MANAGEMENT SCIENCE AND ENGINEERING

Emeriti (Professors): James L. Adams, Kenneth J. Arrow, George B. Dantzig, Donald A. Dunn, B. Curtis Eaves, Frederick S. Hillier, Donald L. Iglehart, James V. Jucker, Alan S. Manne, Michael M. May, Robert V. Oakford, Henry E. Riggs, David A. Thompson
Chair: M. Elisabeth Paté-Cornell
Deputy Chairs: Thomas H. Byers, Peter W. Glynn
Professors: Stephen R. Barley, Margaret L. Brandeau, Robert C. Carlson, Richard W. Cottle, Kathleen M. Eisenhardt, Peter W. Glynn, Warren H. Hausman, Ronald A. Howard, David G. Luenberger, M. Elisabeth Paté-Cornell, William J. Perry, Robert I. Sutton, James L. Sweeney, Arthur F. Veinott, Jr., Yinyu Ye
Associate Professors: Nicholas Bambos, Samuel S. Chiu, Ross D. Shachter, Edison T. S. Tse
Assistant Professors: Diane E. Bailey, Feryal Erhun, Ashish Goel, Pamela J. Hinds, Riitta Katali, Ozalp Ozer, James A. Primbs, Benjamin Van Roy
Professors (Research): Walter Murray, Michael A. Saunders, John P. Weyant
Professors (Teaching): Thomas H. Byers, Robert E. McGinn
Consulting Professors: Hung-Po Chao, Thomas Kosnik, James E. Matheson, Robert R. Maxfield, Nimrod Megiddo, Peter A. Morris, D. Warner North, Sam Savage, Richard D. Smallwood
Consulting Associate Professors: Stephen Barrager, Adam Borison, Naushad Forbes, Samuel Holtzman, Gerd Infanger, Randy Kosimar, Mark Leslie, Audrey MacLean, Burke Robinson, Vic Stanton, Behnam Tabrizi
Consulting Assistant Professors: Blake E. Johnson, Mike Lyons
Lecturers: Peter Haas, Hervé Kieffel, Doug Mackenzie, Tina Seelig
Visiting Professors: Olivier de La Grandville
Visiting Associate Professor: Yee-Tien Fu
Visiting Lecturer: Ferdo Ivanek
Director of the Industrial Affiliates Program: Yinye Ye
Affiliated Faculty: David Beach, Darrell Duffie, J. Michael Harrison, Charles A. Holloway, Kosuke Ishii, James G. March, David B. Montgomery, Evan L. Porteus, Balaji Prabhakar, Krishna Saraswat

Department Offices: Terman Engineering Center
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Courses given in Management Science and Engineering have the subject code MS&E. For a complete list of subject codes, see Appendix B.

In December 1999, the Board of Trustees authorized the creation of the Department of Management Science and Engineering from the Department of Industrial Engineering and Engineering Management and the Department of Engineering-Economic Systems and Operations Research. The department's mission is: "to conduct research and provide education associated with the development of the knowledge, tools, and methods required to make decisions and shape policies, configure organizational structures, design engineering systems, and solve operational problems associated with the information-intensive, technology-based economy."

Management Science and Engineering (MS&E) provides exceptionally strong programs of education and research by integrating three basic strengths: (1) substantial depth in conceptual and analytical foundations, (2) comprehensive coverage of functional areas of application, and (3) vigorous interaction with other Stanford departments, with Silicon Valley industry, and with many organizations throughout the world. The analytical and conceptual foundations include optimization, dynamic systems, stochastic systems, economics, organizational science, and decision and risk analysis. These foundations support the functional areas and provide the basis for further advance in the discipline. The functional areas of application include finance, production, information, organizational behavior, marketing, entrepreneurship, policy, and strategy. Programs in these functional areas emphasize both fundamental concepts and practical applications. Close associations with other engineering departments and with industry enrich the programs by providing opportunities to apply MS&E methods to important problems and by motivating new theoretical developments from practical experience. MS&E's programs also provide a basis for contributing to other important areas such as biotechnology, defense policy, environmental policy, information systems, telecommunications, and other areas where mastery of fundamentals, functional knowledge, and an engineering viewpoint are extremely valuable.

CAREERS IN MS&E

MS&E helps students prepare for a variety of professional careers in business, government, industry, non-profit institutions, and universities. Graduates have pursued successful careers in consulting, enterprise management, financial analysis, government policy analysis, industrial research, line management, product development, project management, strategic planning, and university teaching and research. Some have founded companies specializing in financial services, high technology products, management and systems consulting, or software. Other graduates have helped establish new analytical capabilities in existing firms or government agencies.

Many graduates have become leaders in technology-based businesses, which have an increasing need for well-educated, analytically oriented people who understand both business and technology. The Department of MS&E is attractive to people with engineering, mathematical science, and physical science backgrounds as it complements their technical abilities with the conceptual frameworks needed to analyze problems of investment, management, marketing, operations, production, and strategic planning in a technical environment.

UNDERGRADUATE PROGRAMS

BACHELOR OF SCIENCE

The program leading to the B.S. degree in Management Science and Engineering (MS&E) is stated earlier under the "School of Engineering" section of this bulletin, and more information is contained in the School of Engineering's *Handbook for Undergraduate Engineering Programs*. Students are encouraged to plan their academic programs as early as possible, ideally in the freshman or sophomore year. Please do not wait until you are declaring a major to consult with the department's Student Services staff. This is particularly important if you would like to study overseas or pursue another major or minor.

The undergraduate curriculum in Management Science and Engineering provides students training in the fundamentals of engineering systems analysis to prepare them to plan, design, and implement complex economic and technological management systems where a scientific or engineering background is necessary or desirable. Graduates will be prepared for work in a variety of career paths, including facilities and process management, investment banking, management consulting, or graduate study in industrial engineering, operations research, economics, public policy, medicine, law, or business.

The educational objectives of the undergraduate degree program are:

1. *Principles and Skills:* provide our students with a basic understanding of management science and engineering principles, including analytical problem solving and communications skills.
2. *Preparation for Practice:* prepare our students for practice in a field that sees rapid changes in tools, problems, and opportunities.
3. *Preparation for Continued Growth:* prepare our students for graduate study and self development over an entire career, and
4. *Preparation for Service:* develop in our students the awareness, background, and skills necessary to become responsible citizens, employees, and leaders.

In particular, we want to help our students develop:

a) an ability to apply knowledge of math, science, and engineering.
b) an ability to design and conduct experiments.

c) an ability to design a system or components to meet desired needs.
d) an ability to identify, formulate, and solve engineering problems.
e) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
f) an ability to function on multidisciplinary teams.
g) an ability to communicate effectively.
h) a recognition of the need for and an ability to engage in life-long learning.
i) background necessary for admission to top professional graduate engineering or business programs.
j) an understanding of professional and ethical responsibility.
k) the broad education necessary to understand the impact of engineering solutions in a global and societal context.
l) a knowledge of contemporary issues pertinent to the field of management science and engineering.

The program builds on the foundational courses for engineering, including calculus, physics, chemistry, and engineering fundamentals.

The department core, taken for all concentrations, includes courses in computer science, mathematical modeling, optimization, finance, organization theory, probability, and statistics. Through the core, all students in the program are exposed to the breadth of faculty interests, and are in a good position to choose a concentration during the junior year.

The six concentrations are designed to allow a student to explore one area of the department in greater depth.

1. *Industrial Engineering:* focuses on the design and analysis of manufacturing, production, and service systems. This program includes a capstone project course, and its curriculum is accredited by the Accreditation Board for Engineering and Technology (ABET). Accreditation facilitates the process for those students who wish to become licensed industrial engineers.
2. *Operations Management*: also focuses on the design and analysis of manufacturing, production, and service systems, but does not require the project course.
3. *Financial and Decision Engineering:* focuses on the design and analysis of financial and strategic plans. It features accounting, decision analysis, economics, finance, investment science, and stochastic models.
4. *Operations Research:* provides a more mathematical program, based on algorithms, theory, and applications in economics and operations.
5. *Technology and Organizations:* designed for students seeking a broad technological background coupled with an understanding of the behavior of individuals and groups. It features courses exploring different aspects of technology-based organizations.
6. *Technology and Policy:* designed for students seeking a broad technological background coupled with policy analysis. It features courses in microeconomics, public policy, ethics or the law, and applications in national security and commercial technology policy.

For information about an MS&E minor, see the "School of Engineering" section of this bulletin.

MS&E also participates with the departments of Computer Science, Mathematics, and Statistics in a program leading to a B.S. in Mathematical and Computational Science. See the "Mathematical and Computational Science" section of this bulletin.

GRADUATE PROGRAMS

MS&E, in collaboration with other departments of the University, offers programs leading to the degrees of Master of Science and Doctor of Philosophy. The department also offers a coterminal B.S./M.S. degree, and a dual master's degree in cooperation with each of the other departments in the School of Engineering.

Applicants for admission as graduate students in MS&E must submit the results of the verbal, quantitative, and analytical parts of the Graduate Record Examination. The deadline for application is January 15.

Except in unusual circumstances, admission is limited to the Autumn Quarter because courses are arranged sequentially with basic courses and prerequisites offered early in the academic year.

Assistantships and Fellowships—A limited number of fellowships and assistantships are awarded each year. Applicants admitted to the doctoral program, who have indicated on their application that they would like to be considered for financial aid, are automatically considered for these assistantships and fellowships.

