IE 1560 Operations Research: Deterministic Mathematical Models Cr. 2
Introduction to mathematics of decision making in industry and government. Offered Every Term.
Restriction(s): Enrollment is limited to Undergraduate level students.

IE 3120 Work Design Cr. 3
Role of the human as an element of the work environment. Traditional issues of work standards, productivity analysis and occupational safety are introduced. Examination of functional and organizational role of the worker; impact of emerging computer-based technologies on work design and implementation strategies is discussed. Offered Fall.
Prerequisite: BE 2100 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

IE 3450 Manufacturing Processes I Cr. 3
A study of the field of manufacturing processes from a mechanical engineering design standpoint. Topics include: processing of metals, polymers and ceramics, and computer-aided manufacturing. Offered Fall, Winter.
Prerequisites: BE 1500 with a minimum grade of C- and ME 2420 with a minimum grade of C- and BE 1310 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

Course Material Fees: $25
Equivalent: ME 3450

IE 3460 Manufacturing Processes Lab Cr. 1
Laboratory to accompany IE 3450. Offered Fall.
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

IE 4120 Introduction to Human Factors Engineering Cr. 4
Current practice perspective on human capabilities and limitations as a component in engineering systems. Analysis and design of human-centered systems, with emphasis on applications. Offered Winter.
Prerequisite: BE 2100 with a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

IE 4250 Engineering Data Analysis Cr. 3
Advanced concepts for the analysis of variability in engineering problems, multivariate distributions, hypothesis testing, non-parametric statistics, point and interval estimation, fitting straight lines, goodness of fit tests, contingency tables and introduction to the analysis of variance. Offered Winter.
Prerequisite: BE 3220 with a minimum grade of C- or BE 2100 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

IE 4260 Principles of Quality Control Cr. 3
Statistical quality control including process capability, control charts, and acceptance sampling procedures. Procedures for measurement of dimensional tolerance are introduced. Computer-based data collection and analysis. Offered Yearly.
Prerequisite: BE 2100 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

IE 4310 Production Control Cr. 3
Satisfies General Education Requirement: Writing Intensive Competency
The design of production planning and control systems. Materials management, forecasting, planning, scheduling of production systems, the planning and scheduling for large scale projects and introduction to the design of computerized materials management systems. Applications of operations research models to production control problems. Offered Winter.
Prerequisite: IE 4560 with a minimum grade of C- and ENG 3050 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

IE 4330 Facilities Design Cr. 3
Design of manufacturing, warehouse and material handling facilities. Use of analytic and computer-aided methods in the facilities design process. Offered Winter.
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

IE 4355 Product Engineering Cr. 3
Current principles and processes of product engineering. Use of integrated product engineering processes and methods. Offered Winter.
Prerequisite: BE 2100 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering.
IE 4420 Systems Simulation Cr. 3
Systems modeling and discrete event simulation. Methodology applied to analysis and design of a broad range of systems including both production and service systems. Computer assignments and a term project are required. Offered Yearly.
Prerequisites: BE 1200 with a minimum grade of C- and BE 2100 with a minimum grade of C- and BE 2550 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

IE 4560 Operations Research Cr. 3
An introduction to the philosophy of operations research. Formulation of linear programming models and their solution. Duality and sensitivity analysis. The transportation model. Introduction to probabilistic modeling and applications of queueing models. Offered Fall.
Prerequisite: BE 2100 with a minimum grade of C- and MAT 2150 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

IE 4700 Leadership in Manufacturing Cr. 3
Leadership of individuals and teams in a unionized manufacturing environment. Technical elective for Production Leadership Management Program (PMPL) students. Offered Fall.
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

IE 4710 Labor Relations in Manufacturing Cr. 3
Knowledge and skills in administering labor agreements. Technical elective for Production Leadership Management Program (PMLP) students. Offered Winter.
Restriction(s): Enrollment limited to Undergraduate level students; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

IE 4800 Engineering Design I: Project Management Cr. 2
Project selection, team building, and methodological preparation required for Engineering Design Project II. Offered Yearly.
Prerequisites: 2 of IE 4420 with a minimum grade of C-, IE 4330 with a minimum grade of C-, IE 4560 with a minimum grade of C- and IE 3120 with a minimum grade of C- and IE 4250 with a minimum grade of C- and IE 4850 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

