ENGINEERING MANAGEMENT

Engineering management is the art and science of planning, organizing, allocating resources, and directing and controlling engineering activities. The field of engineering management has become recognized as a professional discipline with a critical role in the modern society. Graduates develop innovative and integrated solutions to problems that arise at the convergence of engineering and business.

Graduate programs leading to the M.S. and Ph.D. degrees are offered in engineering management. The discipline involves designing, operating and continuously improving systems by integrating engineering and management knowledge. This integration starts with an awareness of customer needs and market conditions. It then seeks to optimize the use of people, equipment, money and information to achieve desired objectives. The discipline also seeks to develop students into individuals with leadership potential who can achieve high quality results in an ethical manner and with respect for the environment. The major goal of entering students is to enhance the usefulness of their previously acquired technical background. This is accomplished through coursework and research designed to expand knowledge of the management and operation of organizations in today's competitive environment. This broader understanding is further enhanced with the opportunity to acquire specialized knowledge in many areas that exist at the interface between the classical engineering and management disciplines.

The engineering management department has produced over 6,200 graduates at the B.S., M.S., and Ph.D. level since its inception in 1968. The engineering management and systems engineering department is one of only a few institutions in the world that offers B.S., M.S., and Ph.D. degrees in engineering management. The B.S. in engineering management is fully ABET accredited and the M.S. in engineering management has been certified by the American Society of Engineering Management. Graduates have been successful in working at the intersection of technology, engineering, and management to produce outstanding results.

Requirements for Completion

Students following their approved program of study will be assured of graduation upon maintenance of good academic standing. A minimum of 30 units of course work from the areas listed below must be completed with a cumulative grade point average of 3.00 (on a 4.00 scale) and a C grade or better in each course. Accumulation of more than 10 hours of "C" or "F" results in dismissal from the program. A maximum of nine hours of course work for M.S. degrees may be transferred from universities outside the University of Missouri System. Such credits for transfer must have been registered as graduate courses when they were taken. All courses applied to the degree require prior written advisor approval recorded on the study plan in the student's file. It is the responsibility of each student to apply for graduation with the Missouri S&T registrar's office during his or her last semester. Assistance on this final step can be provided by the engineering management and systems engineering department.

Departmental Laboratories

The department has several "hands on" laboratories that have both a research and teaching focus. Each of our labs is directed by faculty members that work closely with students to enhance their learning experience. The description below gives a brief introduction that will help you understand the purpose of each lab.

Smart Engineering Systems Lab (SESL)

The department established the Smart Engineering Systems Lab (SESL) to develop approaches in building complex systems that can adapt in the environments in which they operate. The term "smart" in the context indicates physical systems that can interact with their environment and adapt to changes both in space and time by their ability to manipulate the environment through self-awareness and perceived models of the world based on both quantitative and qualitative information. The emerging fields of artificial neural networks, fuzzy logic, evolutionary programming, chaos, wavelets, fractals, complex systems, and virtual reality provide essential tools for designing such systems.

The focus of the SESL is in developing smart engineering architectures that integrate and/or enhance the current and future technologies necessary for developing smart engineering systems while illustrating the real life applications of these architectures. The smart engineering systems design and operations cut across a diversity of disciplines, namely manufacturing, electrical, computer, and mechanical, biomedical, civil and other related fields such as applied mathematics, cognitive sciences, biology and medicine. Current research is on developing new models and tools for building complex systems architectures that are intelligent, modular, and adaptive.

Design Engineering Center (DEC)

The center is one of the outreach arms of the engineering management and systems engineering department. The focus is on research and service activities in support of the educational goals of the department through externally funded projects. Current areas of research include total quality management, concurrent engineering, Taguchi Methods®, quality engineering, the product development process, and design optimization.

Laboratory for Investment and Financial Engineering

The goal of the Laboratory for Investment and Financial Engineering is to develop techniques and computational tools for increasing investment and capital return while managing and reducing financial risk. This involves research into stocks and financial derivatives (options, futures, forwards, and swaps), financial risk and uncertainty, financial forecasting, market efficiency and behavioral finance, fundamental and technical analysis, equity valuation, real options, and engineering economics. In cooperation with the Smart Engineering Systems Lab, research in the lab may also involve the use of smart and intelligent systems, such as neural networks, fuzzy logic, genetic and evolutionary algorithms, expert systems, intelligent agents, artificial life, chaos and fractals, and dynamic and complex systems. Data mining, principal component analysis and various other forms of applied statistics are also used. Members of the lab have access to financial data and various financial modeling software packages.

Additional Information

For additional information you can call our main department phone at 573-341-4572 or you can visit our web page at http://emse.mst.edu/.