Information about loan programs and need-based aid for U.S. citizens and permanent residents can be obtained from the Financial Aid Office.

MASTER OF SCIENCE

The M.S. degree programs require a minimum of 45 units beyond the equivalent of a B.S. degree at Stanford. All programs represent substantial progress in the major field beyond the bachelor's degree.

University requirements for the master's degree are described in the "Graduate Degrees" section of this bulletin.

MANAGEMENT SCIENCE AND ENGINEERING

The M.S. program in Management Science and Engineering (MS&E) prepares individuals for a lifelong 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. 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.

Students must take a minimum of 45 course units as follows:

1. At least five core courses.
2. At least three other courses in an area of concentration of their choice.
3. A course in probability, unless a college-level course in probability has already been passed.
4. A project course requirement.
5. 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: MATH 41, 42, 51 (Calculus, 15 units), CS 106A (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, or mathematical or natural sciences. Students are notified at the time of admission of any remaining need to meet background requirements.

Core Courses—M.S. students must take at least five courses out of the following ten options:

Decision Analysis (MS&E 252), or Risk Analysis (MS&E 250A)
Dynamic Systems (MS&E 201) or Stochastic Decision Models (MS&E 251)
Economic Analysis (MS&E 241)
Global Entrepreneurial Marketing (MS&E 271)
Industrial Accounting (MS&E 140), Investment Science (MS&E 242), or Introduction to Finance (MS&E 245G)
Introduction to Stochastic Modeling (MS&E 221) or Simulation (MS&E 223)
Linear and Non-Linear Optimization (MS&E 211)
Organizational Behavior and Management (MS&E 280)
Production Systems (MS&E 261)
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 in an Area of Concentration—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.
2. An area of concentration in one of the seven other departments 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. 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 are:

1. At least 45 units must be in courses numbered 100 and above, with the exception of Engineering Fundamentals courses (10, 14, 15, 20, 25, 30, 40, 50, 60, 62).
2. At least 27 units must be in courses numbered 200 and above in MS&E, taken for a letter grade and a minimum of three units each, and at least 36 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.
3. The degree program must be completed with a grade point average (GPA) of 3.0 or higher.
4. A maximum of three units of language courses (numbered 100 and above) .
5. A maximum of three units of 1-unit seminars, colloquia, workshops, etc., in any department, and a maximum of one unit of MS&E 208 Curricular Practical Training.
6. A maximum of 18 Non-Degree Option (NDO) units through the Stanford Center for Professional Development (SCPD).
7. Courses in athletics may not be applied toward the degree.

Please see student services' office or department web site for complete listing of project, integrated project and approved concentrations.

MANAGEMENT SCIENCE AND ENGINEERING (MS&E) AND ELECTRICAL ENGINEERING (EE)

Admission—For the dual degree, admission to both departments is required, but is coordinated by designated members of both Admissions Committees who make recommendations to the committees of their respective departments. Students may apply to only one Department initially. After the first quarter at Stanford, students may apply to be admitted to the second Department.

Advising—Every student in the dual degree program has one adviser in EE, and one in MS&E.

The Dual Degree Program—This dual-degree program enables a small, selective set of graduate students to obtain both the MS&E master's degree and the EE master's degree simultaneously. Students complete the course requirements for each department. A total of 90 units is required to complete the dual-degree.

PROFESSIONAL EDUCATION

The Stanford Center for Professional Development (SCPD) provides opportunities for employees of some local and remote companies to take courses at Stanford.

The Honors Cooperative Program (HCP) provides opportunities for employees of some local companies to earn an M.S. degree, over a longer period, by taking one or two courses per academic quarter. Some required courses are only offered on campus; HCP students must plan to attend those courses at Stanford to meet the degree requirements. It is possible to complete this program as a remote HCP student although the remote offerings are limited. Students must apply for a degree program through the standard application process, and must meet the standard application deadline of January 15.

The Non-Degree Option (NDO) allows employees of some local companies to take courses for credit from their company sites before being admitted to a degree program. Students apply to take NDO courses each quarter through the Stanford Center for Professional Development.

For additional information about the NDO application process and deadlines, see http://scpd.stanford.edu, or contact the SCPD at (650) 725-3000.

The department offers a Certificate Program within the framework of the NDO program. A certificate can be obtained by completing three MS&E core courses, plus one MS&E elective course for the total of four courses. For further information, see: http://scpd.stanford.edu/ce/ndp/certificate.html.

DOCTOR OF PHILOSOPHY

University requirements for the Ph.D. degree are described in the "Graduate Degrees" section of this bulletin.

The Ph.D. degree in MS&E is intended for students primarily interested in a career of research and teaching, or high-level technical work in universities, industry, or government. The program requires three years of full-time graduate study, at least two years of which must be at Stanford University. Typically, however, students take about four to five years after entering the program to complete all Ph.D. requirements. The Ph.D. is generally organized around the requirement that the students acquire a certain breadth across some of the eight areas of the department, and depth in one of them. These areas are:

Decision analysis and risk analysis
Economics and finance
Information science and technology
Organization, technology, and entrepreneurship
Policy and strategy
Probability and stochastic systems
Production operations and management
Systems modeling and optimization

Doctoral students are required to take a number of courses, both to pass a qualifying exam in one of these areas, or the Systems Program which is a combination of several areas, and to complete a dissertation based on research which must make an original contribution to knowledge.

Each student admitted to the Ph.D. program must satisfy a breadth requirement and pass a qualification procedure. The purpose of the qualification procedure is to assess the student's command of the field and to evaluate his or her potential to complete a high-quality dissertation in a timely manner. The student must complete specified course work in one of the eight areas of the department, or the Systems Program which is a combination of several areas. The qualification decision is based on the student's grade point average (GPA), on the one or two preliminary papers prepared by the student, and on the student's performance in an area examination. Considering this evidence, the department faculty votes on advancing the student to candidacy in the department at large. The Ph.D. requires a minimum of 135 units, at least 54 of which must be in courses of 3 units or more. At least 48 course units in courses of 3 units or more must be taken for a letter grade. Finally, the student must pass a University oral examination and complete a Ph.D. dissertation. During the course of the Ph.D. program, students who do not have a master's degree are strongly encouraged to complete one, either in MS&E or in another Stanford department.

Breadth Requirement—

1. The breadth requirement is to be satisfied by a choice of four courses spanning four out of the above mentioned eight areas of the department. The list of courses satisfying the breadth requirement is available from the MS&E Student Services office.
2. The Ph.D. candidacy form must contain four courses that satisfy the breadth requirement.
3. Courses chosen to satisfy the breadth requirement must be taken for letter grades.

4. At least one of the four courses chosen to satisfy the breadth requirement must be at the 300 level.

Qualification Procedure Requirements—The qualification procedure is based both on breadth across the department's disciplines and depth in an area of the student's choice. The qualification process must be completed by the end of the month of May of the student's second year of graduate study in the department. The performance of all doctoral students is reviewed every year at a department faculty meeting at the end of May or beginning of June. Ph.D. qualification decisions are made at that time and individual feedback is provided.

The Ph.D. qualification requirements comprise three elements:

1. *Grade Point Average:* a student must maintain a GPA of at least 3.4 in the four courses chosen to satisfy the breadth requirements, and a GPA of at least 3.4 in the set of all courses taken by the student within the department. In both cases, the GPA is computed on the basis of the nominal number of units for which each course is offered.
2. *Paper(s):* a student may choose between two options, either to be completed before the Spring Quarter of the student's second year. The first option involves one paper supervised by a primary faculty adviser and a faculty consultant. This paper should be written in two quarters.

   The second option involves two shorter sequential tutorials, with two different faculty advisers. Each tutorial should be completed in one quarter. In both options, the student chooses the faculty adviser(s)/consultant with the faculty members' consent.

   A student may register for up to three units per tutorial and up to 6 units for a paper. These paper or tutorial units do not count towards the 54 course units required for the Ph.D., and letter grades are not given.
3. *Area Qualification:* in addition, during the second year, a student must pass an examination in one of the eight areas of the MS&E Department or the Systems Program which is a combination of several areas, which will be of his or her choice**.** This area examination is written, oral, or both at the discretion of the area faculty administering the exam.
4. *Area Course Requirement:* students must complete the depth requirements of one of the eight areas of the MS&E department or the Systems Program which is a combination of several areas. All courses used to satisfy depth requirements must be taken for a letter grade. The Ph.D. requirements for the eight areas of the MS&E department are available from the MS&E Student Services office.

COURSES

(WIM) indicates that the course satisfies the Writing in the Major requirements.

(AU) indicates that the course is subject to the University Activity Unit limitations for undergraduates (8 units maximum).

UNDERGRADUATE

MS&E 22. The Flaw of Averages—A common cause of bad planning is the flaw of averages. This error occurs whenever an uncertain quantity is represented by a single average number. Examples of the flaw of averages may be obvious or insidious. The information age is changing our perspective of uncertainty. Seminar recognizes the flaw of averages, avoids it in everyday thinking, introduces recent information technologies for preventing the flaw of averages, and relates this new approach of dealing with uncertainty to traditional statistics.

2 units (Savage) not given 2002-03

MS&E 41. Financial Literacy—Practical knowledge about personal finance and money management including budgeting, credit cards, banking, insurance, taxes, and saving. Real-life credit card bills, bank statements, paycheck stubs, and insurance policies. Limited enrollment.

1 unit, Win, Spr (Morrison)

MS&E 60. Engineering Economy—(Enroll in ENGR 60.)

