MECHANICAL ENGINEERING UNDERGRADUATE MAJOR

COVID-19-Related Degree Requirement Changes

For information on how Mechanical Engineering degree requirements have been affected by the pandemic, see the 'COVID-19 Policies tab (http://exploreddegrees.stanford.edu/schoolofengineering/mechanicalengineering/#covid19policies/text)' in the 'Mechanical Engineering' of this bulletin. For University-wide policy changes related to the pandemic, see the 'COVID-19 and Academic Continuity (http://exploreddegrees.stanford.edu/covid-19-policy-changes/)' section of this bulletin.

See the 'Department of Mechanical Engineering (http://exploreddegrees.stanford.edu/schoolofengineering/mechanicalengineering/)' section of this bulletin for additional information on the department, and its programs and faculty.

The department offers a B.S. as well as a minor in Mechanical Engineering.

Mechanical Engineering (ME)

Completion of the undergraduate program in Mechanical Engineering leads to the conferral of the Bachelor of Science in Mechanical Engineering.

Mission of the Undergraduate Program in Mechanical Engineering

The mission of the undergraduate program in Mechanical Engineering is to provide students with a balance of theoretical and practical experiences that enable them to address a variety of societal needs. The curriculum encompasses elements from a wide range of disciplines built around the themes of biomedicine, computational engineering, design, energy, and multiscale engineering. Course work may include mechatronics, computational simulation, solid and fluid dynamics, microelectromechanical systems, biomechanical engineering, energy science and technology, propulsion, sensing and control, nano- and micro-electronics, and design. The program prepares students for entry-level work as mechanical engineers and for graduate studies in either an engineering discipline or other fields where a broad engineering background is useful.

Core Requirements

<table>
<thead>
<tr>
<th>Mathematics</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 units minimum; see Basic Requirement 1</td>
<td></td>
</tr>
<tr>
<td>CME 102/ENGR 155A Ordinary Differential Equations for Engineers</td>
<td>5</td>
</tr>
<tr>
<td>or MATH 53 Ordinary Differential Equations with Linear Algebra</td>
<td></td>
</tr>
<tr>
<td>Select one of the following:</td>
<td>3-5</td>
</tr>
<tr>
<td>CME 106/ENGR 155C Introduction to Probability and Statistics for Engineers</td>
<td></td>
</tr>
<tr>
<td>STATS 110 Statistical Methods in Engineering and the Physical Sciences</td>
<td></td>
</tr>
<tr>
<td>STATS 116 Theory of Probability</td>
<td></td>
</tr>
<tr>
<td>Plus additional courses to total min. 24</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Science</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 units minimum; see Basic Requirement 2</td>
<td></td>
</tr>
<tr>
<td>Plus additional required courses</td>
<td></td>
</tr>
</tbody>
</table>

Technological in Society

One course required; TIS courses should be selected from AA 252, BIOE 131, COMM 120W, CS 181, ENGR 131, HUMBIO 174, ME 267, or MSE 193.

Engineering Fundamentals

Two courses minimum; see Basic Requirement 3

| ENGR 14 | Intro to Solid Mechanics | 3 |
| CS 106A | Programming Methodology | 5 |
| or CS 106B | Programming Abstractions |  |

Engineering Core

Minimum of 68 Engineering Science and Design ABET units; see Basic Requirement 5

| ME 1 | Introduction to Mechanical Engineering | 3 |
| ME 15 | Dynamics | 3 |
| ME 80 | Mechanics of Materials | 3 |
| ME 30 | Engineering Thermodynamics | 3 |
| ME 70 | Introductory Fluids Engineering | 3 |
| ME 102 | Foundations of Product Realization | 3 |
| ME 103 | Product Realization: Design and Making | 4 |
| ME 104 | Mechanical Systems Design | 4 |
| ME 131 | Heat Transfer | 4 |
| ME 123 | Computational Engineering | 4 |
| ME 170A | Mechanical Engineering Design- Integrating Context with Engineering | 4 |
| ME 170B | Mechanical Engineering Design- Integrating Context with Engineering | 4 |

Core Concentrations and Concentration Electives

In addition to completing core requirements, students must choose one of the concentrations paths below. In addition to their concentration specific 3-courses, students select 2-3 additional courses such that the combination adds up to a minimum of 18 units. One of these additional courses must be from technical electives associated with the student's selected concentration. The other 1-2 courses could come from either technical electives from the student's selected concentration or any other concentration and its associated technical electives. Up to 3 units of ME 191 Engineering Problems and Experimental Investigation may be petitioned to count as technical elective.