Master of Science Admission Standards

- B.S. in engineering or a physical science
- Undergraduate courses: Calculus Series (I, II, III), Differential Equations, Statistics, Physics (I, II) or Chemistry, Engineering Economy
- GPA: Regular status: 3.0 cumulative
- Graduate Record Exam (GRE): All students must submit current GRE scores. Students successfully completing one of the department's graduate certificates with a grade of B or better in all the certificate courses can be admitted without the GRE.
- Regular status: V+Q≥ 1100, A≥ 4.0 (former scoring) or V≥ 155, Q≥ 148, A≥ 4.0
- Condition: Student must earn B or better in each of first four graduate (5000 or 6000 level) classes after conditional admission.
- TOEFL: All international applicants must submit a current TOEFL score, regardless of prior academic experience or place of study.
- Regular status: 580/237/92
- Statement of Purpose: All applicants must submit a statement of purpose.
- Financial Support: Students in conditional status are not eligible for financial support from the department.
- Three reference letters

The M.S. degree program is offered on the Rolla campus and several locations including the Missouri S&T Global - St. Louis, Fort Leonard Wood (restricted to Engineer Captain's Career Course), and by distance education throughout the United States and selected international locations. Distance course lectures are archived upon completion of the lecture and all lectures are available to students through streaming video during the semester for review. These courses can be reached from anywhere at any time. It is feasible to obtain a Missouri S&T non-thesis M.S. degree regardless of your location.

The M.S. non-thesis program requires completion of at least 10 three-credit hour courses approved by the academic advisor. The M.S. with thesis option requires thirty credit hours including the thesis. All students are required to take the following:

Core Courses

ENG MGT 5111	Management for Engineers and Scientists	
ENG MGT 5320	Project Management	
ENG MGT 5412	Operations Management Science	
ENG MGT 6211	Advanced Financial Management	

Students are then encouraged to identify an emphasis area depending on their interests and to choose available courses from the selected area. However, courses can be chosen from more than one emphasis area. Students have the option to take up to two out-of-department elective courses.

Students must submit a typed Form I to the EMSE graduate office by the beginning of the semester of their 15th credit hour. Links to forms are available at: http://emgt.mst.edu/currentstudents/formsdeadlines.html. Thesis students cannot register for Graduate Research (ENG MGT 6099) until their Form I is on file. If students vary from Form I, they must file a Form I-A. Non-thesis students must take three 6000-level courses. Thesis students must take two 6000-level courses (in addition to ENG MGT 6099). Students must meet all requirements for graduation

as specified in the Graduate Catalog for engineering management. A graduate student already holding or completing a master's degree may obtain a second M.S. in engineering management by completing at least an additional 24 credit hours of work.

Some recent master thesis titles include:

- Impacting Co-Worker Trust Toward Persons with Disabilities
- Intelligent Technical Analysis Using Neural Networks and Fuzzy Logic
- Applying the Six Sigma Methodology to Improve the Admissions Process at Missouri S&T
- Strategic Inventory Allocation for Vehicle Rental Agencies
- Design and Development of an Interactive Web-Integrated Flexible Manufacturing Cell Control System
- Investigations in the Design of Products and Factories for End-of-Life Disassembly
- Warranty Cost Prediction Using Mahalanobis Distance
- Automotive Braking System Simulation and Optimization

Doctor of Philosophy Admission Standards

- B.S. in engineering, or a physical science
- Undergraduate courses: Calculus Series (I, II, III), Differential Equations, Statistics, Physics (I, II) or Chemistry, Engineering Economy
- GPA: M.S. GPA = 3.5
- Graduate Record Exam (GRE): All students must submit current GRE scores. V+Q≥ 1100, A≥ 4.0 (former scoring) or V≥ 155, Q≥ 148, A≥ 4.0
- TOEFL: All international applicants must submit a current TOEFL score, regardless of prior academic experience or place of study.
- Regular status: 580/237/92
- Statement of Purpose: All applicants must submit a statement of purpose.
- Three reference letters

A candidate for the Ph.D. in engineering management must complete the equivalent of at least three years of full-time work beyond the bachelor's degree. The content of all Ph.D. programs is individually structured by the student in consultation with and approved by the student's advisory committee. All requirements for the degree must normally be completed within an eight-year period. Each candidate must normally spend at least two sequential semesters in full-time residence at Missouri S&T. The department does have special conditions for satisfying residency and meeting research requirements for full time working engineers that meet all admission standards. At appropriate points in their program, Ph.D. students must pass both a qualifying examination and a comprehensive examination. Ph.D. students must conduct original research under the supervision of a doctoral advisor, and write and successfully defend the dissertation. Some recent Ph.D. dissertation titles include:

- Development and Analysis of Intelligent Computation Based Stock Forecasting and Trading
- An Analysis of Intermodal Transportation Mode Selection Considering Stochastic System Parameters
- Surviving the Change to a Competitive Market Place in the Small Local Exchange Carrier Telecommunications Industry
- The Relationship Between R&D Spending and Shareholder Returns in High Technology Industries

- Global Stock Index Forecasting Using Multiple Generalized Regression Neural Networks with a Gating Network
- The Development of Efficient Delivery Routes in Extremely Short Product Life-Cycle Environments
- Quantification of Attribute Driven Cannibalization Induced by New Product Introduction
- Cost Allocation Using Intelligent Agents for New Transmission Investment Under Electricity Deregulation

Residency Requirements

Students must normally spend at least two sequential semesters in full-time residence at Missouri S&T and conduct original research under the supervision of a doctoral advisor. For distance PhD students, alternative methods for meeting this residency requirement are allowed and are up to the discretion of the student's doctoral advisor, but the qualifying examination, comprehensive examination and dissertation defense must be completed on campus. The student has the option of conducting research that is beneficial to the student's professional work.