IE 4850 Engineering Economy Cr. 3
Prerequisite: BE 2100 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.
Course Material Fees: $10
Equivalent: CE 4850

IE 4880 Engineering Design II Cr. 2
Intensive design experience defined and executed by the student. Requires synthesis and application of skills and knowledge gained in the program. Offered Winter.
Prerequisites: May be taken concurrently: IE 4260 with a minimum grade of C- and May be taken concurrently: IE 4310 with a minimum grade of C- and May be taken concurrently: IE 4330 with a minimum grade of C- and May be taken concurrently: IE 4420 with a minimum grade of C- and May be taken concurrently: IE 4560 with a minimum grade of C- and IE 4800 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

IE 4990 Directed Study Cr. 1-6
Supervised study and instruction in a field selected by the student. Offered Intermittently.
Restriction(s): Enrollment limited to students in the College of Engineering; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Industrial Engineering, BS in Mechanical Engineering.

IE 5490 Creative Problem Solving in Design and Manufacturing Cr. 3
Equivalent: ME 5470, SYE 5470

IE 5780 Products Liability Introduction for Engineers Cr. 1
Application of engineering practice to minimize products liability exposure. Stages of a products liability lawsuit; how engineers may be involved at different stages of the process. Offered Yearly.
Restriction(s): Enrollment limited to students with a class of Applicant Masters, Candidate Masters or Senior; enrollment limited to students in the College of Engineering.
Equivalent: ME 5780

IE 5995 Special Topics in Industrial Engineering Cr. 1-4
Special subject matter in industrial engineering. Topics to be announced in Schedule of Classes. Offered Intermittently.

IE 6000 Digital Automation Cr. 3
Fundamentals of digital control and logic; integration and automation solution technologies (barcode systems, vision systems, etc.); data acquisition. Offered Fall, Spring/Summer.
IE 6005 Automotive Engineering Statistics Cr. 3
Introduction to probability and statistics for engineering students: analysis of random component in problems, understanding probability and statistics, opportunities for application, analysis of data using statistical software. Offered for graduate credit only. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students; enrollment limited to students in the College of Engineering.

IE 6210 Applied Engineering Statistics Cr. 3
An introductory statistics course for students in engineering that will build upon introductory statistical knowledge. Students will learn to identify the phenomena they would like to study, design, and run experiments; collect data and analyze it by applying statistical tools such as multiple regression, ANOVA, and non-parametric statistical tools; and report on the statistical results and their implication to engineering phenomena. No credit for AGRADE undergraduates after taking IE 4250. Offered Fall, Winter.

IE 6215 Production and Service Systems Cr. 3
Fundamental theories and concepts in the design and operation of production systems for manufacturing and service organizations. Topics may include: Inventory Management, Production Planning (MRP, JIT, ERP), Factory Physics, Production Control, Introduction to Supply Chain Management Offered Winter.
Prerequisite: IE 6210 with a minimum grade of C and IE 6560 with a minimum grade of C

IE 6220 Value Engineering Cr. 3
Resource management; systematic approach to solving problems and making decisions; forcing latent capabilities to be applied to challenging assumptions; application of unbiased logic techniques to produce superior results. Offered Spring/Summer.

IE 6240 Quality Management Systems Cr. 3
Design of quality management systems. Topics include: QFD, quality planning, business operating systems, TQM, standards, and auditing. Quality management tools such as PDCA and root case analysis. Offered Winter.

IE 6250 Quality Engineering Cr. 3
Quality Engineering means achieving quality by design, so this course covers several important methods in supporting engineering design activities. These methods include quality function deployment, axiomatic design, Theory of Inventive Problem Solving (TRIZ), Taguchi method (robust design) and tolerance design. Offered Fall, Winter.
Prerequisite: IE 6210 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

IE 6255 Quality Engineering Cr. 3
Quality Engineering means achieving quality by design, so this course covers several important methods in supporting engineering design activities. These methods include quality function deployment, axiomatic design, Theory of Inventive Problem Solving (TRIZ), Taguchi method (robust design) and tolerance design. Offered Fall, Winter.