3 units, Aut (Primbs), Win (Chiu), Sum (Staff)

MS&E 92Q. International Environmental Policy—Stanford Introductory Seminar. Preference to sophomores. Introduction to the science, using economics and the politics of international environmental policy. Current negotiations on global climate change are a case study. Lectures/materials are self contained and similar to material the instructor used in briefing international negotiations and the U.S. Congress, integrating the material more comprehensively in policy briefings on individuals, dimensions, or the problem and its potential solutions.

4 units, Win (Weyant)

MS&E 93Q. Nuclear Weapons, Terrorism, Energy—Stanford Introductory Seminar. Preference to sophomores. What are nuclear weapons and what do they do? Why do some nations want them? What are the risks of nuclear terrorism? What is radioactivity? What role does nuclear power play? Can it help with global warming? Emphasis is on policy options in the light of changes in the world. Recommended: a course in economics, engineering, or physical science helpful but not required.

3 units, Spr (May)

MS&E 101. Undergraduate Directed Study—Directed study on a subject of mutual interest to the student and faculty member. Student must find a faculty sponsor and submit a one-page description of plan.

1-15 units, any quarter (Staff)

MS&E 107. Interactive Management Science—(Graduate students register for 207.) Examines analytical techniques such as linear and integer programming, Monte Carlo simulation, forecasting, decision analysis, and Markov chains in the environment of the spreadsheet. Materials include spreadsheet add-ins for implementing these and other techniques. Emphasis is on building intuition through interactive modeling, and extending the applicability of this type of analysis through integration with existing business data structures. Project required of those enrolled in 207.

3 units, Aut (Savage)

MS&E 108. Senior Project—Restricted to MS&E majors in their senior year. Students carry out a major project in groups of four, applying techniques and concepts learned in the major. Project work includes problem identification and definition, data collection and synthesis, modeling, development of feasible solutions, and presentation of results.

5 units, Win (Bailey, Brandeau, Tse)

MS&E 111. Introduction to Optimization—(Enroll in ENGR 62.)

3-4 units, Aut, Spr (Van Roy), Sum (Staff)

MS&E 120. Probablistic Analysis—Concepts and tools for the analysis of problems under uncertainty, focusing on model building and communication: the structuring, processing, and presentation of probabilistic information. Examples from legal social, medical, and physical problems provide motivation and illustrations of modeling techniques. Spreadsheets will be used to illustrate and solve problems as a complement to analytical closed-form solutions. Topics: axioms of probability, probability trees, random variables, distributions, conditioning, expectation, change of variables, and limit theorems. Prerequisite: MATH 51. Recommended: knowledge of spreadsheets.

5 units, Aut (Chiu)

MS&E 121. Introduction to Stochastic Modeling—Stochastic processes and models in operations research. Discrete and continuous time parameter Markov chains. Queuing theory, inventory theory, simulation. Prerequisite: 120 or STATS 116.

4 units, Win (Staff)

MS&E 130. Information Systems—Introduction to the design and use of computer-based information systems. Topics: software and hardware used in information systems, information requirements, database design, information system design, organizational aspects of information systems, and applications of information systems in different industries. Prerequisites: 180; CS 106A, 106B.

4 units, Win (Goel)

MS&E 131. Information Science—Five essential aspects of information science. Information as entropy: bits and bytes, channel capacity, compression, and coding. Information as an economic commodity: how information goods are produced, sold, distributed, and valued. Information as encrypted: classical and modern methods. Information as extracted from data: mining, modeling, and estimation. Information as emitted: information theory underlying telephone, radio, television, and cell phones. Theory, applications, and demonstrations.

3 units, Win (Luenberger)

MS&E 140. Industrial Accounting—Non-majors and minors who have taken or are taking elementary accounting should not enroll. Introduction to accounting concepts and the operating characteristics of accounting systems. The principles of financial and cost accounting, design of accounting systems, techniques of analysis, and cost control. Designed for the user of accounting information and not as an introduction to a professional accounting career. Interpretation and use of accounting information for decision making is stressed.

3-4 units, Aut (Stanton), Sum (Bhimjee)

MS&E 152. Introduction to Decision Analysis—How to make good decisions in a complex, dynamic, and uncertain world. People often make decisions that on close examination they regard as wrong. Decision analysis uses a structured conversation based on actional thought to obtain clarity of action in a wide variety of domains. Topics: distinctions, possibilities and probabilities, relevance, value of information and experimentation, relevance and decision diagrams, risk attitude. Students seeking to fulfill the Writing in the Major requirement should register for 152W. GER:2b.

3-4 units, Spr (Shachter)

MS&E 152W. Introduction to Decision Analysis—(Same as 152.) For students seeking to fulfill the Writing in the Major requirement. (WIM)

3-4 units, Spr (Shachter)

MS&E 160. Analysis of Production and Operating Systems—(Graduate students register for 260.) Introduction to the design, operation, and control of production systems using mathematical, computational, and modern analytical techniques. Topics: determination of optimal facility location, determination of production lot sizes, optimal timing and sizing of production capacity expansion, and introduction to inventory control. Prerequisites: 120 or STATS 116, and ENGR 62.

4 units, Aut (Ozer)

MS&E 164. Manufacturing Systems Design—The concepts and techniques of designing and improving productive systems. Emphasis is on the physical and organizational design of high-performance manufacturing systems. Multidisciplinary approach with the use of digital simulation as a tool for evaluating design alternatives. Prerequisites: 121, 169, 180. (WIM)

5 units, Spr (Bailey)

MS&E 169. Quality Assurance and Control—(Graduate students register for 269.) Introduction to the concepts and statistical methods that companies use to manage and improve quality. Topics: sampling inspection, statistical process control, quality function deployment, cost of quality, and Taguchi's method for designing in quality. Prerequisites: 120 and STATS 110 or 190.

4 units, Win (Garber)

MS&E 180. Organizations: Theory and Management—For undergraduates only, with preference to MS&E majors. Survey of classical and modern organization theory, covering the behavior of the individual, the work group, and the organization. Students must attend first session.

4 units, Spr (Hinds)

MS&E 181. Issues in Technology and Work for a Post-Industrial Economy—How changes in technology and organization are altering the way work and lives. Approaches to studying and designing work. How a grounded understanding of work and work practices can assist engineers in designing better technologies and organizations. Topics include job design, distributed and virtual organizations, the blurring of boundaries between work and family life, computer supported cooperative work, trends in skill requirements and occupational structures, monitoring and surveillance in the workplace, downsizing and its effects on work systems, project work and project based lifestyles, the growth of contingent employment, telecommuting, electronic commerce, and the changing nature of labor relations.

3 units, Aut (Barley)

MS&E 182. Work, Technology, and Society—Fulfills the School of Engineering's Technology in Society requirement. Work in contemporary society as influenced by rapid technological change. Causes and consequences of the current revolution in work, and policies for grappling with resultant problems. Focus is on the U.S., with attention to key trends in selected foreign countries. Topics: new technology in the workplace and its bearing on occupational and organizational changes, employer-employee relations, worker health and safety, economic competitiveness, women workers, workplace ethics, and the future of work. Limited enrollment.

4 units (McGinn) not given 2002-03

MS&E 193. Technology in National Security—(Graduate students register for 293.) Decisions made by the U.S. in security and space programs, emphasizing current issues. Case studies illustrate the process by which technical, political, and economic issues are brought into the policy process. How technical organizations in government, government committees, and science advisory boards interact to bring advice to senior policy makers. Some case decisions in other countries. Students seeking to fulfill the Writing in the Major (WIM) requirement should register for MS&E 193W.

3 units, Aut (Perry)

MS&E 193W. Technology in National Security—(Same as 193/293.) For students seeking to fulfill the Writing in the Major requirement. (WIM)

3 units, Aut (Perry)

MS&E 195. International Security in a Changing World—(Enroll in POLISCI 114S.)

5 units, Win (Blacker)

MS&E 196. Transportation Systems and Urban Development—(Graduate students register for 296.) Introduction to transportation systems and planning, and their roles in society. Analytical tools introduced at a conceptual level examine issues and evaluate alternatives. Policy implications and system effectiveness analysis of transportation in an urban context. Topics: economic analysis of transportation, supply and demand equilibrium analysis, urban transportation networks, congestion management, short and long term transportation planning, the impact of technology on transportation systems, land use and transportation, case studies and analysis of current transportation news items. Prerequisite: MATH 21.

3 units, Win (Chiu)

MS&E 197. Ethics and Public Policy—(Same as STS 110, PUBLPOL 103B.) Ethical issues in science- and technology-related public policy conflicts. Develops the capacity for rigorous critical analysis of complex, value-laden policy disputes. Topics: the natures of ethics and morality; the natures of and rationales for liberty, justice, and human rights; and the use and abuse of these concepts in recent and current policy disputes. Cases from: biomedicine, environmental affairs, the technical professions, communications, and international relations. (WIM)

5 units, Win (McGinn)

PRIMARILY FOR GRADUATE STUDENTS

GENERAL AND SYSTEMS ANALYSIS METHODS

MS&E 201. Dynamic Systems—Goal is to think dynamically in decision making, and recognize and analyze dynamic phenomena in diverse

situations. Concepts: formulation and analysis; state-space formulation; solutions of linear dynamic systems, equilibria, dynamic diagrams; eigenvalues and eigenvectors of linear systems, the concept of feedback; nonlinear dynamics, phase plane analysis, linearized analysis, Liapunov functions, catastrophe theory. Examples: grabber-holder dynamics, technology innovation dynamics, creation of new game dynamics in business competition, ecosystem dynamics, social dynamics, and stochastic exchange dynamics. Prerequisite: MATH 103 or equivalent.

