

# Master's Degree in Management Science and Engineering

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The program of Master of Science in Management Science and Engineering (MS&E) prepares individuals for a life-long career addressing critical technical and managerial needs in private and public decision making. Department requirements for the M.S. degree provide breadth across some of the areas of the department, and flexibility for meeting individual objectives of depth in a particular area of concentration. The Master's degree may be a terminal degree program with a professional focus, or a preparation for a more advanced graduate program. The M.S. degree can normally be earned in one academic year (three academic quarters) of full-time work, although students may choose to continue their education by taking additional MS&E courses beyond that year. Students completing 15 or more units per quarter can easily complete the degree in three quarters. Students completing 8-10 units per quarter can complete the degree in five quarters. Background requirements, taken in addition to degree requirements, must be met by students who have had insufficient course work in mathematical sciences, computer science, engineering and/or natural sciences.

## **Description of the Master's Program**

Students in the Master of Science program in MS&E must take a minimum of 45 unduplicated course units at Stanford as follows:

- at least five core courses (breadth)
- at least three other courses in an area of concentration of their choice (depth)
- a course in probability unless a college-level course in probability has already been passed
- a project course requirement
- the remaining units in elective courses.

### *Background requirements*

Students must have had or must take the following (or equivalent) courses before the M.S. degree is conferred: Mathematics 41, 42, 51 (Calculus: 15 units), CS 106 A (Programming: 5 units), and an additional 15 units of engineering, mathematical sciences, or natural sciences. These courses do not count toward the 45 units of the M.S. degree. Courses taken to meet MS&E background requirements may be at either the undergraduate or graduate level, and may be taken as credit/no credit. These additional background requirements would typically be met by students who have a Bachelor's degree in engineering, mathematical sciences or natural sciences.

### *Core courses (breadth)*

M.S. students must take at least five courses out of the following ten options (as of this day, the numbering is as shown below):

- Dynamic Systems (MS&E 201) or Stochastic Decision Models (MS&E 251)
- Linear and Nonlinear Optimization (MS&E 211)
- Stochastic Modeling (MS&E 221) or Simulation (MS&E 223)
- Economic Analysis (MS&E 241)
- Decision Analysis I (MS&E 252) or Risk Analysis (MS&E 250A)

- Industrial Accounting (MS&E 240) or Investment Science (MS&E 242/242H/242S)\*
- Production Systems (MS&E 261)\*
- Organizational Behavior and Management (MS&E 280)\*
- Global Entrepreneurial Marketing (MS&E 271)\*
- Strategy in Technology-based Companies (MS&E 270)\*

Students may not waive core courses. They may, however, petition to substitute an approved, more advanced course in the same area. Courses used to satisfy the core requirement must be taken for a letter grade, must be taken for a minimum of three units each, and may not also be used to satisfy the concentration requirement. Courses marked with an \* are limited enrollment courses.

#### *Courses in an area of concentration (depth)*

Students must complete a departmentally approved set of three or more letter-graded courses taken for a minimum of three units each, in an area of concentration of one of the following types:

1. An area of concentration in the MS&E department (see list in Appendix B).
2. An area of concentration in one of the other departments or centers of the School of Engineering
3. In exceptional cases, a coherent area of concentration designed by the student.

Petitions for student-designed concentrations must list the three proposed courses (taken for three units or more and at the 200-level or above) and include a brief justification. The petition must be submitted to Student Services no later than the fifth week of the quarter prior to graduation.

#### *Project course requirement*

Students must take either a designated project course or two designated integrated project courses (see list in Appendix A). The project course(s) must be taken for letter grade, and must be taken for a minimum of three units and may also be used to satisfy the core or concentration requirement.

#### *Additional requirements*

- At least 45 units must be in courses numbered 100 and above.
- At least 27 units must be in courses numbered 200 and above in the MS&E department, taken for a letter grade and a minimum of three units each, and at least 36 letter graded units must be in MS&E or closely related fields. Closely related fields include any department in the School of Engineering, mathematics, statistics, economics, sociology, psychology, or business.
- The degree program must be completed with a grade point average of 3.0 or higher.
- A maximum of three units of language courses (numbered 100 and above) may be applied toward the degree.
- A maximum of three units of 1-unit seminars, colloquia, workshops, etc., in any department, may be applied toward the degree, and a maximum of one unit of MS&E 208 Curricular Practical Training may be applied toward the degree.
- A maximum of 18 Non-Degree Option (NDO) units through the Stanford Center for Professional Development (SCPD) may be applied toward the degree.
- Courses in athletics do not apply towards the degree.