IE 6270 Engineering Experimental Design Cr. 3
The design of engineering experiments for manufacturing process analysis, human factors experimentation, societal systems analysis and life testing; basic experimental design models, blocking, factorial experiments, nested designs, covariance analysis, response surface analysis, estimation of effects. Offered Fall.
Prerequisite: IE 6210 with a minimum grade of C or IE 4250 with a minimum grade of C

IE 6275 Reliability Estimation Cr. 3
The course is designed for graduate students specializing in quality engineering. These individuals play a significant role in designing and developing new products and manufacturing systems and processes. Topics include: reliability measures, failure distributions, reliability block diagrams, reliability estimation using exponential and Weibull distributions, sequential life testing, test planning, and Bayesian reliability. Offered Fall.
Prerequisite: IE 4250 with a minimum grade of C or IE 6210 with a minimum grade of C

IE 6301 Lean Operations and Manufacturing Cr. 3
Fundamental theories and concepts in lean manufacturing, six-sigma, mistake proofing, problem solving, process management. Students develop competency in identifying causes and sources of waste in manufacturing, industrial, and business operations. Offered Fall, Winter.
Prerequisite: IE 4250 with a minimum grade of C or IE 6210 with a minimum grade of C
IE 6425 Product Lifecycle Management and Sustainable Design Cr. 3
The aim of this class is to familiarize the current principles, practices, and applications of Product Lifecycle Management (PLM). The sustainable design of products and processes, as well as the early consideration of constraints and factors, are important in the successful development of competitive products. PLM is an integrated, information driven approach to all aspects of a product's life from its design inception, through its manufacture, deployment and maintenance, culminating in its removal from service and final disposal. PLM technology plays a critical role in most modern industries including aerospace, automobile, and medical. Effective integration of PLM technologies into the product development process can put the industry at a competitive advantage to deliver innovative products. Offered Winter.

IE 6430 Computer Simulation Methods Cr. 3
The application of discrete, continuous and combined simulation methods to the solution of a variety of production and service systems problems. Computer simulation and a term project involving an application are required. No credit after IE 4420. Offered Fall, Winter.
Prerequisite: IE 6210 with a minimum grade of C

IE 6435 Fundamentals of Sustainable Manufacturing Cr. 3
Sustainable manufacturing, as defined by the U.S.A. Department of Commerce, is "the creation of manufactured products that use processes that minimize negative environmental impacts, conserve energy and natural resources, are safe for employees, communities, and consumers and are economically sound." This course is designed to introduce the fundamental concepts of sustainable manufacturing. While the focus will be on sustainable manufacturing, topics will also include connections of sustainable design, environmental sciences, and the social sciences with sustainable manufacturing. Offered Every Other Fall.

IE 6442 Facilities Design and Materials Flow Cr. 3
Presents the fundamental concepts, theory and procedures required for effective facilities design and planning. Includes models for determining plant size and time phasing; design of manufacturing, warehouse and material handling facilities; and use of analytic and computer-aided methods in the facilities design process. No credit after IE 4330. Offered Fall, Winter.

IE 6470 Stochastic System Modeling: Queuing and Simulation Cr. 2
Description of queuing systems; analytical solutions; discrete events systems; modeling framework and object models; terminating and non-terminating systems; statistical analysis; case studies. Offered Yearly.

IE 6490 Introduction to Systems Engineering in Design Cr. 3
Provides an introduction to the engineering and analysis of human-made systems with an emphasis on the process of bringing systems into being. Includes an introduction to systems sciences and engineering and will follow the engineering process from conceptual systems design through concept selection, concept validation, life-cycle acquisition, life-cycle costing, software development, system architecture, and risk management. Addresses system engineering program evaluation including: evaluation requirements, evaluation of the system engineering organization, and program reporting, feedback, and control. Offered Fall.
Restriction(s): Enrollment limited to students in the College of Engineering.