3-4 units, Win (Tse)

MS&E 206. Art of Mathematical Modeling—The construction of mathematical models is essential to the engineering method for solving problems. Creating a mathematical model is similar to creating a work of art and this course uses this analog throughout. Opportunities for students to practice and develop their modeling talents. Weekly problems focus on modeling issues such as complexity versus simplicity, design of experiments, validation, degrees of freedom, and uncertainty. Students efforts reviewed to improve modeling skills.

3-4 units, Spr (Smallwood, Morris, Kieffel)

MS&E 207. Interactive Management Science—(Undergraduates register for 107; see 107.)

3 units, Aut (Savage)

MS&E 208A,B,C. Practical Training—Students obtain employment in a relevant industrial or research activity, to enhance their professional experience, and consistent with the degree program they are pursuing. Students must submit a one-page statement showing relevance to degree program along with offer letter before the start of the quarter, and a 2-3 page final report documenting the work done and relevance to degree program at the conclusion of the quarter. One unit counts toward the M.S. degree and 3 units toward the Ph.D. degree. Prerequisite: MS&E student.

1 unit, any quarter (Ye)

OPTIMIZATION

MS&E 211. Linear and Nonlinear Optimization—The fundamental concepts of linear and nonlinear optimization theory and modeling. The role of prices, duality, and problem structure in finding and recognizing solutions. Perspectives: problem formulation, analytical theory, and computational methods. Theory: finite dimensional derivatives, convexity, optimality, duality, and sensitivity. Methods: simplex and variations, gradient, Newton, penalty, and barrier. Team project using software package. Prerequisite: MATH 51.

3-4 units, Aut (Ye)

MS&E 212. Network and Integer Programming—Introduction to modeling and solving optimization problems on networks and problems with integer constraints. Flows, shortest paths, dynamic programming, extreme points, unimodularity, branching, bounding, cuts, tight formulations, complexity, relaxation, approximation, and various commercial solvers. Applications: management of production and inventory systems, crew assignment, and scheduling. Prerequisite: 211, or equivalent.

3 units, Win (Ye)

PROBABILITY AND STOCHASTIC SYSTEMS

MS&E 220. Probabilistic Analysis

3-4 units, Aut (Shachter)

MS&E 221. Stochastic Modeling—Continuation of 220. Topics: limit theorems, discrete and continuous time Markov chains, renewal processes, queuing theory, and transform analysis. Emphasis is on building a framework to formulate and analyze probabilistic systems. Prerequisite: 220 or consent of instructor.

3 units, Win (Glynn)

MS&E 223. Simulation—Generation of uniform and non-uniform random numbers, discrete-event simulations, simulation languages, design of simulations, statistical analysis of the output of simulations, variance reduction, optimization via simulation, applications to modeling stochastic systems in computer science, engineering, finance, and operations research. Prerequisites: a working knowledge of FORTRAN, PASCAL, C, or C++; probability at the level of 120 or STATS 116.

3 units, Spr (Haas)

INFORMATION SCIENCE AND TECHNOLOGY

MS&E 230. Introduction to Computer Networks—(Enroll in EE 284, CS 244A.)

3-4 units, Aut (Tobagi), Win (McKeown)

MS&E 232. Information Technology and Supply Chain Management—Advancements in information technologies have enabled major innovations in the re-engineering of industry supply chains, redefining the ways companies operate their supply chains. New ventures have emerged to create values for business partners and the consumers in supply chain integration. How information technologies have advanced supply chain integration and coordination. The dimensions of business and process improvements. New opportunities using supply chain management concepts and emerging technologies. Enrollment limited.

3 units, Win (Lee)

MS&E 234. Organizations and Information Systems—For students interested in how information systems impact organizations and how organizations take control of information technology (IT) to gain a competitive edge. Topics: IT strategy, the fit between IT and corporate culture, IT architectural alternatives, changing technologies and organizational learning, the effect of IT on competition, and outsourcing as an offensive strategy. Student teams perform field studies based on situations in which information technology is creating a significant management problem or business opportunity.

4 units, Win (Tabrizi)

MS&E 236. Pricing Next Generation Telecommunications Products and Services—Telecommunication products and services pricing as the key to success in a changing, competitive market. Interdisciplinary approach to position, price, and distribution of traditional/innovative telecommunication services. Topics: the telecommunication industry as driven by technological advances, policy choices, and explosive business opportunities; the pricing revolution and arbitrage opportunities in international voice created by data-voice convergence and liberalization; competitive aspects of service delivery channels; commoditizing of bandwidth and basic services; clearinghouses; financial risk hedging through futures/derivatives trading; the need to develop intelligent pricing and provisioning agents for product bundling; grade of service differentiation; positioning and revenue optimization by capturing consumer preferences. Group project in industrial participation.

3 units, Sum (Chiu)

MS&E 237. Progress in Worldwide Telecommunications—Interdisciplinary study of topics in current worldwide developments and economic trends with the participation of prominent guest speakers from telecommunications organizations and industry. Topics: telecommunications services and networks (de)regulation and market-driven competition, technology, standardization, international organizations, and the needs of the underserved parts of the world. Individual or team case study and a verbal presentation. May be repeated for credit. Limited enrollment.

3 units, Sum (Ivanek, Chiu)

ECONOMICS, FINANCE, AND INVESTMENT

MS&E 241. Economic Analysis—Principal methods of the economic analysis of the production activities of firms (production technologies, cost and profit; perfect and imperfect competition); individual choice (preferences and demand); and the market-based system (price formation, efficiency, welfare.) Emphasis is on the analytical foundations and the practical applications of the methods presented. See 341 for continuation of 241. Recommended: 211.

3-4 units, Win (Sweeney)

MS&E 242. Investment Science—Introduction to modern quantitative investment analysis: theory and practical application. How modern

investment concepts can be used to evaluate and manage opportunities; structure portfolios; and use sophisticated investment products including stocks, bonds, mortgages, and annuities. Topics: deterministic cash flows (time-value of money, present value, internal rate of return, term structure of interest rates, bond portfolio immunization, project optimization); mean-variance theory (Markowitz model, capital asset pricing); dynamic and uncertain cash flows. Emphasis is on translating theory into actual procedures. Examples of applications for every major topic. Group project devoted to application of the theory. See 342 for continuation.

3 units, Aut (Primbs), Sum (Feinstein)

MS&E 243. Energy Policy Analysis—Concepts and methods for economic policy analysis. Course examines interplay of economic, environmental, and security issues associated with energy policy. Policy issues are related to all major energy sources and uses. Prerequisite: 241. Recommended: 248

3-4 units, Spr (Sweeney)

MS&E 245G. Finance I: Introduction to Finance for Non-MBAs—(Same as FINANCE 221, ECON 135.) For graduate students and advanced undergraduates. The foundations of finance with applications in corporate finance and investment management. Major financial decisions made by corporate managers and investors with focus on process valuation. Topics include criteria for investment decisions, valuation of financial assets and liabilities, relationships between risk and return, market efficiency, and the valuation of derivative securities. Major corporate financial instruments including debt, equity, and convertible securities. Equivalent to core MBA finance course, FINANCE 220. Prerequisites: 51, or ENGR 60, or equivalent; ability to use spreadsheets, basic probability and statistics concepts including random variables, expected value, variance, covariance, and simple estimation and regression. Limited enrollment.

4 units, Win (Admati)

MS&E 247G. International Finance for Non-MBAs—(Same as FINANCE 323.) A framework for making corporate financial decisions in an international context. Topics in international financial management. Focus is on the markets for spot exchange, currency forwards, options, swaps, international bonds, and international equities. For each of these markets, the valuation of instruments traded in these markets and, through cases, the application of these instruments to managing exposure to exchange rates, financing in international capital markets, and international capital budgeting.

4 units, Spr (Staff)

MS&E 247S. International Investments—International financial markets, their comparative behavior, and their interrelations. Focus is on the assets traded in liquid markets: currencies, equities, bonds, swaps, and derivatives. Topics: institutional arrangements, taxation and regulation, international arbitrage and parity conditions, valuation of target firms for cross-border acquisitions, direct foreign investment, international diversification and portfolio management, derivative instruments and dynamic investment strategies, international performance analysis, international capital flows and financial crises, and topics of current relevance and importance. Prerequisite: basic finance theory (equivalent of 242 or 245G).

3 units, Sum (Fu)

MS&E 248. Economics of Natural Resources—Intertemporal economic analysis of natural resource use, particularly energy, and including air, water, and other depletable mineral and biological resources. Emphasis is on an integrating theory for depletable and renewable resources. Stock-flow relationships; optimal choices over time; short- and long-run equilibrium conditions; depletion/extinction conditions; market failure mechanisms (common-property, public goods, discount rate distortions, rule-of-capture); policy options. Prerequisite: 241 or ECON 51.

3-4 units, Win (Sweeney)

MS&E 249. Growth and Development—How to assess new investment opportunities in the countries of the Pacific Rim and other fast growing economies. Useful for investors and those guiding their country's development choices. Topics: the mechanism of economic growth, the equation of interest, optimal growth, economic interpretation of the calculus of variations and optimal control theory results, uncertainty, tools for evaluating long-term growth rate, geometric moments, and exponormal distribution. Investment incentives, country risk indices. The long view: rule of law versus rule of people. Practical cases from Ireland, E. European countries, China, and other E. Asian countries.