*Appendix A:*

List of the project courses of the MS&E department

MS&E regular project courses (courses that are constituted of one project)

MS&E 250 B Project Course in Engineering Risk Analysis  
MS&E 348 Optimization of Uncertainty and Applications in Finance  
MS&E 430 Tools for Experience Design  
MS&E 444 Investment Practice  
MS&E 445 Projects in Wealth Management  
MS&E 452 Decision Systems II: Business, Consumer, and Medical Applications  
MS&E 457 Decision Analysis Projects: Helping Real Leaders Make Real Decisions  
MS&E 464 Global Project Coordination  
MS&E 485 Crosscultural Design

MS&E integrated project courses (courses that include both lectures and a project)

MS&E 201 Dynamic Systems  
MS&E 206 Art of Mathematical Modeling  
MS&E 211 Linear and Nonlinear Optimization  
MS&E 212 Mathematical Programming and Combinatorial Optimization  
MS&E 234 Organizations and Information Systems  
MS&E 235 Internet Commerce  
MS&E 243 Energy and Environmental Policy Analysis  
MS&E 248 Economics of Natural Resources  
MS&E 262 Supply Chain Management  
MS&E 263 Internet-Enabled Supply Chains  
MS&E 264 Manufacturing Systems Design  
MS&E 265 Supply Chain Logistics  
MS&E 266 Management of New Product Development  
MS&E 267 Innovations in Manufacturing  
MS&E 269 Quality Control and Management  
MS&E 270 Strategy in Technology-Based Companies  
MS&E 273 Technology Venture Formation  
MS&E 274 Building Dynamic Entrepreneurial Organizations  
MS&E 277 Creativity and Innovation  
MS&E 280 Organizational Behavior: Evidence in Action  
MS&E 281 Management and Organization of Research and Development  
MS&E 284 Technology and Work  
MS&E 311 Optimization  
MS&E 315 Numerical Optimization  
MS&E 339 Neuro-Dynamic Programming  
MS&E 347 Credit Risk: Modeling and Management  
MS&E 355 Influence Diagrams and Probabilistic Networks

*Appendix B:*List of the approved concentrations (depth) of the MS&E department**Decision and Risk Analysis**

<u>Course #</u>	<u>Title</u>	<u>Units</u>
250A	Engineering Risk Analysis	3*
250B	Project Course in Engineering Risk Analysis	3
251	Stochastic Decision Models	3*
252	Decision Analysis I	3-4*
254	The Ethical Analyst	3
256	Technology Assessment and Regulation of Medical Devices	3
350	Doctoral Seminar in Risk Analysis	3
351	Dynamic Programming and Stochastic Control	3
352	Decision Analysis II	3-4
353	Decision Analysis III	3
355	Influence Diagrams and Probabilistic Networks	3
451	Decision Systems I: Professional Secrets and Tricks of the Trade	3
452	Decision Systems II: Business, Consumer, and Medical Apps	3
457	Decision Analysts Projects: Helping Leaders Make Real Decns	3

**Economics and Finance**

<u>Course #</u>	<u>Title</u>	<u>Units</u>
241	Economic Analysis	3-4*
242/H/S	Investment Science	3*
243	Energy and Environmental Policy Analysis	3
245G	Finance I for non-MBAs	4
247S	International Investments ( <i>summer only</i> )	3
248	Economics of Natural Resources	3-4
249	Growth and Development ( <i>summer only</i> )	3
252	Decision Analysis I	3-4*
341	Advanced Economic Analysis	3
342	Advanced Investment Science	3
344	Applied Information Economics	3
345	Advanced Topics in Financial Engineering	3
347	Credit Risk: Modeling and Management	3
349	Investment Science Frontiers	3
444	Investment Practice	3-4
FIN 323	International Finance Management	4

\* These courses are also listed as core courses. You may use them to satisfy *either* the core *or* the concentration requirement, *but not both*.