For students choosing the Materials and Structures concentration path, in addition to the 2 concentration-specific courses, students must select at least 2 courses from the Materials and Structures electives, in addition to courses from other concentrations, as technical electives.

| Dynamic Systems and Controls Concentration | Units |
| ME 161 | Dynamic Systems, Vibrations and Control | 3 |
| ENGR 105 | Feedback Control Design | 3 |
| Pick one of: |  |
| ME 227 | Vehicle Dynamics and Control | 3 |
| ME 327 | Design and Control of Haptic Systems (not offered AY21) | 3 |

Dynamic Systems and Controls Electives

<p>| ENGR 205 | Introduction to Control Design Techniques | 3 |
| ME 210 | Introduction to Mechatronics (not offered AY21) | 4 |
| ME 220 | Introduction to Sensors | 3-4 |
| ME 331A | Advanced Dynamics &amp; Computation (not offered AY21) | 3 |</p>
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 485</td>
<td>Modeling and Simulation of Human Movement</td>
<td>3</td>
</tr>
<tr>
<td>ME 227</td>
<td>Vehicle Dynamics and Control</td>
<td>3</td>
</tr>
<tr>
<td>ME 327</td>
<td>Design and Control of Haptic Systems (not offered AY21)</td>
<td>3</td>
</tr>
</tbody>
</table>

**Materials and Structures Concentration**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 149</td>
<td>Mechanical Measurements</td>
<td>3</td>
</tr>
<tr>
<td>ME 152</td>
<td>Material Behaviors and Failure Prediction</td>
<td>3</td>
</tr>
</tbody>
</table>

**Materials and Structures Electives (2 M&S electives required for students in M&S concentration)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA 240</td>
<td>Analysis of Structures</td>
<td>3</td>
</tr>
<tr>
<td>MATSCI 198</td>
<td>Mechanical Properties of Materials</td>
<td>3-4</td>
</tr>
<tr>
<td>ME 234</td>
<td>Introduction to Neuromechanics (not offered AY21)</td>
<td>3</td>
</tr>
<tr>
<td>ME 241</td>
<td>Mechanical Behavior of Nanomaterials (not offered AY21)</td>
<td>3</td>
</tr>
<tr>
<td>ME 281</td>
<td>Biomechanics of Movement</td>
<td>3</td>
</tr>
<tr>
<td>ME 283</td>
<td>Introduction to Biomechanics and Mechanobiology (not offered AY21)</td>
<td>3</td>
</tr>
<tr>
<td>ME 287</td>
<td>Mechanics of Biological Tissues (not offered AY21)</td>
<td>4</td>
</tr>
<tr>
<td>ME 331A</td>
<td>Advanced Dynamics &amp; Computation (not offered AY21)</td>
<td>3</td>
</tr>
<tr>
<td>ME 335A</td>
<td>Finite Element Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ME 338</td>
<td>Continuum Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>ME 339</td>
<td>Introduction to parallel computing using MPI, openMP and CUDA</td>
<td>3</td>
</tr>
<tr>
<td>ME 345</td>
<td>Fatigue Design and Analysis</td>
<td>3</td>
</tr>
<tr>
<td>ME 348</td>
<td>Experimental Stress Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

**Product Realization Concentration**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 127</td>
<td>Design for Additive Manufacturing</td>
<td>3</td>
</tr>
<tr>
<td>ME 128</td>
<td>Computer-Aided Product Realization</td>
<td>3</td>
</tr>
<tr>
<td>ME 129</td>
<td>Manufacturing Processes and Design (offered AY 19-20)</td>
<td>3</td>
</tr>
</tbody>
</table>

**Product Realization Electives**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 110</td>
<td>Perspectives in Assistive Technology (ENGR 110)</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 240</td>
<td>Introduction to Micro and Nano Electromechanical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ME 181</td>
<td>Deliverables: A Mechanical Engineering Design Practicum</td>
<td>3</td>
</tr>
<tr>
<td>CME 106</td>
<td>Introduction to Probability and Statistics for Engineers</td>
<td>4</td>
</tr>
<tr>
<td>ME 210</td>
<td>Introduction to Mechatronics (not offered AY21)</td>
<td>4</td>
</tr>
<tr>
<td>ME 263/298</td>
<td>The Chair or Silversmithing and Design</td>
<td>3-4</td>
</tr>
<tr>
<td>ME 309/321</td>
<td>(not offered AY21) or Precision Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ME 324</td>
<td>Precision Engineering</td>
<td>4</td>
</tr>
</tbody>
</table>