3 units, Sum (de La Grandville)

DECISION AND RISK ANALYSIS

MS&E 250A. Engineering Risk Analysis—The techniques of analysis of engineering systems for risk management decisions involving trade-offs (technical, humans, environmental aspects). Four parts: elements of decision analysis; probabilistic risk analysis (fault trees, event trees); economic analysis of failure consequences (issues of human safety and long-term economic discounting); and case studies (space, systems, nuclear power plants, liquefied natural gas terminals, and dams). Emphasis is on risk management issues in the public and private sectors. Prerequisites: 120 or STATS 116, and ENGR 60, or equivalents.

2-3 units, Win (Paté-Cornell)

MS&E 250B. Project Course in Engineering Risk Analysis—Students, individually or in groups, choose, define, formulate, and resolve a real risk management problem, preferably from a local firm or institution. Oral presentation and report required. Scope of the project is adapted to the number of students involved. Three phases: risk assessment, communication, and management. Emphasis is on the use of probability for the treatment of uncertainties and sensitivity to problem boundaries. Limited enrollment. Prerequisite: 250A, consent of instructor.

3 units, Spr (Paté-Cornell)

MS&E 251. Stochastic Decision Models—Efficient formulation and computational solution of sequential decision problems under uncertainty. Markov decision chains and stochastic programming. Maximum expected present value and rate of return. Optimality of simple policies: myopic, linear, index, acceptance limit, and (s,S). Optimal stationary and periodic infinite-horizon policies. Applications to investment, options, overbooking, inventory, production, purchasing, selling, quality, repair, sequencing, queues, capacity, transportation. MATLAB is used. Prerequisites: probability, linear programming.

3 units, Win (Veinott)

MS&E 252. Decision Analysis I—Coherent approach to decision making, using the metaphor of developing a structured conversation having desirable properties, and producing actional thought that leads to clarity of action. Instruction is Socratic, with computational issues covered in problem sessions. Emphasis is on creation of distinctions, representation of uncertainty by probability, development of alternatives, specification of preference, and the role of these elements in creating a normative approach to decisions. Evaluates information gathering opportunities in terms of a value measure. Relevance and decision diagrams represent and clarify inference and decision. Principles are applied to decisions in business, technology, law, and medicine. See 352 for continuation.

3-4 units, Aut (Howard)

MS&E 254. The Ethical Analyst—The professional analyst who uses technical knowledge in support of any individual, organization, or government is ethically responsible for the consequences. Students are sensitized to ethical issues, providing the means to form ethical judgments, questioning the desirability of physical coercion and deception as a means to reach any end. Exploration of human action and relation in society in the light of previous thought, and additional research on the desired form of social interactions. Attitudes toward ethical dilemmas explored by creating an explicit personal code. Issues from the range of human affairs test the student's framework for ethical judgment.

1-3 units, Spr (Howard)

PRODUCTION OPERATIONS, SERVICES, AND MANUFACTURING

MS&E 260. Analysis of Production and Operating Systems—(Undergraduates register for 160; see 160.)

4 units, Aut (Ozer)

MS&E 261. Inventory Control and Production Systems—Topics in the planning and control of manufacturing systems. The functions of inventory, determination of order quantities and safety stocks, alternative inventory replenishment systems, item forecasting, production-inventory systems, materials requirements planning (MRP), just-in-time systems, master and operations scheduling, supply chain management, and service operations. Limited enrollment. Prerequisite: 120, or STATS 116, or equivalent.

3 units, Win (Hausman)

MS&E 262. Supply Chain Management—Definition of a supply chain, coordination difficulties, pitfalls and opportunities in supply chain management, inventory-service tradeoffs, performance measurement and incentives. Supply chain network design, global supply chain management, the manufacturing/distribution interface, supplier management. Design and redesign of products and processes for supply chain management, tools for design, industrial applications, strategic alliances, current industry initiatives. Enrollment limited to 50 MS&E students. Prerequisite: 260 or 261.

3 units, Spr (Hausman)

MS&E 264. Manufacturing Systems Design—Multidisciplinary. The concepts and techniques of designing and improving performance and productivity in systems composed of and influenced by people, organizational factors, environmental factors, and technology. Emphasis is on the design of high-performance manufacturing systems. Use of simulation as a tool for design evaluation.

3-4 units, Aut (Erhun)

MS&E 265. Reengineering the Manufacturing Function—Preference to undergraduates. Student teams of four to six redesign the manufacturing and distribution system of a medium-sized manufacturer, focusing on the transportation system, inventory policies for a regional warehouse, design of a national distribution system, operational improvements of work flow, layout of the manufacturing plant, and redesign of the planning and control system. Redesign is at an operational level consistent with a strategy of integrating the functions of manufacturing and distribution. Modular approach, with each module requiring analytical or game software. Groups meet twice per module with faculty. Topics: production planning, inventory theory, linear/integer programming, economic analysis, and applied probability. Modules are integrated via the focus on the customer. Enrollment limited. Prerequisite: senior or graduate standing, 160; ENGR 60 and 62.

4 units, Spr (Carlson) alternate years, not given 2003-04

MS&E 266. Management of New Product Development—Techniques of managing or leading the process of new product development that have been found effective. Emphasis is placed on how much control is desirable and how that control can be exercised in a setting where creativity has traditionally played a larger role than discipline. Topics: design for manufacturability, assessing the market, imposing discipline on the new product development process, selecting the appropriate portfolio of new product development projects, disruptive technology, product development at internet speed, uncertainty in product development, role of experimentation in new product development, creating an effective development organization, and developing products to hit cost targets.

3-4 units, Win (Carlson)

MS&E 267. Innovations in Manufacturing—Emphasis is on forces that prompt change and their impact. Topics include changes in the mode of production, performance objectives, sources of inspiration, and work organization. Design and management implications for modern manufacturing.

3-4 units, Spr (Bailey)

MS&E 268. Manufacturing Strategy—The development and implementation of the manufacturing functional strategy. Emphasis is on the integration of manufacturing strategy with the business and corporate strategies of a manufacturing-based firm. Topics: types of manufacturing technologies and their characteristics, quality management, capacity planning and facilities choice, the organization and control of operations, and determining manufacturing's role in corporate strategy. Prerequisites: graduate student; 260 or 261.

3 units, Spr (Carlson)

MS&E 269. Quality Assurance and Control—(Undergraduates register for 169; see 169.)

4 units, Win (Garber)

STRATEGY, ENTREPRENEURSHIP, AND MARKETING

MS&E 270. Strategy in Technology-Based Companies—For graduate students. Introduction to the basic concepts of strategy, with emphasis on high technology firms. Topics: strategic alliances, standards setting, vertical integration, strategic choice, generic and hypercompetitive approaches, organizational capabilities, and complexity/evolutionary perspectives. Enrollment limited.

3-4 units (Eisenhardt) not given 2002-03

MS&E 271. Global Entrepreneurial Marketing—Designed to equip engineers with the marketing skills needed to launch and lead a high-growth, high-tech venture, cultivating the skills needed to market new products to new customers, using new technology in startups and global high tech firms. Case method, working in teams. Students diagnose problems and opportunities; make decisions; analyze customers, competitors, and channels in their own company, and in the economic environments and ethical factors that affect their decisions; and reality test their recommended approach. Each student writes a strategic thinking paper. Prerequisites: 140, and ENGR 60. Recommended: 245G.

4 units, Win (Kosnik)

MS&E 272. Entrepreneurial Finance—Primarily for graduate engineering students. Introduction to the concepts in and around the financing of entrepreneurial companies. Focus is on teaching future general managers how to use financial perspective to make better decisions in entrepreneurial settings, including selecting financial partners, evaluating financing vehicles, and financing companies through all growth stages, from startup through initial public offering. Prerequisites: 140, and ENGR 60. Recommended: 245G.

3 units, Spr (MacKenzie)

MS&E 273. Technology Venture Formation—Open to graduate students interested in high-technology entrepreneurship. Explores in detail the process of starting venture scale high-tech businesses. Coursework includes assessing opportunities, sizing markets, evaluating sales channels, developing R&D and operations plans, raising venture capital, managing legal issues, and building a team. The teaching team includes experienced entrepreneurs, venture capitalists, and distinguished guests. Student teams write a business plan and make a formal presentation to group of first tier venture capitalists. Enrollment limited. Recommended: 140, 270, 271, 272 or equivalent.

3-4 units, Aut (Lyons, MacLean, Leslie)

MS&E 274. Building Dynamic Entrerpreneurial Organizations—Focus is on the dynamic development of corporate skills, knowledge, and infrastructure to compete in a changing global competitive environment due to rapid technology advancement, global economic development, changes in consumer's preference, and government regulations. Model analysis and case studies are used to develop a methodology in building dynamic entrepreneurial organizations in response to dynamic competitive requirements. Links between MS&E core and the notion of managing change as a basis for a normative theory on entrepreneurial activities in new business creation and corporateexpansion.

3 units, Spr (Tse)

MS&E 276. Managing to IPO—(Same as GSBGEN 352.) The operational/execution issues that startups face from their genesis to an IPO or other major liquidity event. Issues include deciding the organization structure, working with infrastructure providers, designing information systems, and the promotion of rapid sustainable growth. Law firms, accounting firms, incubators, venture capital firms, human resource firms, public relations firms, and marketing firms. Cases, readings, and guest speakers from infrastructure providers and startups.