**Information Science and Technology**

<u>Course #</u>	<u>Title</u>	<u>Units</u>	
234	Organizations and Information Systems	4	
235	Internet Commerce	3	
237	Progress in Worldwide Telecommunications ( <i>summer only</i> )	3	
238	Network Structures and Analysis	3	
332	Security and Risk in Computer Networks	3	
335	Queuing Systems and Networks	3	
336	Market Models for Networked Systems	3	
337	Information Networks	3	
338	Advanced Topics in Information Science and Technology	3	
339	Approximate Dynamic Programming	3	
CS 364A	Game Theory in the Internet	3	
EE 284	Introduction to Computer Networks	3	3-4
EE 384S	Network Architectures and Performance Engineering	3	

**Operations Research**

<u>Course #</u>	<u>Title</u>	<u>Units</u>
211	Linear and Nonlinear Optimization	3-4*
212	Mathematical Programming and Combinatorial Optimization	3
221	Stochastic Modeling	3*
223	Simulation	3*
246	Game Theory with Engineering Applications	3
251	Stochastic Decision Models	3*
310	Linear Programming	3
311	Optimization	3
312	Advanced Methods in Numerical Optimization	3
313	Vector Space Optimization ( <i>alternate years</i> )	3
314	Linear and Conic Optimization With Applications	3
315	Numerical Optimization	3
316	Pricing Algorithms and the Internet	3
318	Large-Scale Numerical Optimization	3
319	Models and Algorithms for Nanotechnology	3
321	Stochastic Systems	3
322	Stochastic Calculus and Control ( <i>alternate years</i> )	3
323	Stochastic Simulation ( <i>alternate years</i> )	3
332	Security and risk in Computer Networks	3
334	Network Architectures and Performance Engineering	3
335	Queuing Systems and Networks	3
336	Market Models for Networked Systems	3
337	Information Networks	3
338	Advanced Topics in Information Science and Technology	3
339	Approximate Dynamic Programming	3
348	Optimization of Uncertainty and Applications in Finance	3
351	Dynamic Programming and Stochastic Control	3
355	Influence Diagrams and Probabilistic Networks	3
361	Supply Chain Optimization ( <i>alternate years</i> )	3

\* These courses are also listed as core courses. You may use them to satisfy *either* the core *or* the concentration requirement, *but not both*.

**Organizations, Technology and Entrepreneurship**

<u>Course #</u>	<u>Title</u>	<u>Units</u>
267	Innovations in Manufacturing	3-4
271	Global Entrepreneurial Marketing	4*
272	Entrepreneurial Finance	3
273	Technology Venture Formation	3-4
274	Building Dynamic Entrepreneurial Organizations	3
277	Creativity and Innovation	4
280	Organizational Behavior and Management	3-4
281	Mgmt and Organization of Research and Dev ( <i>alternate years</i> )	3
282	Innovation and Implementation in Complex Organizations	3
282B	Creative Product Marketing	3
285	Negotiation	3
286	Interpersonal Influence and Leadership	3-4
288	Creating Infectious Action	3-4
289	Clicks and Bricks	3

**Policy and Strategy**

<u>Course #</u>	<u>Title</u>	<u>Units</u>
271	Global Entrepreneurial Marketing	4*
272	Entrepreneurial Finance	3
273	Technology Venture Formation	3-4
274	Building Dynamic Entrepreneurial Organizations	3
277	Creativity and Innovation	4
292	Health Policy Modeling	3
293	Technology and National Security	3
294	Climate Policy Analysis	3
299	Designing a Free Society	3

\* These courses are also listed as core courses. You may use them to satisfy *either* the core *or* the concentration requirement, ***but not both***.

**Production and Operations Management**

<u>Course #</u>	<u>Title</u>	<u>Units</u>
246	Game Theory with Engineering Applications	3
260	Analysis of Production and Operating Systems	4
261	Inventory Control and Production Systems	3*
262	Supply Chain Management	3
263	Internet-Enabled Supply Chains	3
263B	Demand and Supply Chain Analytics	3
264	Manufacturing Systems Design	4
265	Supply Chain Logistics ( <i>alternate years</i> )	4
266	Management of New Product Development	3-4
267	Innovations in Manufacturing	3-4
268	Operations Strategy	3
269	Quality Control and Management	4
369	Supply Chain Risk and Flexibility Management	3
464	Global Project Coordination	3-4

Although we expect most M.S. students to select from the above list, students with exceptionally strong analytical backgrounds may wish to take a 300-level doctoral course in this area, such as 361 through 366. These 300-level courses are also allowed as concentration courses in Production and Operations Management.

\* These courses are also listed as core courses. You may use them to satisfy *either* the core *or* the concentration requirement, ***but not both***.