Management Science and Engineering Undergraduate Major

COVID-19-Related Degree Requirement Changes
For information on how Management Science and Engineering degree requirements have been affected by the pandemic, see the 'COVID-19 Policies' tab (http://exploredegrees.stanford.edu/schoolofengineering/managementscienceandengineering/#covid19policies) in the 'Management Science and 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.

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

Management Science and Engineering (MS&E)
Completion of the undergraduate program in Management Science and Engineering leads to the conferral of the Bachelor of Science in Management Science and Engineering.

Requirements

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics and Science</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>Up to ten units of AP/IB Calculus, MATH 19, 20, and/or 21.</td>
<td>10</td>
<td></td>
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<tr>
<td>All required; see SoE Basic Requirements 1 and 2</td>
<td>22</td>
<td></td>
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<tr>
<td>CME 100 or MATH 51</td>
<td>Vector Calculus for Engineers, Linear Algebra, Multivariable Calculus, and Modern Applications</td>
<td></td>
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<tr>
<td>ENGR 108</td>
<td>Introduction to Matrix Methods (formerly CME 103)</td>
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<tr>
<td>MS&amp;E 120</td>
<td>Introduction to Probability</td>
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<tr>
<td>MS&amp;E 121</td>
<td>Introduction to Stochastic Modeling</td>
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<tr>
<td>MS&amp;E 125</td>
<td>Introduction to Applied Statistics</td>
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<tr>
<td>Select two of the following:</td>
<td>8</td>
<td></td>
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<tr>
<td>CHEM 31B</td>
<td>Chemical Principles II</td>
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<tr>
<td>CHEM 33</td>
<td>Structure and Reactivity of Organic Molecules</td>
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<tr>
<td>PHYSICS 41 or PHYSICS 21</td>
<td>Mechanics, Fluids, and Heat</td>
<td></td>
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<tr>
<td>PHYSICS 43 or PHYSICS 23</td>
<td>Electricity, Magnetism, and Optics</td>
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<tr>
<td>BIO 81</td>
<td>Introduction to Ecology</td>
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<tr>
<td>BIO 82</td>
<td>Genetics</td>
<td></td>
</tr>
<tr>
<td>BIO 83</td>
<td>Biochemistry &amp; Molecular Biology</td>
<td></td>
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<tr>
<td>BIO 84</td>
<td>Physiology</td>
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<tr>
<td>BIO 85</td>
<td>Evolution</td>
<td></td>
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<tr>
<td>BIO 86</td>
<td>Cell Biology</td>
<td></td>
</tr>
<tr>
<td>Math, Science, or Statistics Elective from SoE approved lists.</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Technology in Society

Select one of the following; see SoE Basic Requirement 4
- AA 252 Techniques of Failure Analysis
- BIOE 131 Ethics in Bioengineering
- COMM 120W The Rise of Digital Culture
- CS 181 Computers, Ethics, and Public Policy
- CS 182 Ethics, Public Policy, and Technological Change
- ENGR 117 Expanding Engineering Limits: Culture, Diversity, and Equity
- ENGR 148 Principled Entrepreneurial Decisions
- ME 267 Ethics and Equity in Transportation Systems
- MS&E 193 Technology and National Security: Past, Present, and Future
- POLSCI 114S International Security in a Changing World
- STS 1 The Public Life of Science and Technology

Engineering Fundamentals

Three required; see SoE Basic Requirement 3
- CS 106A Programming Methodology
- MS&E 111 Introduction to Optimization
  or MS&E 111X Introduction to Optimization (Accelerated)

Select one of the following:
- ENGR 10 Introduction to Engineering Analysis
- ENGR 14 Intro to Solid Mechanics
- ENGR 15 Dynamics
- ENGR 20 Introduction to Chemical Engineering
- ENGR 21 Engineering of Systems
- ENGR 40A Introductory Electronics
- ENGR 40M An Intro to Making: What is EE
- ENGR 42 Introduction to Electromagnetics and Its Applications
- ENGR 50 Introduction to Materials Science, Nanotechnology Emphasis
- ENGR 50E Introduction to Materials Science, Energy Emphasis
- ENGR 50M Introduction to Materials Science, Biomaterials Emphasis
- ENGR 80 Introduction to Bioengineering (Engineering Living Matter)
- ENGR 90 Environmental Science and Technology

Area Courses (eight required; see below)

Depth Areas
Choose eight courses; four courses from a primary area and two courses from each of the other two areas.