IE 6510 Information Systems for the Manufacturing Enterprise Cr. 3
Information systems are used to make organizations leaner and more integrated across the entire Manufacturing Enterprise. A suite of information systems is to provide an environment that allows an engineer to consider both product and manufacturing requirements throughout the design, development, manufacturing cycle, resulting in a single unified concurrent engineering process, an integral knowledge management process, and rapid response to market changes. This course will teach information technologies and applications in the manufacturing industry. Offered Fall.

IE 6520 Negotiating in an IE Environment Cr. 3
Analytic and interpersonal skills needed to negotiate effectively. Students integrate the analytic and interpersonal skills necessary to be an effective negotiator in a rapidly-changing technical environment. Offered for graduate credit only. Offered Every Other Winter.
Restriction(s): Enrollment is limited to Graduate level students.

IE 6560 Deterministic Optimization Cr. 3
The primary goals are to develop the ability to formulate fairly complex optimization problems, provide an appreciation of the main classes of problems that are practically solvable, describe the available solution methods, and build an understanding of the qualitative properties of the solutions they provide. The class participant will develop skills in recognizing and formulating deterministic optimization models and gain an appreciation for the role of sensitivity analysis in analyzing a problem. Covers methods for quantifying the impact of specific constraints on the overall performance of the system. Application areas include production scheduling, product mix planning, manpower planning, routing and scheduling, financial planning, and prototype builds. Offered Fall, Winter.

IE 6580 Engineering Financial Practice Cr. 3
Combines the central concepts of engineering financial and engineering managerial economics. Demonstrates, from an engineering financial perspective, how engineering decisions can impact the economic goals of the company. Offered Every Other Winter.
Restriction(s): Enrollment is limited to Graduate level students.

IE 6590 Engineering Leadership: Strategic Communications Cr. 3
Leaders in an engineering work environment face unique team and organizational communication challenges. Strong and precise communication is key to effective leadership and organizational efficiency. Participants in this course will engage in the practical and theoretical aspects of verbal and nonverbal communications in leadership and in the workplace. Offered Every Other Winter.
Restriction(s): Enrollment is limited to Graduate level students.

IE 6611 Fundamentals of Six Sigma Cr. 3
The attraction of Lean Six Sigma is obvious — designs that work, fewer defects and wastes in manufacturing, faster processes, lowered production costs, and greater customer satisfaction. With these pluses, it’s no wonder the world’s leading companies are adopting the Six Sigma approach to product development in ever-growing numbers. This comprehensive course covers the fundamental aspects of Lean and Six Sigma, Lean operation principles and tools, and the Six Sigma process improvement, that is Define-Measure-Analyze-Improve-Control (DMAIC). Offered Winter, Spring/Summer.

IE 6720 Engineering Risk and Decision Analysis Cr. 3
Structure, modeling and analysis of technical management decisions with emphasis on multiple objectives and trade-offs, and significant uncertainty. Explores barriers to rational decision making. Offered Spring/Summer.
Prerequisite: IE 6210 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

IE 6830 Management of Technology Change Cr. 3
Focuses on technology change and use of systems approach to plan for, manage and implement the diffusion and dynamics of product, process and business model innovation. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.
IE 6840 Project Management Cr. 3
Provides an appreciation for the role and importance that project management has in delivering complex engineering projects on time, within budget, within performance specifications, and satisfying the customer. Reviews the fundamental content of the nine knowledge areas and five process groups included in the PMI’s Project Management Body of Knowledge and how they apply to the general stages of a product development project with a look at some basic techniques and tools. Offered Winter.

IE 6850 Manufacturing Strategies Cr. 3
Manufacturing strategy is one aspect of a company’s business strategy that also includes marketing, finance, and research and development. Each strategy development must coexist to achieve the company’s goal, meet customer demands, and stay competitive. The objective of this course is to introduce and discuss key components of manufacturing strategy and how this fits within an overall business strategy. Offered Intermittently.

