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" 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" section of this bulletin.

See the "Department of Management Science and Engineering" 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>Mathematics and Science</th>
<th>Units</th>
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<tbody>
<tr>
<td>All required; see SoE Basic Requirements 1 and 2</td>
<td>22</td>
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<table>
<thead>
<tr>
<th>Engineering Fundamentals</th>
<th>Units</th>
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<tbody>
<tr>
<td>All required; see SoE Basic Requirement 3</td>
<td>12</td>
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<table>
<thead>
<tr>
<th>Engineering Depth</th>
<th>Units</th>
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<tbody>
<tr>
<td>All required; see below</td>
<td>52</td>
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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
- POLISCI 114S International Security in a Changing World
- STS 1 The Public Life of Science and Technology

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

Core Courses (all six required)

| CS 106B Programming Abstractions |
| ECON 1 Principles of Economics |
| ECON 50 Economic Analysis I |
| MS&E 108 Senior Project (WIM) |
| MS&E 140 Accounting for Managers and Entrepreneurs |
| MS&E 180 Organizations: Theory and Management |

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).
Introduction (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

Applications

- MS&E 130 Information Networks and Services
- MS&E 230 Market Design for Engineers
- 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

	| 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 or PSYCH 50 Introduction to Cognitive Neuroscience, may not repeat material from any other requirement, and may not be used to also satisfy an engineering fundamentals or depth requirement. AP/IB credit for Chemistry and Physics may be used if not used above.
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 CS 106A Programming Methodology after completion of CS 106B Programming Abstraction, and/or ECON 1 Principles of Economics after completion of ECON 50 Economic Analysis I.
7. 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).

Management Science and Engineering (MS&E) Minor

The following courses are required to fulfill the minor requirements:

<table>
<thead>
<tr>
<th>Prerequisites (two courses; letter-graded or CR/NC)</th>
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<tbody>
<tr>
<td>Units</td>
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<tr>
<td>CME 100 or MATH 51</td>
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<tr>
<td>CS 106A</td>
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Minor requirements (seven courses; all letter-graded)

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<th>Units</th>
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<tr>
<td>MS&amp;E 111</td>
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<tr>
<td>or MS&amp;E 111X</td>
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<tr>
<td>MS&amp;E 120</td>
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<td>MS&amp;E 121</td>
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<tr>
<td>MS&amp;E 125</td>
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<tr>
<td>MS&amp;E 180</td>
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Electives (select any two 100- or 200-level MS&E courses) | 6 |

Recommended courses

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<th>Units</th>
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<tbody>
<tr>
<td>ECON 50</td>
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<tr>
<td>MS&amp;E 140</td>
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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.