Graduate Certificate Programs

This program is designed to appeal to working professionals. Certificate courses taken for graduate credit can be counted in the M.S. degree once accepted into the M.S. degree. If the four-course sequence is completed with a grade of "B" or better in each of the courses taken, they can apply to the M.S. program in engineering management. The certificate program may be followed by six additional 3 credit courses to complete the M.S. degree. The certificate program is open to all persons holding a B.S., M.S., or Ph.D. degree in engineering or a physical science and who have a minimum of 12-months of professional employment experience or are currently accepted into a graduate degree program at Missouri S&T.

Admission Standards

- B.S. in engineering or a physical science
- Undergraduate courses: Calculus Series (I, II, III), Differential Equations, Statistics, Physics or Chemistry, Engineering Economy
- GPA: Regular status: 2.75 cumulative
- TOEFL: All international applicants must submit a current TOEFL score, regardless of prior academic experience or place of study
- Regular status: 580/237/92

Once admitted to the program, the student must take the four designated courses as given below. In order to receive a graduate certificate, the student must have an average cumulative grade point of 3.0 or better in the certificate courses.

Engineering Management

The engineering management certificate program aims to provide individuals with a core body of engineering management knowledge that includes key technical management concepts, processes, and methods for individuals preparing to transition from individual technical contributors to managers of complex technological projects.

The certificate program coverage includes planning, organizing, allocating resources, and directing and controlling technical projects and people in technical jobs. Students will be responsible for prerequisite knowledge as determined by course instructors.

ENG MGT 5111	Management for Engineers and Scientists
ENG MGT 5320	Project Management
ENG MGT 5412	Operations Management Science
ENG MGT 6211	Advanced Financial Management

Financial Engineering

The financial engineering certificate program aims to equip students with a set of tools that will help them meet the standards of the Global Association of Risk Professionals (GARP) and the Professional Risk Managers' International Association (PRMIA) certifications. While being separate organizations, both GARP and PRMIA have become the standards in financial engineering and financial risk management, due to their similar knowledge of requirements for certification.

Certificate topics will help prepare students to take the GARP Financial Risk Managers (FRM) exam and/or the PRMIA Professional Risk Managers (PRM) exam. Both exams are set around topics in financial theory, financial markets and financial instruments, market risk measures, quantitative analysis, mathematical foundations of risk management, financial derivatives for risk reduction, risk management best practices, operational risk, market risk, credit risk, case studies, ethics, and governance. The certificate courses will provide a strong foundation in these areas.

Students will be responsible for prerequisite knowledge as determined by course instructors and are expected to have taken ENG MGT 5210 Economic Decision Analysis, ENG MGT 5202 Financial Decision Analysis, SYS ENG 6103 Systems Life Cycle Costing, or an equivalent introduction to finance and/or engineering economics course, as a prerequisite to the certificate program.

ENG MGT 6212	Investment
ENG MGT 6213	Financial Engineering
ENG MGT 6214	Financial Engineering II
ENG MGT 6215	Financial Risk Management

Human Systems Integration (HSI)

This certificate will prepare students to have a significant impact on complex tasks involving humans. In our increased threat environment, the consequences of HSI failures will become even more critical. We can no longer afford to have a token human factors specialist added to teams addressing complex military issues. A more effective comprehensive approach is to broadly educate military personnel and defense contractors and others in HSI. An increased understanding of human performance will allow for improved performance across the areas of interest which will be gained from this certificate and will result in improved survivability in response to disasters and catastrophes.

The human systems integration certificate program consists of four of five courses. Students will be responsible for prerequisite knowledge as determined by course instructors. With the prior approval of the department, appropriate courses may be substituted for a certificate course if that course is not available.

ENG MGT 4330	Human Factors
ENG MGT 6001	Special Topics
IS&T 5885	Human-Computer Interaction
Select one of the following:	
ENG MGT 5316	Safety Engineering Management
IS&T 5887	Human-Computer Interaction Evaluation

Lean Six Sigma

This certificate program offers an opportunity for professionals to expand their knowledge in Lean Six Sigma through a flexible graduate education program. The certificate provides a solid foundation of Lean Six Sigma

methods and practices that can be immediately applied to process improvement projects in the work place. The certificate consists of four courses designed to prepare professionals for variation and waste reduction projects and provide a sound statistical background.

The Lean Six Sigma certificate program consists of four of the five courses below, which are delivered as part of our regular master's degree programs in engineering management. Students will be responsible for prerequisite knowledge determined by course instructors.

ENG MGT 5710	Six Sigma	
ENG MGT 6710	Design for Six Sigma	
ENG MGT 6611	Lean Systems	
Select one of the following:		
STAT 5643	Probability And Statistics	
STAT 5353	Statistical Data Analysis	

Military Construction Management

(Certificate restricted to the Engineer Captain's Career Course at Fort Leonard Wood.)