IE 6991 Industrial Internship Cr. 1-3
Offered Fall, Winter.
Repeatable for 99 Credits

IE 7100 Mathematical Modeling in Impact Biomechanics Cr. 4
Review of models created for impact simulations. Regional impact simulation models. Human and dummy models subject to various restraint systems. Offered Winter.
Prerequisite: BME 5010 with a minimum grade of B-
Restriction(s): Enrollment is limited to Graduate level students.
Equivalent: BME 7100, ECE 7100

IE 7125 Human Factors Engineering Cr. 4
Current methods and topics in engineering research on human capabilities and limitations as a system component. Advanced analysis, modeling and design of human-centered systems. Offered Winter.
Prerequisite: BE 2100 with a minimum grade of C-
Restriction(s): Enrollment is limited to Graduate level students.

IE 7220 Advanced Statistical Methods Cr. 3
Statistics is the science to collect, describe, analyze, interpret, and draw conclusions on data. This course introduces students to the conceptual underpinnings of statistical methods and how to apply them to address more advanced statistical questions than are covered in an introductory statistics course. The statistical methods covered in this course are useful for many types of questions that relate to multiple variables and/or multiple groups. Offered Every Other Winter.
Restriction(s): Enrollment is limited to Graduate level students.

IE 7290 Quality and Productivity Management Cr. 4
Topics in product assurance management including: definition, history, philosophy of quality. Strategic elements of proactive quality, design for quality, process project control, reliability program management. Offered Yearly.
Restriction(s): Enrollment is limited to Graduate level students.

IE 7400 Capstone: Integrated Product Engineering Cr. 4
Integration of product development tools and theory. Industry-based project to develop hands-on experience with integrated project design and development. Application to robust product development methodologies. Offered Winter.
Prerequisite: IE 6400 with a minimum grade of C and IE 6410 with a minimum grade of C and IE 6420 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

IE 7410 Agile Systems for the Manufacturing Enterprise Cr. 2
Factors that help define the agility of a system; greater workforce autonomy and changes in training and production of technical personnel. Main elements of operations management. Offered Yearly.
Restriction(s): Enrollment is limited to Graduate level students.

IE 7445 Manufacturing Analytics Cr. 3
Provides a deep understanding of the intersection of manufacturing and analytics and its application in current manufacturing industries to improve operations and gain competitive advantages. Covers fundamental concepts from data acquisition to analysis to decision making in manufacturing, specifically, manufacturing process and systems data acquisition; manufacturing data and information systems hierarchies and flows (IT/OT layers); manufacturing analytics, both real-time and historical; and data driven manufacturing decision making. Offered Every Other Fall.
Prerequisite: IE 6210 with a minimum grade of C
Restriction(s): Enrollment limited to students in a Doctor of Philosophy degree.

IE 7480 Knowledge-Based Design Cr. 3
Provides in-depth understanding of knowledge roles, knowledge elicitation techniques, knowledge based system and system modeling issues, and semantic modeling to support product design. Students will learn the concepts via lecture, articles, and semantic product model implementation projects. Offered Every Other Winter.
Restriction(s): Enrollment is limited to Graduate level students; enrollment limited to students in the College of Engineering.

IE 7511 Linear and Nonlinear Optimization Cr. 3
The primary goal of the course is to provide a solid foundation in the deterministic optimization field. The basic concepts in linear programming and nonlinear programming will be covered. Topics include: convex sets/functions, duality, and sensitivity from different perspectives; simplex algorithm for solving linear programming problems; unconstrained and constrained optimization, nonlinear duality theory, Lagrangian relaxation, and algorithmic methods for solving nonlinear programs (including descent methods, Newton's method, conjugate gradient methods, and penalty and barrier methods). Offered Every Other Fall.
Restriction(s): Enrollment is limited to Graduate level students.

IE 7520 Optimization Methods Cr. 4
Restriction(s): Enrollment is limited to Graduate level students.

