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

Mathematics and Science

<table>
<thead>
<tr>
<th>Units</th>
<th>Description</th>
</tr>
</thead>
</table>
| 23    | CME 100 Vector Calculus for Engineers  
               or MATH 51 Linear Algebra, Multivariable Calculus, and Modern Applications |
|       | CME 103 Introduction to Matrix Methods  
               MS&E 120 Probabilistic Analysis  
               MS&E 121 Introduction to Stochastic Modeling  
               MS&E 125 Introduction to Applied Statistics |

Select two of the following options: 8-10

<table>
<thead>
<tr>
<th>Units</th>
<th>Description</th>
</tr>
</thead>
</table>
| 8-10  | CHEM 31B Chemical Principles II  
               or CHEM 31X Chemical Principles Accelerated  
               CHEM 33 Structure and Reactivity of Organic Molecules  
               PHYSICS 41 Mechanics  
               or PHYSICS 21 Mechanics, Fluids, and Heat  
               PHYSICS 43 Electricity and Magnetism  
               or PHYSICS 23 Electricity, Magnetism, and Optics  
               BIO 81 Introduction to Ecology  
               BIO 82 Genetics  
               BIO 83 Biochemistry & Molecular Biology  
               BIO 84 Physiology  
               BIO 85 Evolution  
               BIO 86 Cell Biology  
               Math, Science, or Statistics Elective from SoE approved lists. |

Math, Science, or Statistics Elective from SoE approved lists. 3

Up to ten units of AP/IB Calculus, MATH 19, 20, 21, 41, or 42. 10

Engineering Fundamentals 1

Two courses; see SoE Basic Requirement 3 8-10

<table>
<thead>
<tr>
<th>Units</th>
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</table>
|       | CS 106A Programming Methodology  
               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 25B Biotechnology  
               ENGR 25E Energy Chemical Transformations for Production, Storage, and Use  
               ENGR 40A Introductory Electronics  
               ENGR 40M An Intro to Making: What is EE  
               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 |

Engineering Depth 2

Core Courses (all six required) 25-27

<table>
<thead>
<tr>
<th>Units</th>
<th>Description</th>
</tr>
</thead>
</table>
|       | CS 106B Programming Abstractions  
               or CS 106X Programming Abstractions (Accelerated)  
               ECON 50 Economic Analysis I  
               MS&E 108 Senior Project (WIM)  
               MS&E 111 Introduction to Optimization  
               or MS&E 111X Introduction to Optimization (Accelerated)  
               MS&E 140 Accounting for Managers and Entrepreneurs  
               or MS&E 140X Financial Accounting Concepts and Analysis  
               MS&E 180 Organizations: Theory and Management |

Area Courses (see below) 27

Choose four or five courses (minimum 15 units) from a primary area and two courses (minimum 6 units) from each of the other two areas.

Depth Areas

Finance and Decision Area 6-15

<table>
<thead>
<tr>
<th>Units</th>
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</tr>
</thead>
</table>
|       | 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), as part of their 15 units  
               Introductory (no prerequisites)  
               MS&E 147 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 Investment Science  
               MS&E 146 Corporate Financial Management |
Management Science and Engineering Undergraduate Major

### Operations and Analytics Area

Students choosing O&A as their primary area must take at least two of ENGR 145, MS&E 175, MS&E 182, MS&E 184, and MS&E 185 as part of their 15 units. Recommended engineering fundamentals are E25B, E25E, E40A, E40M, and E80.

### Applications

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 193.

### Organizations, Technology, and Policy Area

Students choosing OT&P as their primary area must take at least two of ENGR 145, MS&E 175, MS&E 182, MS&E 184, and MS&E 185 as part of their 15 units. Students may petition to place out of CS 106A Programming Methodology.

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>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS&amp;E 252</td>
<td>Decision Analysis I: Foundations of Decision Analysis</td>
</tr>
<tr>
<td>MS&amp;E 245A</td>
<td>Investment Science</td>
</tr>
<tr>
<td>MS&amp;E 245B</td>
<td>Advanced Investment Science</td>
</tr>
<tr>
<td>MS&amp;E 246</td>
<td>Financial Risk Analytics</td>
</tr>
<tr>
<td>MS&amp;E 250A</td>
<td>Engineering Risk Analysis</td>
</tr>
<tr>
<td>MS&amp;E 250B</td>
<td>Project Course in Engineering Risk Analysis</td>
</tr>
</tbody>
</table>

#### Background requirements (two courses; letter-graded or CR/NC)

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<tbody>
<tr>
<td>CME 100</td>
<td>Vector Calculus for Engineers</td>
</tr>
<tr>
<td>or MATH 51</td>
<td>Linear Algebra, Multivariable Calculus, and Modern Applications</td>
</tr>
<tr>
<td>CS 106A</td>
<td>Programming Methodology</td>
</tr>
</tbody>
</table>

#### Minor requirements (seven courses; all letter-graded)

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>MS&amp;E 111</td>
<td>Introduction to Optimization</td>
</tr>
<tr>
<td>or MS&amp;E 111X</td>
<td>Introduction to Optimization (Accelerated)</td>
</tr>
<tr>
<td>MS&amp;E 120</td>
<td>Probabilistic Analysis</td>
</tr>
<tr>
<td>MS&amp;E 121</td>
<td>Introduction to Stochastic Modeling</td>
</tr>
<tr>
<td>MS&amp;E 125</td>
<td>Introduction to Applied Statistics</td>
</tr>
<tr>
<td>MS&amp;E 180</td>
<td>Organizations: Theory and Management</td>
</tr>
<tr>
<td>Electives</td>
<td>(select any two 100- or 200-level MS&amp;E courses)</td>
</tr>
</tbody>
</table>

#### Recommended courses

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

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<th>Course Code</th>
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</tr>
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<tbody>
<tr>
<td>ECON 50</td>
<td>Economic Analysis I</td>
</tr>
<tr>
<td>MS&amp;E 140</td>
<td>Accounting for Managers and Entrepreneurs</td>
</tr>
<tr>
<td>or MS&amp;E 140X</td>
<td>Financial Accounting Concepts and Analysis</td>
</tr>
</tbody>
</table>

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1. Math and Science must total a minimum of 44 units. Electives must come from the School of Engineering approved list or PSYCH 50.  
3. Students may petition to place out of CS 106A Programming Methodology.  
4. 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.  
5. 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.

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