering</td>
</tr>
<tr>
<td>ME 3263</td>
<td>Manufacturing Engineering</td>
</tr>
<tr>
<td>ME 3293</td>
<td>Thermodynamics I</td>
</tr>
<tr>
<td>ME 3541</td>
<td>Dynamics and Controls Laboratory</td>
</tr>
<tr>
<td>ME 3543</td>
<td>Dynamic Systems and Control</td>
</tr>
<tr>
<td>ME 3663</td>
<td>Fluid Mechanics</td>
</tr>
<tr>
<td>ME 3813</td>
<td>Mechanics of Solids</td>
</tr>
<tr>
<td>ME 3823</td>
<td>Machine Element Design I</td>
</tr>
<tr>
<td>ME 4293</td>
<td>Thermodynamics II</td>
</tr>
<tr>
<td>ME 4312</td>
<td>Thermal and Fluids Laboratory</td>
</tr>
<tr>
<td>ME 4313</td>
<td>Heat Transfer</td>
</tr>
<tr>
<td>ME 4543</td>
<td>Mechatronics</td>
</tr>
<tr>
<td>ME 4801</td>
<td>Manufacturing Practices Laboratory</td>
</tr>
<tr>
<td>ME 4812</td>
<td>Senior Design I</td>
</tr>
<tr>
<td>ME 4813</td>
<td>Senior Design II</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>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 3323</td>
<td>Mechanical Vibration</td>
</tr>
<tr>
<td>ME 4183</td>
<td>Compressible Flow and Propulsion Systems</td>
</tr>
<tr>
<td>ME 4603</td>
<td>Finite Element Analysis</td>
</tr>
<tr>
<td>ME 4723</td>
<td>Reliability and Quality Control in Engineering Design</td>
</tr>
</tbody>
</table>

Design and Control of Mechanical Systems

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

Energy, Thermal and Fluid Systems

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 4183</td>
<td>Compressible Flow and Propulsion Systems</td>
</tr>
<tr>
<td>ME 4323</td>
<td>Thermal Systems Design</td>
</tr>
<tr>
<td>ME 4343</td>
<td>Heating, Air Conditioning, and Refrigeration Design</td>
</tr>
<tr>
<td>ME 4593</td>
<td>Alternative Energy Sources</td>
</tr>
</tbody>
</table>
### Department of Mechanical Engineering

**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 4533**  
Computer Integrated Manufacturing

**ME 4573**  
Facilities Planning and Design

**ME 4583**  
Enterprise Process Engineering

**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 4693**  
Mechanical Engineering Applications to Biomedical Systems

### Oil and Gas

**EGR 3713**  
Engineering Economic Analysis

**ME 3323**  
Mechanical Vibration

**ME 4323**  
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 (when topic is Operations Research Quality)

**ME 4953**  
Special Studies in Mechanical Engineering (when topic is Systems Modeling and Analysis)

### 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 I

**CHE 2603**  
Organic Chemistry I

**ES 2013**  
Introduction to Environmental Science I

**GEO 1123**  
Life Through Time

**MAT 3013**  
Foundations of Mathematics

**MAT 3103**  
Data Analysis and Interpretation

**PHY 2103**  
Modern Physics

**PHY 3203**  
Classical Mechanics I

**STA 2303**  
Applied Probability and Statistics for Engineers

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

#### First Year

**Fall**  
- **AIS 1203** Academic Inquiry and Scholarship (core)  
  3 Credit Hours
- **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**  
- **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**  
- **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
- **ME 3241** Materials Engineering Laboratory  
  1
- **ME 3243** Materials Engineering  
  3
- **ME 3293** Thermodynamics I  
  3
  
  **Credit Hours**  
  16

**Spring**  
- **EGR 2103** Statics  
  3
- **EGR 2323** Applied Engineering Analysis II  
  3
- **ME 3241** Materials Engineering Laboratory  
  1
- **ME 3243** Materials Engineering  
  3
- **ME 3293** Thermodynamics I  
  3
- **Graduate Courses in Mechanical Engineering**  
  2
  
  **Credit Hours**  
  17

#### Third Year

**Fall**  
- **ME 2173** Numerical Methods  
  3
- **ME 3113** Measurements and Instrumentation  
  3

**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.
## 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:

### Required courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 3663</td>
<td>Fluid Mechanics</td>
<td>3</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 4183</td>
<td>Compressible Flow and Propulsion Systems</td>
<td>3</td>
</tr>
<tr>
<td>ME 4953</td>
<td>Special Studies in Mechanical Engineering (SS in Aerodynamics)</td>
<td>3</td>
</tr>
<tr>
<td>ME 4953</td>
<td>Special Studies in Mechanical Engineering (SS in Propulsion)</td>
<td>3</td>
</tr>
<tr>
<td>ME 4953</td>
<td>Special Studies in Mechanical Engineering (SS in Astrodynamics)</td>
<td>3</td>
</tr>
</tbody>
</table>

### 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:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 3323</td>
<td>Mechanical Vibration</td>
<td>3</td>
</tr>
<tr>
<td>ME 4603</td>
<td>Finite Element Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ME 4723</td>
<td>Reliability and Quality Control in Engineering Design</td>
<td>3</td>
</tr>
</tbody>
</table>

### 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:

### Required courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 3263</td>
<td>Manufacturing Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 4503</td>
<td>Lean Manufacturing and Enterprise Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ME 4563</td>
<td>Computer Integrated Manufacturing</td>
<td>3</td>
</tr>
<tr>
<td>ME 4573</td>
<td>Facilities Planning and Design</td>
<td>3</td>
</tr>
<tr>
<td>ME 4583</td>
<td>Enterprise Process Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ME 4723</td>
<td>Reliability and Quality Control in Engineering Design</td>
<td>3</td>
</tr>
<tr>
<td>ME 4953</td>
<td>Special Studies in Mechanical Engineering (SS in Operations Research Quality)</td>
<td>3</td>
</tr>
</tbody>
</table>

### 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:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGR 3713</td>
<td>Engineering Economic Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ME 4773</td>
<td>Robotics</td>
<td>3</td>
</tr>
<tr>
<td>ME 4953</td>
<td>Special Studies in Mechanical Engineering (SS in Systems Modeling and Analysis)</td>
<td>3</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:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 3823</td>
<td>Machine Element Design I</td>
<td>3</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 3323</td>
<td>Mechanical Vibration</td>
<td>3</td>
</tr>
<tr>
<td>ME 4323</td>
<td>Thermal Systems Design</td>
<td>3</td>
</tr>
<tr>
<td>ME 4373</td>
<td>Separation Processes</td>
<td>3</td>
</tr>
<tr>
<td>ME 4593</td>
<td>Alternative Energy Sources</td>
<td>3</td>
</tr>
<tr>
<td>ME 4603</td>
<td>Finite Element Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ME 4643</td>
<td>Pressure Vessel and Piping Design</td>
<td>3</td>
</tr>
<tr>
<td>ME 4653</td>
<td>Oil and Gas Engineering and Reservoir Geomechanics</td>
<td>3</td>
</tr>
<tr>
<td>ME 4683</td>
<td>Corrosion Engineering</td>
<td>3</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:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGR 3713</td>
<td>Engineering Economic Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ME 4603</td>
<td>Finite Element Analysis</td>
<td>3</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 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 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.) 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 1 224. 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. (Formally 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 3233 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 1 224. 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 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 2323 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 optimization. Generally offered: Fall. Differential Tuition: $165.

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.

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, Spring. 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.