IE 7521 Large Scale Optimization and Integer Programming Cr. 3
Examines modeling and solution methodologies for large scale optimization and integer programming problems. Presents the theory and the exact and approximate techniques that have been developed to solve related models. Techniques include branch and bound, cutting planes, Lagrangian relaxation, Benders' decomposition, and column generation. Polyhedral theory will be discussed at some length. Offered Every Other Winter.
Prerequisite: IE 6560 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

IE 7535 Stochastic Programming and Robust Optimization Cr. 3
Introduction to models, theory and computational methods for stochastic programming and robust optimization. Methods include decomposition-coordination algorithms for large-scale mathematical programming such as Benders, regularized Benders, Dantzig-Wolfe, L-shaped and statistically motivated decomposition methods. Applications, theory and practical algorithm implementation and computational experimentation will be emphasized. Particular attention will be given to large-scale problems, and use of cluster and grid computing architectures to solve them to optimality. Offered Every Other Fall.
Restriction(s): Enrollment limited to students in a Doctor of Philosophy degree.
IE 7570 Deterministic System Models and Optimization Cr. 2
Methods for quantifying impact of specific constraints on overall performance of a system; use of journal articles on corporate use of these models. Offered Yearly.
Restriction(s): Enrollment is limited to Graduate level students.

IE 7620 Advanced Reliability and Survival Analysis Cr. 3
Focuses on general methods used to analyze the reliability and survival data. Introduces the methods to analyze the expected duration of time until one or more events happen, such as death in biological organisms and failure in mechanical systems. Illustrates the use of proven traditional techniques for reliability and survival data analysis and prediction, and brought up to date with modern computer-based graphical, analytical, and simulation-based methods. Offered Every Other Year.
Restriction(s): Enrollment is limited to Graduate level students.

IE 7710 Introduction to Stochastic Processes Cr. 4
Fundamental understanding of various probability models from applied and theoretical perspectives. Topics include: probability review, Markov chains, Poisson process, continuous time Markov chains, queueing processes, and inventory applications. Offered Every Other Year.
Restriction(s): Enrollment is limited to Graduate level students.

IE 7811 Data Mining: Algorithms and Applications Cr. 3
Application of various basic/advanced data mining techniques to real-world problems. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students.
Equivalent: CSC 7810

IE 7860 Intelligent Analytics Cr. 3
Computational intelligence methods used to solve complex analytics problems and develop decision support systems. Project-centric approach with the goal of developing several analytics solutions for real-world problems. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.

IE 7990 Directed Study Cr. 1-6
Student selects some field of industrial engineering for advanced study and instruction. An outline approved by the instructor must be presented before registration in this course. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 6 Credits

IE 7995 Graduate Special Topics Cr. 1-4
Special subject matter in industrial engineering. Topics to be announced in Schedule of Classes. Offered Yearly.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 12 Credits

IE 7996 Research Cr. 1-6
Advanced design, investigation or experimental work. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 6 Credits

IE 7999 Engineering Management Leadership Project Cr. 1-6
Integration of knowledge from individual courses in M.S. engineering management curriculum. Team-oriented focus on major industrial problem. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students; enrollment limited to students with a class of Candidate Masters.
Repeatable for 10 Credits

IE 8920 Decision and Risk Analysis for Research Cr. 3
Structure, modeling, and analysis of technical global management decisions with emphasis on multiple objectives and trade-offs, and significant uncertainty. Explores current trends in decision analysis research. Offered Every Other Fall.
Restriction(s): Enrollment is limited to students with a major in Industrial Engineering GET or Industrial Engineering; enrollment limited to students in a Doctor of Philosophy degree.

IE 8930 Global Perspectives and Networks Cr. 3
Provides technical leaders with a system of frameworks to holistically understand and practically manage operations, to be technologically competitive in the global marketplace. Foundation for the Country Courses. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students; enrollment is limited to students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET.

IE 8941 From Idea through Launch: Products and Services I Cr. 2-3
Course comprised of twelve modules; the processes and progression from product or service innovation to development and launch. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students; enrollment is limited to students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET.

IE 8942 From Idea through Launch: Products and Services II Cr. 2-4
Course comprised of twelve modules; the processes and progression from product or service innovation to development and launch. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students; enrollment is limited to students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET.

IE 8943 From Launch through Sustainability: Products and Services I Cr. 2-4
From when the finished product hits the market to all the steps necessary to make the product sustainable. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students; enrollment is limited to students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET.

IE 8944 From Launch through Sustainability: Products and Services II Cr. 2-4
From when the finished product hits the market to all the steps necessary to make the product sustainable. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students; enrollment is limited to students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET.