Finance and Decision Area
Students choosing F&D as their primary area must take at least two of ECON 51 (or MS&E 241), MS&E 145 (or 245A), and MS&E 152 (or 252).
Introductory (no prerequisites)

- **ECON 143**: Finance, Corporations, and Society
- **MS&E 152**: Introduction to Decision Analysis

Intermediate (has prerequisites and/or appropriate for juniors and seniors)

- **MS&E 145**: Introduction to Finance and Investment
- **MS&E 146**: Corporate Financial Management
- **MS&E 252**: Decision Analysis I: Foundations of Decision Analysis

Advanced (intended primarily for graduate students, but may be taken by advanced undergraduates)

- **MS&E 241**: Economic Analysis
- **MS&E 245A**: Investment Science
- **MS&E 245B**: Advanced Investment Science
- **MS&E 246**: Financial Risk Analytics
- **MS&E 250A**: Engineering Risk Analysis
- **MS&E 250B**: Project Course in Engineering Risk Analysis

**Operations and Analytics Area**

Students choosing O&A as their primary area may also include one of CS 161, CS 229, or STATS 202 in their selections.

**Methods**

- **MS&E 112**: Mathematical Programming and Combinatorial Optimization
- **MS&E 135**: Networks
- **MS&E 213**: Introduction to Optimization Theory
- **MS&E 223**: Simulation
- **MS&E 226**: Fundamentals of Data Science: Prediction, Inference, Causality
- **MS&E 231**: Introduction to Computational Social Science
- **MS&E 251**: Introduction to Stochastic Control with Applications

**Applications**

- **MS&E 130**: Information Networks and Services
- **MS&E 230**: Incentives and Algorithms
- **MS&E 232**: Introduction to Game Theory
- **MS&E 232H**: Introduction to Game Theory
- **MS&E 234**: Data Privacy and Ethics
- **MS&E 235**: Network Structure and Epidemics
- **MS&E 260**: Introduction to Operations Management
- **MS&E 263**: Healthcare Operations Management
- **MS&E 267**: Service Operations and the Design of Marketplaces
- **MS&E 330**: Law, Order, & Algorithms
- **MS&E 463**: Healthcare Systems Design

**Organizations, Technology, and Policy Area**

Introductory (no prerequisites)

- **ENGR 148**: Principled Entrepreneurial Decisions
- **MS&E 193**: Technology and National Security: Past, Present, and Future

Advanced (has prerequisites and/or appropriate for juniors and seniors)

- **BIOE 177**: Inventing the Future
- **ENGR 145**: Technology Entrepreneurship
- **MS&E 175**: Innovation, Creativity, and Change
- **MS&E 182A**: Leading Organizational Change
- **MS&E 182B**: Leading Organizational Change II
- **MS&E 184**: Future of Work: Issues in Organizational Learning and Design

**Electives (select any two 100- or 200-level MS&E courses)**

- MS&E 185: Global Work
- MS&E 188: Organizing for Good
- MS&E 243: Energy and Environmental Policy Analysis
- MS&E 292: Health Policy Modeling

1. Students without AP/IB mathematics credit, who skip MATH 19, 20, and/or 21, may petition to waive up to 10 units of math.
2. AP/IB credit for Chemistry and Physics may be used.
3. Electives must come from the School of Engineering approved list.
4. A course may only be counted towards one requirement; courses used to satisfy the TiS requirement may not be used to also satisfy a depth area requirement.
5. Engineering fundamentals plus engineering depth must total a minimum of 60 units. Recommended engineering fundamentals are E25B, E25E, E40A, E40M, and E80. MS&E majors may not use E60, or E70B as engineering fundamentals.
6. Students may petition to waive up to 10 units of math.
7. 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).

## Management Science and Engineering (MS&E) Minor

The following courses are required to fulfill the minor requirements:

<table>
<thead>
<tr>
<th>Units</th>
<th><strong>Prerequisites (two courses; letter-graded or CR/NC)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>CME 100 or MATH 51: Vector Calculus for Engineers</td>
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<tr>
<td>5</td>
<td>CS 106A: Programming Methodology</td>
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<tr>
<td>3-4</td>
<td><strong>Minor requirements (seven courses; all letter-graded)</strong></td>
</tr>
<tr>
<td>4</td>
<td>MS&amp;E 111 or MS&amp;E 111X: Introduction to Optimization</td>
</tr>
<tr>
<td>4</td>
<td>MS&amp;E 120: Introduction to Probability</td>
</tr>
<tr>
<td>4</td>
<td>MS&amp;E 121: Introduction to Stochastic Modeling</td>
</tr>
<tr>
<td>4</td>
<td>MS&amp;E 125: Introduction to Applied Statistics</td>
</tr>
<tr>
<td>4</td>
<td>MS&amp;E 180: Organizations: Theory and Management</td>
</tr>
<tr>
<td>6</td>
<td>Electives (select any two 100- or 200-level MS&amp;E courses)</td>
</tr>
</tbody>
</table>

**Recommended courses**

In addition to the required prerequisite and minor courses, it is recommended that students also take the following courses.

- **ECON 50**: Economic Analysis I
- **MS&E 140**: Accounting for Managers and Entrepreneurs (may be used as one of the required electives above)

1. Students completing a calculus-based probability course such as CS 109 or STATS 116 for their major, may substitute another MS&E course for MS&E 120.