4 units, Win, Spr (Foster)

MS&E 277. Creativity and Innovation in Organizations—Factors that contribute to creativity of individuals and groups within organizations. Experiential methods, hands-on exercises, and team projects, supported by guest speakers and readings.

4 units, Win, Sum (Seelig)

ORGANIZATIONAL BEHAVIOR, MANAGEMENT, AND WORK

MS&E 278. Startup Globalization Strategies—(Same as GSBGEN 354.) Startups have adopted different approaches to the global marketplace. How these approaches are employed in different industries and in different continents. Global strategies of the startup financing community. Infrastructure providers aiming to lubricate globalization. Intercontinent and intra-continent expansion strategies of startups. Case studies from both the online and offline world. U.S. entry strategies of startups initially founded in Europe, Asia, Latin America, and the Pacific Region. Export strategies of U.S.-based startups into Europe, Asia, Latin America, and the Pacific Region. Startups that have a global strategy from the outset. Group project and individual assignments.

4 units, Spr (Staff)

MS&E 279. Innovation Strategy—For graduate students. How organizations plan technology strategy decisions and create innovations. Case discussions, group projects.

4 units, Win (Katila)

MS&E 280. Organizational Behavior and Management—Organization theory; concepts and functions of management; behavior of the individual, work group, and organization. Emphasis is on case and related discussion. Enrollment limited to 65 graduate students per section; priority given to MS&E majors.

3-4 units, Aut (Tabrizi)

MS&E 281. Management and Organization of Research and Development—The organization of R&D in industry and the problems of the technical labor force. Relevant theoretical perspectives from sociology, anthropology, and management theory on the social and pragmatic issues that surround technical innovation and the employment of scientists and engineers. Possible topics: organization of scientific and technical communities, industrialization of research, the nature of scientific and technical work, strategies for fostering innovation, careers of scientists and engineers, and managerial problems characteristic of R&D settings.

3-4 units (Barley) alternate years, given 2003-04

MS&E 284. Technology and Work—Theory and research on the social implications of technology and technological change for workers at all levels. Alternate conceptions of technology as social phenomenon, approaches to the study of technology in the workplace, reactions of individuals and groups to technological change, the construction of a technology's social meaning, and the management of technological change. Emphasis is on automation, electronic data processing, and sophisticated microelectronic technologies, including CAD-CAM systems, telecommunication networks, medical imaging technologies, artificial intelligence, and personal computers.

4 units, Win (Barley) alternate years, not given 2003-04

PUBLIC POLICY ANALYSIS

MS&E 290. Public Policy Analysis—Focus is on national security, health/medical, technology regulation/intellectual property rights, and energy/environment. Each student writes a short policy analysis brief in each of the four areas. Enrollment limited to graduate students in engineering.

3 units, Win (Weyant, Perry, Shachter, Brandeau)

MS&E 292. Health Policy Modeling—For Master's students. The application of mathematical, statistical, economic, and systems models to problems in health policy. Areas include disease screening, prevention, and treatment; assessment of new technologies; and drug control policies.

3 units, Spr (Brandeau)

MS&E 293. Technology in National Security—(Undergraduates register for 193; see 193.)

3 units, Aut (Perry)

MS&E 296. Transportation Systems and Urban Development—(Undergraduates register for 196; see 196.)

3 units, Win (Chiu)

MS&E 298. Technology, Policy, and Management in Newly-Industrializing Countries—(Same as STS 279.) Technology as the key to development and prosperity in most parts of the world. Building technological capability in newly industrializing countries at the national and firm level. Government intervention, the concept of technology leader and follower environments, the transfer of technology from leader countries, indigenous technological capability, human capital, culture and innovation, the role of small firms and new enterprises in technological capability. How innovation is different in technology followers, organizing for shop floor innovation, building an innovation culture, the role of R&D, design, and technology strategy in followers. Cases from Korea, India, Brazil, Singapore, and other NICs. Enrollment limited to 50.

2-4 units, Aut (Forbes)

MS&E 299. Voluntary Social Systems—Exploration of ethical theory, feasibility, and desirability of a social order in which coercion by individuals and government is minimized and people pursue ends on a voluntary basis. Topics: efficacy and ethics; use rights for property; contracts and torts; spontaneous order and free markets; crime and punishment based on restitution; guardian-ward theory for dealing with incompetents; the effects of state action-hypothesis of reverse results; applications to help for the needy, armed intervention, victimless crimes, and environmental protection; transition strategies to a voluntary society.

1-3 units, Win (Howard)

PRIMARILY FOR DOCTORAL STUDENTS

GENERAL AND SYSTEMS ANALYSIS METHODS

MS&E 300. Ph.D. Qualifying Tutorial or Paper—Restricted to Ph.D. students assigned tutorials as part of the MS&E Ph.D. qualifying process. Enrollment optional.

1-3 units, any quarter (Staff)

MS&E 301. Dissertation Research—Prerequisite: doctoral candidacy.

1-15 units, any quarter (Staff)

MS&E 302. Optimal Dynamic Systems—Controllability and observability, stabilizing feedback. Optimal control theory and the Pontryagin maximum principle; problems with inequality constraints, transversality condition, discounting cost, infinite horizon problem; the Hamilton-Jacobi-Bellman equation; stochastic control. Applications: optimal economic growth, control of predator/prey systems, spread of product innovation. Prerequisite: 201.

3 units (Staff) not given 2002-03

OPTIMIZATION

MS&E 310. Linear Programming—Formulation of standard linear programming models. Theory of polyhedral convex sets, linear inequalities, alternative theorems, and duality. Variants of the simplex method, dual simplex method, product form of the inverse. Interior-point meth-

ods for solving linear programs. Sensitivity analysis, economic interpretations. Large-scale linear programming, decomposition principle, and extensions oflinear programming. Prerequisite: MATH 113 or consent of instructor.

3 units, Aut (Ye)

MS&E 311. Optimization—Applications, theory, and algorithms for finite-dimensional linear and nonlinear optimization problems with continuous variables. Elements of convex analysis, first- and second-order optimality conditions, sensitivity and duality. Algorithms for unconstrained optimization, linearly constrained optimization problems (including linear and quadratic programs), and nonlinearly constrained problems. Prerequisites: MATH 113, 115.

3 units, Win (Cottle)

MS&E 312. Optimizations Algorithms—Review of optimality conditions. Detailed description of algorithms for unconstrained, linearly constrained, and nonlinear constrained problems. Numerical linear algebra techniques required for practical implementations. Convergence, rate of convergence. Impact on the performance of algorithms due to the use of finite-precision arithmetic. Algorithms for large problems. Sparse matrix technology. Use of software. Recommended: 211, 311.

3 units (Murray) not given 2002-03

MS&E 313. Vector Space Optimization—Optimization theory from the unified framework of vector space theory, i.e., treating together problems of mathematical programming, calculus of variations, optimal control, estimation, and other optimization problems. Emphasizes geometric interpretation. Duality theory. Examples. Topics: vector spaces, including function spaces; Hilbert space and the projection theorem; dual spaces and the separating hyperplane theorem; linear operators and adjoints; optimization of functionals, including theory of necessary conditions in general spaces, and convex optimization theory; constrained optimization, including Fenchel duality theory. Prerequisite: MATH 115.

3 units, Aut (Luenberger) alternate years, not given 2003-04

MS&E 314. Semidefinite Programming—Semidefinite programming is a significant, new generalization of linear programming. Its objective function and constraints are linear, but its variables lie in a positive-semidefinite matrix cone. Recent theories and interior-point algorithms for this subject, and its applications to discrete optimization, control theory, machine learning, statistics, finance and networks. Prerequisite: MATH 113, 115. Recommended: 310.

3 units, Win (Ye)

MS&E 315. Linearly Constrained Optimization—Solution of nonlinear equations; unconstrained optimization; linear programming; quadratic programming; global optimization: general linearly constrained optimization. Algorithms to solve the above problems. No previous knowledge of optimization is required but a strong background in analysis and numerical linear algebra is needed.

3 units, Spr (Murray)

MS&E 316. Linear Complementarity—Linear and nonlinear complementarity problems, variational inequalities, fixed points problems, and their applications to equilibrium problems of both economic and physical types. Prerequisites: 311 or equivalent, and MATH 113 and 115.

3 units, Spr (Cottle)

MS&E 318. Large-Scale Numerical Optimization—The main algorithms for general constrained optimization, with emphasis on the sparse-matrix techniques required for their implementation. Sparse factorizations and updating. Iterative methods for linear equations least squares. Their use in simplex, reduced-gradient, sequential quadratic programming, linearly constrained Lagrangian, and interior methods. Software implementing such methods. Prerequisite: Linear algebra and optimization. Recommended: 310, 311, or 312; CS 137 or 237A.

3 units, Spr (Saunders)

PROBABILITY AND STOCHASTIC SYSTEMS

MS&E 321. Stochastic Systems—Topics in stochastic processes, emphasizing applications. Markov chains in discrete and continuous time; Markov processes in general state space; Lyapunov functions; regenerative process theory; renewal theory; martingales, Brownian motion, and diffusion processes. Application to queuing theory, storage theory, reliability, and finance. Prerequisites: 221 or STATS 217; MATH 113 and 115.

3 units, Spr (Glynn)

MS&E 322. Stochastic Calculus and Control—Emphasis is on the theoretical foundations of simulation methodology. Generation of uniform and non-uniform random variables. Discrete-event simulation and generalized semi-Markov processes. Output analysis (autoregressive, regenerative, spectral, and stationary times series methods). Variance reduction techniques (antithetic variables, common random numbers, control variables, discrete-time, conversion, importance sampling). Stochastic optimization (likelihood ratio method, perturbation analysis, stochastic approximation). Simulation in a parallel environment.

