Management Science and Engineering Undergraduate Major

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.

The department offers a B.S. as well as a minor in Management Science and Engineering.

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>Units</th>
<th>Mathematics and Science</th>
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<tbody>
<tr>
<td>44</td>
<td>Up to ten units of AP/IB Calculus, MATH 19, 20, 21, 41, or 42.</td>
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<tr>
<td>10</td>
<td>All required; see SoE Basic Requirements 1 and 2</td>
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<tr>
<td>23</td>
<td>CME 100 or MATH 51 Vector Calculus for Engineers Linear Algebra, Multivariable Calculus, and Modern Applications</td>
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<tr>
<td></td>
<td>CME 103 Introduction to Matrix Methods</td>
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<td></td>
<td>MS&amp;E 120 Probabilistic Analysis</td>
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<td></td>
<td>MS&amp;E 121 Introduction to Stochastic Modeling</td>
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<td></td>
<td>MS&amp;E 125 Introduction to Applied Statistics</td>
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<tr>
<td>8</td>
<td>Select two of the following: CHEM 31B Chemical Principles II CHEM 33 Structure and Reactivity of Organic Molecules PHYSICS 41 Mechanics PHYSICS 21 Mechanics, Fluids, and Heat PHYSICS 43 Electricity and Magnetism PHYSICS 23 Electricity, Magnetism, and Optics BIO 81 Introduction to Ecology BIO 82 Genetics BIO 83 Biochemistry &amp; Molecular Biology BIO 84 Physiology BIO 85 Evolution BIO 86 Cell Biology Math, Science, or Statistics Elective from SoE approved lists.</td>
</tr>
</tbody>
</table>

Technology in Society

Select one of the following; see SoE Basic Requirement 4 AA 252 Techniques of Failure Analysis COMM 120W The Rise of Digital Culture BIOE 131 Ethics in Bioengineering CS 181 Computers, Ethics, and Public Policy ENGR 117 Expanding Engineering Limits: Culture, Diversity, and Equity ENGR 148 Principled Entrepreneurial Decisions ME 267 Ethics and Equity in Transportation Systems

Engineering Fundamentals

Two courses; see SoE Basic Requirement 3 CS 106A Programming Methodology

Select one of the following:

<table>
<thead>
<tr>
<th>Engineering Depth</th>
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<tr>
<td>Core Courses (all six required)</td>
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<tr>
<td>27</td>
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<tr>
<td>CS 106B Programming Abstractions</td>
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<tr>
<td>or CS 106X</td>
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<tr>
<td>ECON 50 Economic Analysis I</td>
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<tr>
<td>MS&amp;E 108 Senior Project (WIM)</td>
</tr>
<tr>
<td>MS&amp;E 111 Introduction to Optimization</td>
</tr>
<tr>
<td>or MS&amp;E 111X Introduction to Optimization (Accelerated)</td>
</tr>
<tr>
<td>MS&amp;E 140 Accounting for Managers and Entrepreneurs</td>
</tr>
<tr>
<td>MS&amp;E 180 Organizations: Theory and Management</td>
</tr>
</tbody>
</table>

Area Courses (see below) Choose four courses from a primary area and two courses from each of the other two areas.

Depth Areas

Finance and Decision Area

Students choosing F&D as their primary area must take at least two of ECON 51, MS&E 145 (or 245A), and MS&E 152 (or 252). Introductory (no prerequisites) ECON 143 Finance and Society for non-MBAs 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 245A Investment Science
Management Science and Engineering (MS&E) Minor

The following courses are required to fulfill the minor requirements:

**Background requirements (two courses; letter-graded or CR/NC)**
- CME 100 or MATH 51: Linear Calculus for Engineers: 5 units
- CS 106A: Programming Methodology: 5 units

**Minor requirements (seven courses; all letter-graded)**
- MS&E 111 or MS&E 111X: Introduction to Optimization: 3-4 units
- MS&E 120: Probabilistic Analysis: 1 unit 1
- MS&E 121: Introduction to Stochastic Modeling: 4 units
- MS&E 125: Introduction to Applied Statistics: 4 units
- MS&E 180: Organizations: Theory and Management: 4 units
- Electives (select any two 100- or 200-level MS&E courses): 6 units

**Recommended courses**
- ECON 50: Economic Analysis I: 5 units
- MS&E 140: Accounting for Managers and Entrepreneurs (may be used as one of the required electives above): 3-4 units

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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.
2. Students without AP/IB mathematics credit, who skip MATH 19, 20, 21, 41, and/or 42, may petition to waive up to 10 units of math.
3. AP/IB credit for Chemistry and Physics may be used.
5. Students may petition to waive CS 106A Programming Methodology. A course may only be counted towards one requirement; it may not be double-counted. For example, MS&E 193 may not count towards both TiS and towards the OTP depth area, and MS&E 111/ENGR 62 may not count towards both an engineering fundamental and towards the MS&E core depth.
6. All courses taken for the major must be taken for a letter grade. 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).

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**Management Science and Engineering Undergraduate Major**

**Operations and Analytics Area**

Students choosing O&A as their primary area may also include CS 161, CS 229, and 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 232: Introduction to Game Theory
- MS&E 234: Data Privacy and Ethics
- 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, Bias, & Algorithms
- MS&E 463: Healthcare Systems Design

**Organizations, Technology, and Policy Area**

Students choosing OTP as their primary area must take at least two of ENGR 145, MS&E 175, MS&E 182A, MS&E 182B, MS&E 184, and MS&E 185.

**Introductory (no prerequisites)**
- ENGR 148: Principled Entrepreneurial Decisions
- MS&E 190: Methods and Models for Policy and Strategy Analysis
- MS&E 193: Technology and National Security: Past, Present, and Future

**Advanced (has prerequisites and/or appropriate for juniors and seniors)**
- ENGR 145: Technology Entrepreneurship
- MS&E 175 or MS&E 177: 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
- 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

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1. Students without AP/IB mathematics credit, who skip MATH 19, 20, 21, 41, and/or 42, 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 or PSYCH 50 Introduction to Cognitive Neuroscience, and may not repeat material from any other requirement. AP/IB credit for Chemistry and Physics may be used if not used above.