**Thermo, Fluids, and Heat Transfer Concentration**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 149</td>
<td>Mechanical Measurements</td>
<td>3</td>
</tr>
<tr>
<td>ME 132</td>
<td>Intermediate Thermodynamics</td>
<td>4</td>
</tr>
<tr>
<td>ME 133</td>
<td>Intermediate Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>ME 352D</td>
<td>Nanoscale heat, mass and charge transport</td>
<td>3</td>
</tr>
</tbody>
</table>

**Thermo, Fluids, and Heat Transfer Electives**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 257</td>
<td>Gas-Turbine Design Analysis (not offered AY21)</td>
<td>3</td>
</tr>
<tr>
<td>ME 351A</td>
<td>Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>ME 351B</td>
<td>Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>ME 352B</td>
<td>Fundamentals of Heat Conduction (not offered AY21)</td>
<td>3</td>
</tr>
<tr>
<td>ME 352C</td>
<td>Convective Heat Transfer (not offered AY21)</td>
<td>3</td>
</tr>
<tr>
<td>ME 362A</td>
<td>Physical Gas Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>ME 370A</td>
<td>Energy Systems I: Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>ME 370B</td>
<td>Energy Systems II: Modeling and Advanced Concepts</td>
<td>4</td>
</tr>
<tr>
<td>ME 371</td>
<td>Combustion Fundamentals</td>
<td>3</td>
</tr>
<tr>
<td>AA 283</td>
<td>Aircraft and Rocket Propulsion</td>
<td>3</td>
</tr>
</tbody>
</table>

Units

Math and science must total 45 units.
- Math: 24 units required and must include a course in differential equations (CME 102 Ordinary Differential Equations for Engineers or MATH 53 Ordinary Differential Equations with Linear Algebra; one of these required) and calculus-based Statistics (CME 106 Introduction to Probability and Statistics for Engineers or STATS 110 Statistical Methods in Engineering and the Physical Sciences or STATS 116 is required).
- Science: 20 units minimum and requires courses in calculus-based Physics and Chemistry, with at least a full year (3 courses) in one or the other. CHEM 31A Chemical Principles I and CHEM 31B Chemical Principles II are considered one course because they cover the same material as CHEM 31M but at a slower pace. CHEM 31M is recommended.

**BSME 1.0 Notes**

For additional information and sample programs see the Handbook for Undergraduate Engineering Programs (UGHB) (http://ughb.stanford.edu).

**Honors Program in Mechanical Engineering**

The Department of Mechanical Engineering offers a program leading to a B.S. in Mechanical Engineering with honors. This program offers a unique opportunity for qualified undergraduate engineering majors to conduct independent study and research at an advanced level with a faculty mentor.

Mechanical Engineering majors who have a grade point average (GPA) of 3.5 or higher in the major may apply for the honors program. Students who meet the eligibility requirement and wish to be considered for the honors program must submit a written application to the Mechanical Engineering student services office no later than the second week of Autumn Quarter in the senior year. The application to enter the program can be obtained from the ME student services office, and must contain...
a one-page statement describing the research topic and include an unofficial Stanford transcript. In addition, the application must be approved by a Mechanical Engineering faculty member who agrees to serve as the thesis adviser for the project. Thesis advisers must be members of Stanford’s Academic Council.

In order to receive departmental honors, students admitted to the program must:

1. Maintain the 3.5 GPA required for admission to the honors program.
2. Submit a completed thesis draft to the adviser by the 3rd week of the quarter they intend to confer. Further revisions and final endorsement by the adviser are to be finished by week 6, when two bound copies are to be submitted to the Mechanical Engineering student services office.
3. Present the thesis at the Mechanical Engineering Poster Session held in mid-April. If the poster session is not offered or the student does not confer in the spring, an alternative presentation will be approved on a case by case basis with advisor and UGCC chair approval.

Note: Students may not use work completed towards an honors degree to satisfy the B.S. in ME course requirements.