ENG MGT 5110	Managerial Decision Making	
ENG MGT 5111	Management for Engineers and Scientists	
CIV ENG 5445	Construction Methods	
CIV ENG 5360	Water Resources And Wastewater Engineering	
or CIV ENG 6443	Contract Formulation And Project Delivery Systems	

Project Engineering & Construction Management

Although available to all interested students, the project engineering and construction management graduate certificate program was created to specifically meet the needs of visiting faculty/graduate students from Algeria as part of the collaborative program "Development of Engineering Management Curriculum and Distance-Learning Methodologies in Algeria: An Educational Partnership," sponsored by the United States Department of State, Bureau of Educational and Cultural Affairs, and the North African Partnerships Program.

The objective of this collaborative program is to provide educational and technical assistance to Algeria in order for that country to develop new graduate programs in engineering management and construction engineering and modern teaching methodologies, including Internet and distance learning. The cooperative framework provides participants with engineering management skills and expertise to prepare them to be leaders at their home institutions.

Choose two:		
CIV ENG 5445	Construction Methods	
CIV ENG 5449	Engineering and Construction Contract Specifications	
CIV ENG 6442	Construction Administration, Planning and Control	
CIV ENG 6445	Advanced Construction Engineering	
Choose two:		
ENG MGT 5111	Management for Engineers and Scientists	
ENG MGT 5210	Economic Decision Analysis	
ENG MGT 5320	Project Management	
ENG MGT 6323	Global Project Management	

Project Management

The project management certificate program aims to equip students with a set of tools that will allow them to achieve Project Management Institute (PMI) standards in the project management area, to successfully manage projects and human resources, and to analyze, evaluate, and improve systems.

The certificate program will consist of four required courses:

ENG MGT 5210	Economic Decision Analysis	
ENG MGT 5320	Project Management	
ENG MGT 6322	Case Studies in Project Management	
ENG MGT 6323	Global Project Management	

Safety Engineering

Safe engineering systems protect the health of workers and the public, preserve the environment, and improve the profitability of industrial facilities. The graduate certificate in safety engineering is a program of study that focuses on methods to reduce risks, prevent accidents, and/or mitigate the consequences to acceptable levels. Risk reduction is accomplished by identifying hazards with unacceptable consequences and then reducing the probability of occurrence (accident reduction) and/or reducing the consequences to acceptable levels (mitigation). The program of study consists of four courses: two required core courses and two courses selected from a specialization track.

Required Courses:		
ENG MGT 4312/ CHEM ENG 5130	Risk Assessment and Reduction	
ENG MGT 5316	Safety Engineering Management	
Available Specialization Tracks:		
Safety Engineering Management		
ENG MGT 5713	Management And Methods In Reliability	
SYS ENG 6110	Risk Modeling and Optimization under Uncertainty	
Human Factors		
Required course:		
ENG MGT 5330	Advanced Human Factors	
Choose one of the following:		
PSYCH 4700	Industrial Psychology	
BIO SCI 4383	Toxicology	
PSYCH 4730	Environmental Psychology	

John F Bade, Adjunct Associate Professor
PHD University of Missouri-Rolla

Robert T Berry, Adjunct Professor
PHD University of Kansas

Steven M. Corns, Associate Professor
PHD Iowa State University

Elizabeth Anne Fargher Cudney, Associate Professor
PHD Missouri S&T
Quality, Six Sigma, Robust Engineering, and Lean Enterprise.

Cihan H Dagli, Professor
PHD University of Birmingham, UK
Director of Systems Engineering Program and Director of the Smart Engineering Systems Laboratory. Systems Architecting as Engineering, Systems of Engineering, Smart Engineering System Design, Systems Architecting, Neural Networks, Fuzzy Logic, Evolutionary Programming, Data Mining, Nesting Problems.

David Enke, Professor
PHD University of Missouri-Rolla
Investments, Derivatives, Options and Futures, Financial Forecasting, Trading Strategies, Hedge Funds, Endowment Investing, Financial Risk Management, Engineering Economy, Computational Finance, Computational Intelligence, Neural Networks.

Abhijit Gosavi, Associate Professor
PHD University of South Florida
Supply chain management, simulation based optimization, and lean enterprise.

Katie Grantham, Associate Professor
PHD University of Missouri-Rolla

Kellie Sue Grasman, Lecturer
MBA University of Michigan Ann Arbor

Sheryl Hodges, Assistant Teaching Professor
DEng Louisiana Tech Univeristy

Suzanna K. Long, Professor
PHD University of Missouri-Rolla
Strategic Management, change management, business logistics, supply chain management, transportation systems, and civil infrastructure management.

Ruwen Qin, Associate Professor
PHD Pennsylvania State University
Financial engineering, real options, and operations research.

Stephen A Raper, Associate Professor
PHD University of Missouri-Rolla
Associate Chair of Undergraduate Studies in Engineering Management. Packaging engineering, operations, productivity, total quality management, packaging systems design, environmental aspects of packaging, and statistical process control.