IE 8950 Advanced Engineering Statistics Cr. 3
Skill development in model building, ANOVA, multiple regression, multivariate statistics, forecasting, and time series modeling. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students; enrollment limited to students in the College of Engineering; enrollment is limited to students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET; enrollment limited to students in the PhD in Engineering program.

IE 8951 Research Design Cr. 3
Focus on qualitative research design and methods. Discussion of conceptual and practical facets of the process of framing a research question, up to development of an instrument for data collection. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students; enrollment limited to students in the College of Engineering; enrollment is limited to students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET.
IE 8952 Research Methods Cr. 3
Focus on quantitative research design and methods. Topics such as purpose of statistical models, mathematical representation, interpretation, and methods are covered. Typical methods include multiple regression, multivariate analysis (including survey data), and structural equation modeling. Offered Fall.

Restriction(s): Enrollment is limited to Graduate level students; enrollment limited to students in the College of Engineering; enrollment is limited to students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET.

IE 8960 Literature Review Cr. 1-2
Development of library skills for identifying key authors, articles, journals, books, dissertations, case studies, conferences, web sites, professional associations, and NSF funding for a scholarly area of interest. Offered Spring/Summer.

Restriction(s): Enrollment is limited to Graduate level students; enrollment limited to students in the College of Engineering; enrollment is limited to students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET; enrollment limited to students in the PhD in Engineering program.

IE 8970 Leadership of the Global Technical Organization Cr. 3
Understanding the elements of leadership and the dynamics of leadership behavior; development of the skills necessary for leading in a global technical organization. Offered Winter.

Restriction(s): Enrollment is limited to Graduate level students; enrollment is limited to students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET.

IE 8993 Graduate Seminar: Supply Chain Management Cr. 1
Research and development methods for Ph.D. students: literature review, identification of research opportunities, investigation of specific topics; assessment of major contributions and of gap between application and theory. Students present research findings and receive feedback. Offered Intermittently.

Restriction(s): Enrollment is limited to Graduate level students; enrollment limited to students in the PhD in Engineering program.

IE 8995 Graduate Seminar Cr. 1
Research and development methods. Leading-edge research topics. Platform for student to present preliminary research findings and obtain feedback. Offered Fall, Winter.

Restriction(s): Enrollment is limited to Graduate level students; enrollment limited to students in the PhD in Engineering program.

Repeatable for 99 Credits

IE 8999 Master's Thesis Research and Direction Cr. 1-8
Offered Every Term.

Restriction(s): Enrollment is limited to Graduate level students; enrollment limited to students with a class of Candidate Masters.

Repeatable for 8 Credits

IE 9990 Pre-Doctoral Candidacy Research Cr. 1-8
Research in preparation for doctoral dissertation. Offered Every Term.

Restriction(s): Enrollment is limited to Graduate level students.

Repeatable for 12 Credits

IE 9991 Doctoral Candidate Status I: Dissertation Research and Direction Cr. 7.5
Offered Every Term.

Prerequisite: IE 9992 with a minimum grade of S

Restriction(s): Enrollment is limited to Graduate level students.

IE 9992 Doctoral Candidate Status II: Dissertation Research and Direction Cr. 7.5
Offered Every Term.

Prerequisite: IE 9991 with a minimum grade of S

Restriction(s): Enrollment is limited to Graduate level students.

IE 9993 Doctoral Candidate Status III: Dissertation Research and Direction Cr. 7.5
Offered Every Term.

Prerequisite: IE 9992 with a minimum grade of S

Restriction(s): Enrollment is limited to Graduate level students.

IE 9994 Doctoral Candidate Status IV: Dissertation Research and Direction Cr. 7.5
Offered Every Term.

Prerequisite: IE 9993 with a minimum grade of S

Restriction(s): Enrollment is limited to Graduate level students.

IE 9995 Candidate Maintenance Status: Doctoral Dissertation Research and Direction Cr. 0
Offered Every Term.

Restriction(s): Enrollment is limited to Graduate level students.

Course Material Fees: $370.26

Repeatable for 0 Credits