# Mechanical Engineering Undergraduate Major

See the "Department of Mechanical Engineering (http://exploredegrees.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 biomechanics, 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- mechanics, 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

#### Mathematics

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

#### Science

20 units minimum; see Basic Requirement 2  
Plus additional required courses  
CHEM 31M Chemical Principles: From Molecules to Solids  
One course required; TIS courses should be selected from AA 252, BIOE 131, COMM 120W, CS 181, ENGR 117, ENGR 131, HUMBIO 174, ME 267, or MSE 193.

#### Engineering Fundamentals

Two courses minimum; see Basic Requirement 3  
ENGR 14 Intro to Solid Mechanics  
CS 106A Programming Methodology  

### Engineering Core

Minimum of 68 Engineering Science and Design ABET units; see Basic Requirement 5  
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 1</td>
<td>Introduction to Mechanical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 15</td>
<td>Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>ME 80</td>
<td>Mechanics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>ME 30</td>
<td>Engineering Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>ME 70</td>
<td>Introductory Fluids Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ME 102</td>
<td>Foundations of Product Realization</td>
<td>3</td>
</tr>
<tr>
<td>ME 103</td>
<td>Product Realization: Design and Making</td>
<td>4</td>
</tr>
<tr>
<td>ME 104</td>
<td>Mechanical Systems Design</td>
<td>4</td>
</tr>
<tr>
<td>ME 131</td>
<td>Heat Transfer</td>
<td>4</td>
</tr>
<tr>
<td>ME 123</td>
<td>Computational Engineering</td>
<td>4</td>
</tr>
<tr>
<td>or ME 151</td>
<td>Introduction to Computational Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>ME 170A</td>
<td>Mechanical Engineering Design: Integrating Context with Engineering</td>
<td>4</td>
</tr>
<tr>
<td>ME 170B</td>
<td>Mechanical Engineering Design: Integrating Context with Engineering</td>
<td>4</td>
</tr>
</tbody>
</table>

### 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.

#### Dynamic Systems and Controls Concentration

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 161</td>
<td>Dynamic Systems, Vibrations and Control</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 105</td>
<td>Feedback Control Design</td>
<td>3</td>
</tr>
<tr>
<td>Pick one of:</td>
<td></td>
<td></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</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Dynamic Systems and Controls Electives

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 171E</td>
<td>Aerial Robot Design</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 205</td>
<td>Introduction to Control Design Techniques</td>
<td>3</td>
</tr>
<tr>
<td>ME 210</td>
<td>Introduction to Mechatronics</td>
<td>4</td>
</tr>
<tr>
<td>ME 220</td>
<td>Introduction to Sensors</td>
<td>3-4</td>
</tr>
<tr>
<td>ME 331A</td>
<td>Advanced Dynamics &amp; Computation</td>
<td>3</td>
</tr>
<tr>
<td>ME 485</td>
<td>Modeling and Simulation of Human Movement</td>
<td>3</td>
</tr>
<tr>
<td>Pick one, if not used in concentration already:</td>
<td></td>
<td></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</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Materials and Structures Concentration

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>ME 149</td>
<td>Mechanical Measurements</td>
<td>3</td>
</tr>
<tr>
<td>ME 151</td>
<td>Introduction to Computational Mechanics</td>
<td>5</td>
</tr>
<tr>
<td>ME 152</td>
<td>Material Behaviors and Failure Prediction</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Materials and Structures Electives

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<tr>
<th>Course</th>
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<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 234</td>
<td>Introduction to Neuromechanics</td>
<td>3</td>
</tr>
<tr>
<td>ME 241</td>
<td>Mechanical Behavior of Nanomaterials</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</td>
<td>3</td>
</tr>
</tbody>
</table>

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ME 287 Mechanics of Biological Tissues 4
ME 331A Advanced Dynamics & Computation 3
ME 335A Finite Element Analysis 3
ME 338 Continuum Mechanics 3
ME 339 Introduction to parallel computing using MPI, openMP and CUDA 3
ME 345 Fatigue Design and Analysis 3
ME 348 Experimental Stress Analysis 3

Units

Product Realization Concentration
ME 127 Design for Additive Manufacturing 3
ME 128 Computer-Aided Product Realization 3
ME 129 Manufacturing Processes and Design (offered AY 19-20) 3

Product Realization Electives
ENGR 110 Perspectives in Assistive Technology (ENGR 110) 3
ENGR 240 Introduction to Micro and Nano Electromechanical Systems 3
ME 181 Deliverables: A Mechanical Engineering Design Practicum 3
CME 106 Introduction to Probability and Statistics for Engineers 4
ME 210 Introduction to Mechatronics 4
ME 263 The Chair 3-4
or ME 298 Silversmithing and Design
ME 309 Finite Element Analysis in Mechanical Design 3
ME 324 Precision Engineering 4

Units

Thermo, Fluids, and Heat Transfer Concentration
ME 132 Intermediate Thermodynamics 4
ME 133 Intermediate Fluid Mechanics 3
ME 149 Mechanical Measurements 3

Thermo, Fluids, and Heat Transfer Electives
ME 257 Gas-Turbine Design Analysis 3
ME 351A Fluid Mechanics 3
ME 351B Fluid Mechanics 3
ME 352B Fundamentals of Heat Conduction 3
ME 352C Convective Heat Transfer 3
ME 362A Physical Gas Dynamics 3
ME 370A Energy Systems I: Thermodynamics 3
ME 370B Energy Systems II: Modeling and Advanced Concepts 4
ME 371 Combustion Fundamentals 3
AA 283 Aircraft and Rocket Propulsion 3

BSME 1.0 Notes
Those students (primarily seniors) who are completing BSME 1.0 from AY 2017-2018 or earlier should refer to bulletins from the academic year that corresponds with their program sheet.

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:

Units

General Minor
ENGR 14 Intro to Solid Mechanics 3
ENGR 15  Dynamics  3
ME 1  Introduction to Mechanical Engineering  3
ME 30  Engineering Thermodynamics  3
ME 70  Introductory Fluids Engineering  3
Plus two of the following:
ME 80  Mechanics of Materials  3
ME 103  Product Realization: Design and Making  4
ME 104  Mechanical Systems Design  4
ME 161  Dynamic Systems, Vibrations and Control  3
Total Units: 21

Thermosciences Minor  **
ENGR 14  Intro to Solid Mechanics  3
ME 30  Engineering Thermodynamics  3
ME 70  Introductory Fluids Engineering  3
ME 149  Mechanical Measurements  3
ME 104  Mechanical Systems Design  4
ME 132  Intermediate Thermodynamics  4
ME 133  Intermediate Fluid Mechanics (offered SPR 18-19; more information to come)  3
Total units: 22

Mechanical Design Minor  ***
ENGR 14  Intro to Solid Mechanics  3
ENGR 15  Dynamics  3
ME 80  Mechanics of Materials  3
ME 1  Introduction to Mechanical Engineering  3
ME 102  Foundations of Product Realization  3
ME 103  Product Realization: Design and Making  4
Plus one of the following:
ME 104  Mechanical Systems Design  4
ME 210  Introduction to Mechatronics  4
ME 127  Design for Additive Manufacturing  3
ME 128  Computer-Aided Product Realization  3-4
ME 129  Manufacturing Processes and Design  3
ME 220  Introduction to Sensors  3-4
Total units: 24-25

*  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.