Joan Barker Schuman, Associate Teaching Professor
PHD University of Southern Mississippi
Project Management and Engineering Economics.

David G Spurlock, Associate Teaching Professor
PHD University of Illinois Urbana

Zeyi Sun, Assistant Professor
PHD University of Illinois at Chicago

ENG MGT 5000 Special Problems (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

ENG MGT 5001 Special Topics (LEC 0.0-6.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

ENG MGT 5070 Teaching Engineering (LEC 3.0)
Introduction to teaching objectives and techniques. Topics include: using course objectives to design a course; communication using traditional and cutting-edge media; textbook selection; assessment of student learning; grading; student learning styles; cooperative/active learning; and student discipline. Prerequisite: Graduate standing. (Co-listed with Env Eng 5070, Comp Eng 5070, Elec Eng 5070, Civ Eng 5070).

ENG MGT 5099 Research (IND 0.0-15)
Investigations of an advanced nature leading to the preparation of a thesis or dissertation. Consent of instructor required.

ENG MGT 5110 Managerial Decision Making (LEC 3.0)
Individual and group decision making processes and principles for engineers and technical managers with emphasis on the limitations of human rationality and the roles of social influence and organizational contexts; principles and skills of negotiation. Prerequisite: Senior or graduate standing.

ENG MGT 5111 Management for Engineers and Scientists (LEC 3.0)
The transition of the engineer or scientist to manager; study of management roles and theory, organizational systems and behavior, managing and motivating technical personnel, leadership, communication, processes, and customer focus. Prerequisite: Graduate standing.

ENG MGT 5210 Economic Decision Analysis (LEC 3.0)
Comprehensive treatment of engineering economy including effects of taxation and inflation; sensitivity analysis; decisions with risk and uncertainty; decision trees and expected value, normally includes solutions on personal computer and student problem report. Prerequisite: Graduate students without previous course in engineering economy because of partial overlap.

ENG MGT 5212 Intelligent Investing (LEC 3.0)
An overview of the essential elements of intelligent investing. Coverage includes stocks, bonds, exchange traded funds, mutual funds, stock screening, fundamental and technical analysis, valuation, market and industry analysis, macroeconomic indicators, investing strategies, and portfolio construction. Prerequisites: Senior or Graduate Standing.

ENG MGT 5312 Advanced Risk Assessment and Reduction (LEC 3.0)
Safe, secure manufacturing facilities protect the health of employees and the public, preserve the environment, and increase profitability. Methods for systematically identifying hazards and estimating risk improve the safety performance and security of manufacturing facilities. Prerequisite: Senior or Graduate Standing.

ENG MGT 5313 Packaging Management (LEC 3.0)
Provides a comprehensive background in the field of packaging and its place in productive systems. Emphasizes the design or economics of the system. Analyzes the management of the packaging function and interrelationship with other functions of an enterprise.

ENG MGT 5315 Interdisciplinary Problems In Manufacturing Automation (LEC 1.0 and LAB 2.0)
Introduction to basic techniques and skills for concurrent engineering, manufacturing strategies, product design, process planning, manufacturing data management and communication are the topics covered. Students experiment the design process through team projects and structured manufacturing laboratory work. (Co-listed with Mech Eng 5644, Chem Eng 4310).

ENG MGT 5316 Safety Engineering Management (LEC 3.0)
This course is an introduction to the principles of safety engineering applied to industrial situations. Job safety analysis, reduction of accident rates, protective equipment, safety rules and regulations, environmental hazards, health hazards, and ergonomic hazards are covered. Prerequisite: Senior or graduate standing.

ENG MGT 5320 Project Management (LEC 3.0)
Organization structure and staffing; motivation, authority and influence; conflict management; project planning; network systems; pricing, estimating, and cost control; proposal preparation; project information systems; international project management. Prerequisite: Graduate Standing.

ENG MGT 5330 Advanced Human Factors (LEC 3.0)
An in-depth review of the foundations of human factors, focusing on the interaction of people with various forms of technology in a variety of environments. Topics include research and evaluation methods, displays (e.g., visual, auditory), attention and information processing, decision making, motor skills, anthropometry, and biomechanics. (Co-listed with PSYCH 5710).

ENG MGT 5410 Industrial System Simulation (LEC 3.0)
Simulation modeling of manufacturing and service operations through the use of computer software for operational analysis and decision making. Prerequisite: Stat 3115 or Stat 3117.

ENG MGT 5411 Engineering Design Optimization (LEC 3.0)
This course is an introduction to the theory and practice of optimal design as an element of the engineering design process. The use of optimization as a tool in the various stages of product realization and management of engineering and manufacturing activities is stressed. The course stresses the application of nonlinear programming methods. Prerequisite: Math 3304 or 3329.

ENG MGT 5412 Operations Management Science (LEC 3.0)
Application of management science with an emphasis on supporting managerial decision-making. Design and operations of systems are modeled and analyzed using quantitative and qualitative techniques implemented using modern technology. Specific approaches include mathematical modeling and optimization, probabilistic/statistical analysis, and simulation. Prerequisites: Graduate standing.