3 units (Glynn) alternate years, given 2003-04

MS&E 323. Stochastic Simulation—Emphasis is on the theoretical foundations of simulation methodology. Generation of uniform and non-uniform random variables. Discrete-event simulation and generalized semi-Markov processes. Output analysis (autoregressive, regenerative, spectral, and stationary times series methods). Variance reduction techniques (antithetic variables, common random numbers, control variables, discrete-time, conversion, importance sampling). Stochastic optimization (likelihood ratio method, perturbation analysis, stochastic approximation). Simulation in a parallel environment. Prerequisite: 221 or equivalent.

3 units, Win (Glynn) alternate years, not given 2003-04

INFORMATION SCIENCE AND TECHNOLOGY

MS&E 334. Network Architectures and Performance Engineering—(Same as EE 384S.) Introduction to the modeling and control methodologies used in network performance engineering: Markov chains and stochastic modeling, queueing networks, stochastic simulation, dynamic programming, network optimization algorithms, large-scale distributed computation for networking operations. Application sof such methodologies to key design issues in high-performance network architectures for wireline and wireless networking: traffic modeling, congestion control, IP network dynamics, TCP flow control, quality of service support, network admission control and operations management, power control and dynamic bandwidth allocation in wireless networks etc. Prerequisites: 284, and good understanding of probability and general systems modeling.

3 units, Spr (Bambos)

MS&E 335. Queuing Systems and Networks—Advanced stochastic modeling and analysis of systems involving queuing delays. Markovian queues. Stability analysis of the G/G/1 queue. Key results on single and multi-server queues. Approximation methods. Queuing networks. Introduction to controlled queuing systems. Applications to performance modeling, analysis, and evaluation of communication networks, computer systems, flexible manufacturing systems, service systems, etc. Prerequisite: 221 or equivalent.

3 units, Aut (Bambos)

MS&E 339. Neuro-Dynamic Programming and Reinforcement Learning—Dynamic programming formulations and algorithms. Parallel computation and real-time dynamic programming. Reinforcement learning. Value function approximation. Recent research topics and applications in queuing networks, dynamic resource allocation, games, and combinatorial optimization.

3 units, Win (Van Roy)

ECONOMICS, FINANCE, AND INVESTMENT

MS&E 341. Advanced Economic Analysis—Builds on 241 concepts. Market structure and industrial organization (oligopoly, strategic behav-

ior of firms, game theoretic models); economics of uncertainty; general equilibrium theory and economic efficiency (formulation, Walras' Law, existence, uniqueness, duality between efficiency and general equilibrium; trade); intertemporal equilibrium and asset markets; macroeconomic analysis and economic growth (accounting identities, general equilibrium perspective); public goods, externalities. Background for additional advanced economics. Prerequisite: 241.

3 units, Spr (Peck)

MS&E 342. Advanced Investment Science—Advanced topics and research in the theory and application of investment concepts. Topics: forwards and futures contracts, continuous and discrete time models of stock price behavior, geometric Brownian motion, Ito's lemma, basic options theory, Black-Scholes equation, advanced options techniques, models and applications of stochastic interest rate processes, and optimal portfolio growth. Computational issues and general theory. Teams work on independent projects that apply the principles. Prerequisite: 242.

3 units, Win (Luenberger)

MS&E 345. Advanced Topics in Financial Engineering—Advanced modeling of assets for derivative pricing. Pricing and hedging of derivative securities, including exotic options and other structured securities. Risk management and analysis of portfolios with derivative securities. Greek analysis and analytic and numerical Value at Risk computation for static and dynamic portfolios. Prerequisites: 242, 220, 221, 342, or consent of instructor.

3 units, Spr (Primbs)

MS&E 346. Economic Analysis of Market Organizations—For second-year or more advanced graduate students. Applies theories of microeconomics and management science to decision behavior and mechanism design in market organizations, emphasizing incentives and asymmetric information structures. Topics: game theory, economics of information, nonlinear pricing, theory of contracts, auction markets, emissions trading, and market design in network infrastructure industries, Prerequisites: basic knowledge of microeconomics, optimization, probability theory, and decision theory.

3 units (Chao) not given 2002-03

MS&E 348. Optimization of Uncertainty and Applications in Finance—How to make optimal decisions in the presence of uncertainty, solution techniques for large-scale systems resulting from decision problems under uncertainty, and selected applications in finance. Decision trees, utility, two-stage and multi-stage decision problems, approaches to stochastic programming, model formulation; large-scale systems, Benders and Dantzig-Wolfe decomposition, Monte Carlo sampling and variance reduction techniques, risk management, portfolio optimization, mortgage finance.

3 units, Win (Infanger)

MS&E 349. Investment Science Frontiers—Advanced concepts of investment science with emphasis on theories and methods for solving practical problems: real options theory and practice; valuing and structuring projects, mergers, acquisition and contracts; designing portfolios for optimal growth; and managing risk and enhancing value within a complex business enterprise. Combination lecture, seminar, and project. No auditors. Prerequisites: 242, 342.

3 units (Luenberger) alternate years, given 2003-04

DECISION AND RISK ANALYSIS

MS&E 350. Doctoral Seminar in Risk Analysis—Limited to doctoral students. Reading/review of the literature in the fields of engineering risk assessment and management. New methods and topics, emphasizing probabilistic methods and decision analysis. Applications to risk management problems involving the technical, economic, and organizational aspects of engineering system safety. Possible topics: treatment of uncertainties, learning from near misses, and use of expert opinions.

3 units, Spr (Paté-Cornell)

MS&E 351. Dynamic Programming and Stochastic Control—Markov population decision chains in discrete and continuous time. Risk posture. Present value and Cesaro overtaking optimality. Optimal stopping. Successive approximation, policy improvement, and linear programming methods. Team decisions and stochastic programs; quadratic costs and certainty equivalents. Maximum principle. Controlled diffusions. Examples from inventory, overbooking, options, investment, queues, reliability, quality, capacity, transportation. MATLAB. Prerequisites: MATH 113, 115; Markov chains; linear programming.

3 units, Spr (Veinott)

MS&E 352. Decision Analysis II—Necessary considerations to assist people and organizations in decision making: decision engineering. How to organize the decision conversation, the role of the decision analysis cycle and the model sequence, assessing the quality of decisions, framing decisions, the decision hierarchy, strategy tables for alternative development, creating spare and effective decision diagrams, biases in assessment, knowledge maps, uncertainty about probability. Sensitivity analysis, approximations, value of revelation, joint information, options, flexibility, bidding, assessing and using corporate risk attitude, risk sharing and scaling, and decisions involving health and safety. See 353 for continuation. Prerequisite: 252.

3-4 units, Win (Howard)

MS&E 353. Decision Analysis III—Decision analysis beyond the basic paradigm; extending the boundaries of systematic analysis of decisions. The concept of decision composite; probabilistic insurance and other challenges to the normative approach; the relationship of decision analysis to classical inference and data analysis procedures; the likelihood and exchangeability principles; inference, decision, and experimentation using conjugate distributions; developing a risk attitude based on general properties; alternative decision aiding practices such as analytic hierarchy and fuzzy approaches. Students presentations on current research. Goal is to prepare doctoral students for research. Prerequisite: 352.

3 units, Spr (Howard)

MS&E 355. Influence Diagrams and Probabilistics Networks—Network representations for reasoning under uncertainty: influence diagrams, belief networks, and Markov networks. Structuring and assessment of decision problems under uncertainty. Learning from evidence. Conditional independence and requisite information. Node reductions. Belief propagation and revision. Simulation. Linear-quadratic-Gaussian decision models and Kalman filters. Dynamic processes. Bayesian meta-analysis. Prerequisites: 220, 252, or equivalents; or consent of the instructor.

3 units, Win (Shachter)

PRODUCTION OPERATIONS, SERVICES, AND MANUFACTURING

MS&E 361. Supply-Chain Optimization—Characterization and computation of optimal and nearly optimal multiperiod supply chain policies with known or uncertain demands using dynamic, lattice, network, and convex and concave programming. Cooperation: sharing benefits of alliances. Competition. Leontief-substitution and network-flow models. Lattice programming: comparison of optima; existence and comparison of equilibria of non-cooperative games. Stochastic comparison. Invariant properties of optimal flows: graphical optimization of supply chains. Optimality of myopic policies. Prerequisites: MATH 115, optimization theory, probability.

3 units, Aut (Veinott)

MS&E 362. Advanced Models in Production and Operations—The design and operation of production-inventory systems, production scheduling, capacity planning, plant location, sequencing, assembly-line balancing, multigoal optimizations. Readings primarily from journal articles. Prerequisite: 260.

3 units (Carlson) alternate years, given 2003-04

MS&E 363. Advanced Models in Management Science—Primarily for doctoral students. Theoretical treatment of advanced models for procurement, transportation, storage, and distribution problems in production systems. Topics: logistics models for global supply chain management, distribution network design, routing and routing/scheduling models, network models, and logistics management. Prerequisite: 260 or equivalent.

3 units, Win (Ozer) alternate years, not given 2003-04

MS&E 364. Single and Multi-Location Inventory Models—Theoretical treatment of control problems arising in inventory management, production, and distribution systems. Periodic and continues review inventory control for single and multi-location systems. Emphasis is on operating characteristics, performance measures, and optimal operating and control policies. Introduction to dynamic programming and applications in inventory control. Prerequisite: STATS 217 or equivalent, linear programming.

