

# 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://exploreddegrees.stanford.edu/schoolofengineering/managementscienceandengineering/#covid19policiestext>) 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://exploreddegrees.stanford.edu/covid-19-policy-changes/>) section of this bulletin.

See the "Department of Management Science and Engineering" (<http://exploreddegrees.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

	<b>Units</b>
<b>Mathematics and Science</b>	<b>43</b>
Up to ten units of AP/IB Calculus, MATH 19, 20, and/or 21. <sup>1</sup>	10
All required; see SoE Basic Requirements 1 and 2	22
CME 100 Vector Calculus for Engineers or MATH 51 Linear Algebra, Multivariable Calculus, and Modern Applications	
ENGR 108 Introduction to Matrix Methods (formerly CME 103)	
MS&E 120 Introduction to Probability	
MS&E 121 Introduction to Stochastic Modeling	
MS&E 125 Introduction to Applied Statistics	
Select two of the following: <sup>2</sup>	8
CHEM 31B Chemical Principles II	
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. <sup>3</sup>	3

## Technology in Society <sup>4</sup> 3

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

## Engineering Fundamentals <sup>5</sup> 12

Three required; see SoE Basic Requirement 3

CS 106A	Programming Methodology <sup>6</sup>
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

## Engineering Depth <sup>5</sup> 52

Core Courses (all six required) 28

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) 24

### 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&amp;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

- Students without AP/IB mathematics credit, who skip MATH 19, 20, and/or 21, may petition to waive up to 10 units of math.
- AP/IB credit for Chemistry and Physics may be used.
- 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.
- 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.
- 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.
- 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.
- 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:

	Units
<b>Prerequisites (two courses; letter-graded or CR/NC)</b>	
CME 100	Vector Calculus for Engineers 5
or MATH 51	Linear Algebra, Multivariable Calculus, and Modern Applications
CS 106A	Programming Methodology 5
<b>Minor requirements (seven courses; all letter-graded)</b>	
MS&E 111	Introduction to Optimization 3-4
or MS&E 111X	Introduction to Optimization (Accelerated)
MS&E 120	Introduction to Probability <sup>1</sup> 4
MS&E 121	Introduction to Stochastic Modeling 4
MS&E 125	Introduction to Applied Statistics 4
MS&E 180	Organizations: Theory and Management 4
Electives (select any two 100- or 200-level MS&E courses)	6
<b>Recommended courses</b>	
In addition to the required prerequisite and minor courses, it is recommended that students also take the following courses.	
ECON 50	Economic Analysis I 5
MS&E 140	Accounting for Managers and Entrepreneurs (may be used as one of the required electives above) 3-4

- 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.