ENG MGT 5414 Introduction To Operations Research (LEC 3.0)
Mathematical methods for modeling and analyzing industrial systems, topics including linear programming, transportation models, and network models. Prerequisite: Stat 3115 or Stat 3117.

ENG MGT 5510 Industrial Marketing Systems Analysis (LEC 3.0)
An analysis of the factors of engineered products, customers, communication, promotion, personal selling, persuasion and management within a dynamic industrial sales environment. Prerequisites: Senior or graduate standing.

ENG MGT 5511 Technical Entrepreneurship (LEC 3.0)
Student teams develop a complete business plan for a company to develop, manufacture and distribute real technical/product service. Lectures & business fundamentals, patents, market/ technical forecasting, legal and tax aspects, venture capital, etc., by instructor and successful technical entrepreneurs. Prerequisite: Senior or graduate standing.

ENG MGT 5512 Legal Environment (LEC 3.0)
Study of the effect of the legal environment on the decisions which the engineering manager must make. The course investigates the social forces that produced this environment and the responsibilities incumbent upon the engineer. Prerequisites: Senior or graduate standing.

ENG MGT 5513 Energy and Sustainability Management Engineering (LEC 3.0)
This course explores strategic processes and partnership required for the management of sustainable energy infrastructures and innovation in energy systems. Topics relate to renewable energy, energy efficiencies, energy conversion, energy technology, and economic efficiency of energy sources. Prerequisite: Senior or Graduate Standing.

ENG MGT 5514 Patent Law (LEC 3.0)
A presentation of the relationship between patent law and technology for students involved with developing and protecting new technology or pursuing a career in patent law. Course includes an intense study of patentability and preparation and prosecution of patent applications. Prerequisite: Senior or graduate standing. (Co-listed with Chem Eng 4300).

ENG MGT 5515 Integrated Product And Process Design (LEC 3.0)
Emphasize design policies of concurrent engineering and teamwork, and documenting of design process knowledge. Integration of product realization activities covering important aspects of a product life cycle such as "customer" needs analysis, concept generation, concept selection, product modeling, process development, and end of product life options. Prerequisites: Junior or above standing. (Co-listed with MECH ENG 5757).

ENG MGT 5516 Integrated Product Development (LEC 1.0 and LAB 2.0)
Students in design teams will simulate the industrial concurrent engineering development process. Areas covered will be design, manufacturing, assembly, process quality, cost, supply chain management, and product support. Students will produce a final engineering product at the end of the project. Prerequisite: Eng Mgt 5515 or Mech Eng 5757 or Mech Eng 3653 or Mech Eng 5708. (Co-listed with Mech Eng 5758).

ENG MGT 5610 Advanced Facilities Planning & Design (LAB 1.0 and LEC 2.0)
An integrated approach to the planning and design of facilities; examination of advanced techniques and tools for facility location, space allocation, facility layout materials handling system design, work place design; e.g. mathematical programming and simulation modeling. Prerequisites: Graduate standing.

ENG MGT 5613 Value Analysis (LEC 3.0)
An organized effort at analyzing the function of goods or services for the purpose of achieving the basic functions at the lowest overall cost, consistent with achieving the essential characteristics. Covers the basic philosophy, function analysis, FAST diagramming, creativity techniques, evaluation of alternatives, criteria analysis, and value stream mapping. Prerequisite: Senior or graduate standing.

ENG MGT 5614 Supply Chain Management Systems (LEC 3.0)
This course focuses on the development of logistics management skills related to global supply chains. Particular attention will be given to supply chain systems management as part of the firm's strategic positioning, cultural interactions and transportation sourcing decisions. Prerequisite: Stat 3115 or Stat 3117.

ENG MGT 5615 Production Planning And Scheduling (LEC 3.0)
Introduction to basic techniques of scheduling, manufacturing planning and control, just-in-time systems, capacity management, master production scheduling, single machine processing, constructive Algorithms for flow-shops, scheduling heuristics, intelligent scheduling systems are the topics covered. Prerequisite: Eng Mgt 3310.

ENG MGT 5710 Six Sigma (LEC 3.0)
This course is an introduction to the principles of implementing the Six Sigma philosophy and methodology. Topics include tools and methods including process flow diagrams, cause and effect diagrams, failure mode and effects analysis, gage R&R, capability studies, design of experiments and strategy for organizing six sigma techniques in industry. Prerequisite: Graduate standing.

ENG MGT 5711 Total Quality Management (LEC 3.0)
Examination of various quality assurance concepts and their integration into a comprehensive quality management system: statistical techniques, FMEA's, design reviews, reliability, vendor qualification, quality audits, customer relations, information systems, organizational relationships, motivation. Prerequisite: Senior or graduate standing.

ENG MGT 5712 Introduction To Quality Engineering (LEC 3.0)
This course is an introduction to the theory and practice of quality engineering with particular emphasis on the work of Genichi Taguchi. The application of the quality loss function, signal to noise ratio and orthogonal arrays is considered in-depth for generic technology development; system, product and tolerance design; and manufacturing process design. The emphasis of the course is off-line quality control. Other contributions in the field are also considered. Prerequisite: Eng Mgt 5711.

