MECHANICAL ENGINEERING UNDERGRADUATE MAJOR

COVID-19-Related Degree Requirement Changes
For information on how Mechanical Engineering degree requirements may have been affected by the pandemic, see the "COVID-19 Policies tab (http://exploredegrees.stanford.edu/schoolofengineering/mechanicalengineering/#covid19policiestext) in the "Mechanical Engineering" of this bulletin. For University-wide policy changes related to the pandemic, see the "COVID-19 and Academic Continuity (http://exploredegrees.stanford.edu/covid-19-policy-changes/)" section of this bulletin.

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 conferment 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, micro- and nano- 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

<table>
<thead>
<tr>
<th>Course (Units)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 31M</td>
<td>Chemical Principles: From Molecules to Solids</td>
</tr>
<tr>
<td>ENGR 155A or MATH 53</td>
<td>Ordinary Differential Equations for Engineers or Ordinary Differential Equations with Linear Algebra</td>
</tr>
<tr>
<td>ENGR 103</td>
<td>Introduction to Mechanical Engineering</td>
</tr>
<tr>
<td>ME 80</td>
<td>Mechanics of Materials</td>
</tr>
<tr>
<td>ME 102</td>
<td>Foundations of Product Realization</td>
</tr>
<tr>
<td>ENGR 155C</td>
<td>Programming Methodology</td>
</tr>
<tr>
<td>CS 106A</td>
<td>Programming Abstractions</td>
</tr>
</tbody>
</table>

Technology 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 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
ME 161 | Dynamic Systems, Vibrations and Control | 3 |
ENGR 105 | Feedback Control Design | 3 |
ME 227 | Vehicle Dynamics and Control | 3 |
ME 327 | Design and Control of Haptic Systems (not offered AY21) | 3 |

Dynamic Systems and Controls Electives
ENGR 205 | Introduction to Control Design Techniques | 3 |
ME 210 | Introduction to Mechatronics (not offered AY21) | 4 |
ME 220 | Introduction to Sensors | 4 |
ME 331A | Advanced Dynamics & Computation (not offered AY21) | 3 |

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

ME 485 Modeling and Simulation of Human Movement 3
Pick one, if not used in concentration already:
ME 227 Vehicle Dynamics and Control 3
ME 327 Design and Control of Haptic Systems (not offered AY21) 3

Materials and Structures Concentration
ME 149 Mechanical Measurements 3
ME 152 Material Behaviors and Failure Prediction 3

Materials and Structures Electives
(2 M&S electives required for students in M&S concentration)
AA 240 Analysis of Structures 3
MATSCI 198 Mechanical Properties of Materials 3-4
ME 234 Introduction to Neuromechanics (not offered AY21) 3
ME 241 Mechanical Behavior of Nanomaterials (not offered AY21) 3
ME 281 Biomechanics of Movement 3
ME 283 Introduction to Biomechanics and Mechanobiology (not offered AY21) 3
ME 287 Mechanics of Biological Tissues (not offered AY21) 4
ME 331A Advanced Dynamics & Computation (not offered AY21) 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) 1-2
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 (not offered AY21) 4
ME 263 The Chair or ME 298 Silversmithing and Design 3-4
ME 309 (not offered AY21) 3
ME 324 Precision Engineering 4

Units
Thermo, Fluids, and Heat Transfer Electives
ME 257 Gas-Turbine Design Analysis (not offered AY21) 3
ME 351A Fluid Mechanics 3
ME 351B Fluid Mechanics 3
ME 352B Fundamentals of Heat Conduction (not offered AY21) 3
ME 352C Convective Heat Transfer (not offered AY21) 3
ME 352D Nanoscale heat, mass and charge transport 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

1 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/ 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.

2 ME 170A and ME 170B fulfill the WIM requirement. In AY 2020-21, the same grading basis applies to both ME 170A and ME 170B, and cannot be changed after week 8 of enrollment in ME 170A.

3 ME 170A (http://exploredegrees.stanford.edu/search/?P=ME%20170A) and ME 170B (http://exploredegrees.stanford.edu/search/?P=ME%20170B) are a two quarter Capstone Design Sequence and must be taken in consecutive quarters.

4 A course may only be counted towards one requirement; it may not be double-counted. All courses taken for the major must be taken for a letter grade if that option is offered by the instructor. Minimum combined GPA for all courses in Engineering Topics (Engineering Fundamentals and Depth courses) is 2.0.

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

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:

<table>
<thead>
<tr>
<th>Units</th>
<th>General Minor *</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENGR 14</strong> Intro to Solid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td><strong>ENGR 15</strong> Dynamics</td>
<td>3</td>
</tr>
<tr>
<td><strong>ME 1</strong> Introduction to Mechanical Engineering</td>
<td>3</td>
</tr>
<tr>
<td><strong>ME 30</strong> Engineering Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td><strong>ME 70</strong> Introductory Fluids Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

Plus two of the following:

<table>
<thead>
<tr>
<th>Units</th>
<th>Thermosciences Minor **</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ME 80</strong> Mechanics of Materials</td>
<td>3</td>
</tr>
<tr>
<td><strong>ME 102</strong> Foundations of Product Realization</td>
<td>3</td>
</tr>
<tr>
<td><strong>ME 131</strong> Heat Transfer</td>
<td>4</td>
</tr>
<tr>
<td><strong>ME 161</strong> Dynamic Systems, Vibrations and Control</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Units: 21

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<thead>
<tr>
<th>Units</th>
<th>Mechanical Design Minor ***</th>
</tr>
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<tbody>
<tr>
<td><strong>ENGR 14</strong> Intro to Solid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td><strong>ME 80</strong> Mechanics of Materials</td>
<td>3</td>
</tr>
<tr>
<td><strong>ME 1</strong> Introduction to Mechanical Engineering</td>
<td>3</td>
</tr>
<tr>
<td><strong>ME 102</strong> Foundations of Product Realization</td>
<td>3</td>
</tr>
<tr>
<td><strong>ME 103</strong> Product Realization: Design and Making</td>
<td>4</td>
</tr>
<tr>
<td><strong>ME 104</strong> Mechanical Systems Design</td>
<td>4</td>
</tr>
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</table>

Plus one of the following:

<table>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>ME 127</strong> Design for Additive Manufacturing</td>
<td>3</td>
</tr>
<tr>
<td><strong>ME 128</strong> Computer-Aided Product Realization</td>
<td>3-4</td>
</tr>
<tr>
<td><strong>ME 129</strong> Manufacturing Processes and Design</td>
<td>3</td>
</tr>
<tr>
<td><strong>ME 210</strong> Introduction to Mechatronics</td>
<td>4</td>
</tr>
</tbody>
</table>

Total units: 23

* 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.