Mechanical Engineering (ME) Minor

The following courses fulfill the minor requirements:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Minor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 14</td>
<td>3</td>
<td>Intro to Solid Mechanics</td>
</tr>
<tr>
<td>ENGR 15</td>
<td>3</td>
<td>Dynamics</td>
</tr>
<tr>
<td>ME 1</td>
<td>3</td>
<td>Introduction to Mechanical Engineering</td>
</tr>
<tr>
<td>ME 30</td>
<td>3</td>
<td>Engineering Thermodynamics</td>
</tr>
<tr>
<td>ME 70</td>
<td>3</td>
<td>Introductory Fluids Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plus two of the following:</td>
</tr>
<tr>
<td>ME 80</td>
<td>3</td>
<td>Mechanics of Materials</td>
</tr>
<tr>
<td>ME 102</td>
<td>3</td>
<td>Foundations of Product Realization</td>
</tr>
<tr>
<td>ME 131</td>
<td>4</td>
<td>Heat Transfer</td>
</tr>
<tr>
<td>ME 161</td>
<td>3</td>
<td>Dynamic Systems, Vibrations and Control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total Units: 21</td>
</tr>
<tr>
<td><strong>Thermosciences Minor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 14</td>
<td>3</td>
<td>Intro to Solid Mechanics</td>
</tr>
<tr>
<td>ME 30</td>
<td>3</td>
<td>Engineering Thermodynamics</td>
</tr>
<tr>
<td>ME 70</td>
<td>3</td>
<td>Introductory Fluids Engineering</td>
</tr>
<tr>
<td>ME 131</td>
<td>4</td>
<td>Heat Transfer</td>
</tr>
<tr>
<td>ME 132</td>
<td>4</td>
<td>Intermediate Thermodynamics</td>
</tr>
<tr>
<td>ME 133</td>
<td>3</td>
<td>Intermediate Fluid Mechanics (offered SPR 18-19; more information to come)</td>
</tr>
<tr>
<td>ME 149</td>
<td>3</td>
<td>Mechanical Measurements</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total units: 23</td>
</tr>
<tr>
<td><strong>Mechanical Design Minor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENGR 14</td>
<td>3</td>
<td>Intro to Solid Mechanics</td>
</tr>
<tr>
<td>ME 80</td>
<td>3</td>
<td>Mechanics of Materials</td>
</tr>
<tr>
<td>ME 1</td>
<td>3</td>
<td>Introduction to Mechanical Engineering</td>
</tr>
<tr>
<td>ME 102</td>
<td>3</td>
<td>Foundations of Product Realization</td>
</tr>
<tr>
<td>ME 103</td>
<td>4</td>
<td>Product Realization: Design and Making</td>
</tr>
<tr>
<td>ME 104</td>
<td>4</td>
<td>Mechanical Systems Design</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plus one of the following:</td>
</tr>
<tr>
<td>ME 127</td>
<td>3</td>
<td>Design for Additive Manufacturing</td>
</tr>
<tr>
<td>ME 128</td>
<td>3-4</td>
<td>Computer-Aided Product Realization</td>
</tr>
<tr>
<td>ME 129</td>
<td>3</td>
<td>Manufacturing Processes and Design</td>
</tr>
<tr>
<td>ME 210</td>
<td>4</td>
<td>Introduction to Mechatronics</td>
</tr>
</tbody>
</table>

* This minor aims to expose students to the breadth of ME in terms of topics and analytic and design activities. Prerequisites: MATH 19 Calculus, MATH 20 Calculus, MATH 21 Calculus, and PHYSICS 41 Mechanics or PHYSICS 41E Mechanics, Concepts, Calculations, and Context.

** Prerequisites: MATH 19 Calculus, MATH 20 Calculus, MATH 21 Calculus, MATH 51 Linear Algebra, Multivariable Calculus, and Modern Applications (or CME 100 Vector Calculus for Engineers) and PHYSICS 41 Mechanics or PHYSICS 41E Mechanics, Concepts, Calculations, and Context.

*** This minor aims to expose students to design activities supported by analysis. Prerequisites: MATH 19 Calculus, MATH 20 Calculus, MATH 21 Calculus, PHYSICS 42 Classical Mechanics Laboratory, and PHYSICS 41 Mechanics or PHYSICS 41E Mechanics, Concepts, Calculations, and Context.