ENG MGT 5713 Management And Methods In Reliability (LEC 3.0)
Study of basic concepts in reliability as they apply to the efficient operation of industrial systems. Prerequisite: Stat 3115, 3117, or 5643.

ENG MGT 5714 Statistical Process Control (LEC 3.0)
The theoretical basis of statistical process control procedures is studied. Quantitative aspects of SPC implementation are introduced in context along with a review of Deming's principles of quality improvement and a brief introduction to sampling inspection. Prerequisite: Stat 3115, or Stat 3117.

ENG MGT 6000 Special Problems (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

ENG MGT 6001 Special Topics (LEC 0.0-6.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

ENG MGT 6010 Seminar (IND 0.0-6.0)
Discussion of current topics.

ENG MGT 6040 Oral Examination (IND 0.0)
After completion of all other program requirements, oral examinations for on-campus M.S./Ph.D. students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/ comprehensive examination (oral/ written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

ENG MGT 6050 Continuous Registration (IND 1.0)
Doctoral candidates who have completed all requirements for the degree except the dissertation, and are away from the campus must continue to enroll for at least one hour of credit each registration period until the degree is completed. Failure to do so may invalidate the candidacy. Billing will be automatic as will registration upon payment.

ENG MGT 6099 Research (IND 0.0-15)
Investigations of an advanced nature leading to the preparation of a thesis or dissertation. Consent of instructor required.

ENG MGT 6101 Advanced Research Methodology In Engineering Management (LEC 3.0)
An advanced study of research methodology techniques and theories in conducting research activities. The research problems, hypotheses, literature search, data requirements and analyses, interpretation and presentation of results are examined. Prerequisite: Graduate standing.

ENG MGT 6110 Case Studies In General Management (LEC 3.0)
A quantitative study of engineering management problems related to the functioning of the industrial enterprise through case studies. Prerequisite: Preceded or accompanied by an Eng Mgt 6000 level course.

ENG MGT 6112 Leadership for Engineers (LEC 3.0)
Provides engineers with a background in leadership concepts and principles; enables students to develop practical skills in leading and managing through multiple personal assessment. Topics include leadership styles, managing commitments, conflict resolution, change management, emotional intelligence, team dynamics and business ethics. Prerequisite: Eng Mgt 5110 or Psych 4602. (Co-listed with Psych 6611).

ENG MGT 6113 Advanced Personnel Management (LEC 3.0)
Current practices of procurement and maintenance of technical personnel in research, development, and design organizations. Adaptation of such personnel to the technological enterprise, current practices in personnel administration, labor management relationships.

ENG MGT 6211 Advanced Financial Management (LEC 3.0)
Principles of financial organization and management in the technological enterprise; demands for funds; internal and external supply of funds; budgetary control; reserve and dividends policy. Emphasizes systems approach and problems of engineering design and automation as they influence financial decisions. Prerequisite: Eng Mgt 1210 or 5210.

ENG MGT 6212 Investment (LEC 3.0)
An introduction to the theory and practice of investment, including financial markets and instruments, security trading, mutual funds, investment banking, interest rates, risk premiums, the capital asset pricing model, arbitrage pricing theory, market efficiency, bonds and the fixed income market, equity valuation, fundamental and technical analysis. Prerequisite: Eng Mgt 1210 or 5210. (Co-listed with Sys Eng 6612).

ENG MGT 6213 Financial Engineering (LEC 3.0)
An introduction to financial engineering, with an emphasis on financial derivatives, including the future markets, the pricing of forwards and futures, forward rate agreements, interest and exchange rate futures, swaps, the options markets, option strategies, the binomial and Black-Scholes models for option valuation, the option Greeks, and volatility smiles. Prerequisites: Eng Mgt 1210 or 5210. (Co-listed with Sys Eng 6613).

ENG MGT 6214 Financial Engineering II (LEC 3.0)
This course introduces advanced topics in financial engineering, which includes introduction to Wienver processes, martingales and Ito's lemma; basic numerical methods for options pricing, exotic options; interest rate models; stochastic volatility models and jump-diffusion models; and value-at-risk. Prerequisite: Eng Mgt 6213/Sys Eng 6613. (Co-listed with Sys Eng 6614).

ENG MGT 6215 Financial Risk Management (LEC 3.0)
Techniques and methods for managing financial risk, including portfolio theory, Monte Carlo methods, ARIMA, time series forecasting, Value-at-Risk, stress testing, extreme value theory, GARCH and volatility estimation, random variables and probability distributions, real options, decision trees, utility theory, statistical decision techniques, and game theory. Prerequisite: Eng Mgt 1210 or 5210. (Co-listed with Sys Eng 6615).

ENG MGT 6310 Human Systems Integration (LEC 3.0)
This course considers Human Systems Integration (HSI) in a variety of applications including systems acquisition and training, HSI tools, techniques, and procedures. Prerequisite: Eng Mgt 4330 or Psych 4710.