3 units, not given 2002-03

STRATEGY, ENTREPRENEURSHIP, AND MARKETING

MS&E 371. Innovation and Strategic Change—Doctoral research seminar. Current research on innovation strategy. Topics: scientific discovery, innovation search, organizational learning, evolutionary approaches, and incremental and radical change. Recommended: course in statistics or research methods. Enrollment limited to Ph.D. students.

3 units, Win (Kitali)

MS&E 376. Strategy and Organization Doctoral Research Seminar—Review of current research at the interface between strategy policy and organization theory. Topics: top management teams and strategic decision making processes; strategic boundary issues (e.g., strategic alliances, vertical integration, and diversification); reward structure and board relationships; evolution of strategies, technology, and populations of organizations. Enrollment limited and at the discretion of instructor. Prerequisite: SOC 360 or equivalent.

3 units, Spr (Eisenhardt)

ORGANIZATIONAL BEHAVIOR, MANAGEMENT, AND WORK

MS&E 380. Doctoral Research Seminar in Organizations—Limited to Ph.D. students. Topics from current published literature and working papers. Content varies. Prerequisite: consent of instructor.

3 units (Hinds) not given 2002-03

MS&E 381. Doctoral Research Seminar in Work, Technology, and Organization—Enrollment limited to Ph.D. students. Topics from current published literature and working papers. Content varies. Prerequisite: consent of instructor.

3 units, Win (Barley) alternate years, not given 2003-04

MS&E 383. Doctoral Seminar on Ethnographic Research—For graduate students; upper-level undergraduates with consent of instructor. Ethnosemantic interviewing and participant observation. Techniques for taking, managing, and analyzing field notes and other qualitative data. 15 hours per week outside class collecting and analyzing own data. Methods texts and ethnographies offer examples of how to analyze and communicate ethnographic data. Prerequisite: consent of instructor.

5-6 units (Barley) alternate years, given 2003-04

MS&E 385. Geographically Distributed Work—Focus is on understanding how being distributed from one's coworkers can affect productivity, interpersonal relationships, perceptions of work, information sharing, organizational structure, and other factors related to work and work effectiveness. Current research on distributed work and research in related areas that provide a theoretical foundation for understanding the impact of distance on work. Prerequisite: consent of instructor.

1-3 units, Win (Hinds)

PROJECT COURSES, SEMINARS, AND WORKSHOPS

MS&E 408. Directed Reading and Research—Directed study and research on a subject of mutual interest to student and faculty member. Prerequisite: faculty sponsor.

1-15 units, any quarter (Staff)

MS&E 411. Topics in Mathematical Programming Seminar—Presentations by students and invited speakers. Introduction to techniques for solving structured linear programs. A fundamental problem of the decision sciences is finding an optimal solution when some of the parameters of a planning or design problem (including coefficients and right-hand sides of a linear program) are not known with certainty. Such problems, when converted to deterministic equivalent, were too large to solve in practice. Recent approaches that solve important classes of stochastic programs using decomposition and importance sampling techniques.

3 units, Spr (Infanger)

MS&E 412. Affiliate Project Course—Students work on a project with an MS&E Department Affiliate Company. Projects not necessarily available every year. Prerequisite: consent of instructor.

3-4 units, Win (Savage)

MS&E 430. Contextual and Organizational Issues in Human-Computer Interaction—(Same as CS 247B.) Focus is on the contextual issues associated with designing and using computer interfaces and technology, providing insights into, experience with, and ways of understanding issues in work and consumer settings that influence the design of computer interfaces. Student team projects develop skills in: observing individuals and groups of people in context, using models of work and other activity to extend their design capabilities, identifying constraints and tradeoffs on designs within the context of use, and observing and working with people in interdisciplinary design groups. Enrollment limited. Prerequisite: 247A, or consent of instructor.

3-4 units, Spr (Hinds)

MS&E 444. Investment Practice—Projects enhance the student's abilities to formulate and design superior solutions to financial issues in industry and the financial services sector. Short projects illustrate the basic application and implementation of investment principles. Students complete a new project from industry. Enrollment limited to 30 MS&E students. Prerequisites: 242, 342.

4 units, Spr (R. Luenberger)

MS&E 446. Policy and Economics Research Roundtable (PERR)—Presentations and discussions of research in progress or contemplated, in policy and economics areas. Students present either their own research or, subject to approval, recent research by others. Particular emphasis depends on research interests of participating students, but is likely to include energy, environment, transportation, or technology policy and analysis.

1 unit, Aut, Win, Spr (Sweeney)

MS&E 451. Decision Systems I: Professional Secrets and Tricks of the Trade—How to assist thousands, or even millions, of decision makers at the same time. Professional tricks for designing decision systems that simultaneously help many decision makers who face similar decisions, such as purchasing an automobile or making investments over the Internet. Commercial system demonstration.

2 units, Win (Holtzman, Robinson)

452: Decision Systems II: Business, Consumer, and Medical Applications—Design a decision system to help decision makers who face business, consumer, and medical decisions. In previous years, student teams designed decision systems for areas such as auction bidding, cancer treatment, sailing tactics, automobile purchasing, network design, Mars exploration, flu treatment, platoon missions, high-tech manufacturing, and oil-and-gas exploration. This project course combines

lectures, examples, and a team project of your own choosing. Prerequisites: 252 or equivalent; recommended 352 and 451.

3-4 units, Spr (Holtzman/Robinson)

MS&E 454. Decision Analysis Seminar—Discussion of current research in decision analysis and related topics presented by doctoral students and invited speakers.

1 unit, Aut, Win, Spr (Howard)

MS&E 455. Decision Making in Organizations I: How to Avoid Traps, Clarify Frames, and Improve Process—Lectures and war stories from experienced professional consultants demonstrate practical decision tools and techniques. Student teams critique current decisions by decision makers as described in news articles, case studies, and interviews with executives of various community organizations. Leadership profiles, organizational structure and defenses, decision quality, dialogue decision process, creativity, decision psychology, efficient value creation, and rewards for good decisions.

2 units, Aut (Robinson, Holtzman)

MS&E 456. Decision Making in Organizations II: How to Structure, Model, and Analyze—Lectures and war stories from experienced professional consultants demonstrate practical decision tools and techniques. Student teams critique current decisions by actual decision makers, as described in news articles, case studies, and interviews with executives of community organizations. Learn and practice how to build decision hierarchies, make value trade-offs, construct decision diagrams, develop strategy tables, create economic and/or business models, analyze sensitivities, and understand portfolio risk.

2 units, Win (Holtzman, Robinson)

MS&E 457. Decision Making in Organizations III: Decision Analysis Projects—A virtual consulting firm directed by experienced professional consultants. Student teams help decision makers with choices they face in business, health-care, educational, non-profit, or government organizations. Teams receive guidance on how to frame and structure decisions, develop and refine models, analyze sensitivities, assess probabilities and preferences, determine information value, recommend actions, and communicate with all parties. Satisfies project course requirement for MS&E degrees. Prerequisite: 252.

3-4 units, Spr (Holtzman, Robinson)

MS&E 458. Decision Making in Organizations IV: Professional Decision Consulting—Experienced consultants reveal the secrets of their success. Student teams help decision makers with choices they face in business, health-care, educational, non-profit, or government organizations. Teams receive guidance on how to identify the value of consulting, find decisions among worries, write proposals, market and sell personal services, organize tasks, lead and manage project teams, incorporate decision and risk analyses, present results to diverse audiences, and gain commitment for implementation.

2-6 units, Sum (Holtzman, Robinson)

MS&E 459. Interdisciplinary Seminar on Conflict and Dispute—(Same as LAW 611, PSYCH 283.) Problems of conflict resolution and negotiation from an interdisciplinary perspective. Presentations by faculty and scholars from other universities.

1 unit, Spr semester (Hensler)

MS&E 464. Global Project Coordination—Students engage in projects that are global in nature, and which are related to the planning and design of supply chains and product development. Project teams from Stanford and an overseas university work on common projects using telephones, faxes, emails, the Internet, video conferencing, face-to-face meetings. As part of the project, students travel to Hong Kong or the Netherlands. Applications due in Autumn Quarter.

3-4 units, Win (Tabrizi)

MS&E 472. Entrepreneurial Thought Leaders' Seminar—The Entrepreneurial Thought Leader Lectures provide students with real-world experiences from the perspective of high-technology industry leaders. Every quarter, this series brings world-class entrepreneurs, CEOs, venture capitalists, and authors to campus to share their perspectives on entrepreneurial leadership and strategic management.

1 unit, Aut, Win (Kosnik), Spr (Byers)

MS&E 473. Project Course in Strategy Modeling—Design and application of formal models in strategic planning problems. Problems involving issues of technology development, resource management, and uncertainty in a corporate setting. Emphasis is on the integrated utilization of modeling tools drawn from diverse methodologies and the requirements for successful application in a policy making or corporate strategy context. Emphasis is on links among art, theory, and practice.

4 units (Weyant) alternate years, given 2003-04

MS&E 474. Business and Environmental Issues—(Same as GES 203B.)

1-2 units

MS&E 478. Topics in International Technology Management—(Enroll in EE 402A.)

1 unit, Aut (Dasher)

MS&E 498. Medical Modeling Workshop—Current research in quantitative medical modeling by students, faculty, and invited speakers.

1 unit, not given 2002-03