ENG MGT 6322 Case Studies in Project Management (LEC 3.0)
Includes the main components of the Project Management Institute (PMI) Body of Knowledge; case studies in project management including project implementation, organizational structures, project estimating, project scheduling, project risk management, and conflict management. Prerequisite: Eng Mgt 5320 or equivalent.

ENG MGT 6323 Global Project Management (LEC 3.0)
In depth and advanced topics in project management including project management methodologies, strategic planning for excellence, project portfolio management, integrated processes, culture, and behavioral excellence; normally includes a hands-on group project. Prerequisite: Eng Mgt 5320 or equivalent.

ENG MGT 6410 Markov Decision Processes (LEC 3.0)
Introduction to Markov Decision Processes and Dynamic Programming. Application to Inventory Control and other optimization and control topics. Prerequisite: Graduate standing in background of probability or statistics. (Co-listed with Comp Eng 6310, Mech Eng 6447, Aero Eng 6447 and Comp Sci 6202).

ENG MGT 6411 Advanced Topics in Simulation Modeling (LEC 3.0)
Design and analysis of distributed systems using discrete-event simulations and synchronization of distributed models. Design and implementation of finite state automata and simulation models as control execution systems. Functioning of real-time, agent-based, and multipass simulations. Prerequisite: Eng Mgt 5410 or Graduate standing.

ENG MGT 6412 Mathematical Programming (LEC 3.0)
An introduction to linear optimization and its engineering applications; problem modeling, search-based optimization, the simplex method for solving linear problems, multi-objective optimization, discrete dynamic programming. Applications of optimization in the fields such as transportation, project management, manufacturing and facility location will be discussed. Prerequisites: Stat 3113 or equivalent and (Eng Mgt 5414 or Math 3103 or Math 3108) (Co-listed with Math 6665).

ENG MGT 6413 Advanced Engineering Management Science (LEC 3.0)
Solving of managerial problems utilizing management science techniques. Problems are analyzed, modeled and solved using such techniques as linear, goal, dynamic, programming, simulation, statistical analysis or other non-linear methods. Solutions will involve the use of personal or mainframe computers. A study of the current literature in management science will also be conducted. Prerequisite: Eng Mgt 5414 or graduate standing.

ENG MGT 6415 Risk Modeling and Optimization under Uncertainty (LEC 3.0)
Risk analysis of products and systems will be explored. Traditional probabilistic risk assessment techniques will be covered along with recent approaches (i.e., stochastic programming, robust optimization, and dynamic programming) that use historical data based risk models to realize optimal risk management. Prerequisites: Graduate standing. (Co-listed with Sys Eng 6110).

ENG MGT 6510 Technological Innovation Management (LEC 3.0)
Technological innovation is new technology creating new products and services. This course studies the issues of managing technological innovation under four topics: 1) Innovation; 2) New Ventures; 3) Corporate Research & 4) R&D Infrastructure. Prerequisite: Eng Mgt 5111.

ENG MGT 6511 Advanced Marketing Management (LEC 3.0)
Study of marketing decision areas in the technically based firm, including product selection and development, marketing research, market development, distribution, advertising, and promotion. Pricing policies including legal aspects and problems in selecting, training and controlling field sales force. Examination of interaction within consumer and industrial marketing environments. Prerequisites: Eng Mgt 5111, Econ 1200.

ENG MGT 6610 Advanced Production Management (LEC 3.0)
Examination of responsibilities of production manager in the technological enterprise for providing finished goods to meet the quality, price, quantity and specification needs of the market place. Study of functions of production manager. Quantitative approach to decision making in production management. Prerequisites: Senior or graduate standing and advanced mathematical modelling competence.

ENG MGT 6611 Lean Systems (LEC 3.0)
Lean Systems embodies a total enterprise philosophy built on removing waste. Concepts such as flow, just-in-time, lead times, inventory turns, standardized work, pull system, value streams, quick changeover, workplace organization, and visual controls are discussed to improve system performance. Prerequisite: Graduate standing.

ENG MGT 6710 Design for Six Sigma (LEC 3.0)
Principles of Design for Six Sigma for product development.Topics include tools and methods including quality function deployment, concept generation, concept selection, product modeling, process development, DFX strategies, failure mode and effects analysis, design of experiments, TRIZ, and robust design. Prerequisite: Eng Mgt 5710.

ENG MGT 6711 Quality Engineering (LEC 3.0)
This course is an examination of the theory and practice of quality engineering with particular emphasis on the work of Genichi Taguchi. The application of the quality loss function, signal to noise ratio and orthogonal arrays is considered indepth for generic technology development; system, product and tolerance design; and manufacturing process design. The emphasis of the course is off-line quality control. Prerequisites: Eng Mgt 5711 and Math 3329 or equivalent.

ENG MGT 6713 Tolerance Design (LEC 3.0)
This course is an examination of the theory and practice of allowance allocation for high quality and low cost manufacture of mass-produced consumer products, including technology intensive products, such as automobiles, trucks, military and commercial airplanes, computers and consumer electronics. Prerequisite: Eng Mgt 5711 or equivalent.