IE - INDUSTRIAL ENGINEERING

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 Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of 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-, ME 2420 with a minimum grade of C-, BE 1300 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 Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of Engineering.
Course Material Fees: $25
Equivalent: ME 3450

IE 4250 Data Science and Analysis Cr. 3
This course is designed to explore the must-knows of data analysis and data science for engineering students. As data analysis focuses on processing and performing statistical analysis to solve problems for well-defined questions, data science complements it by fixating on unearthing answers to the questions that are not well-defined. This course not only covers how to perform descriptive statistics, design of experiment, and hypothesis testing for drawing conclusions, but also introduces how to apply machine learning and predictive analytics to extract critical information from the datasets. This course equips students with methods which are the key tools that enable engineers with descriptive as well as predictive methods to identify and deal with viability of measurements in stochastic environments. Offered Winter.
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 Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of 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 following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of 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: ENG 3050 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 Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of 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 following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of 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-, BE 2100 with a minimum grade of C-, and (BE 1500 with a minimum grade of C- or BE 1600 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 Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of 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 following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of 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 students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment is limited to Undergraduate level students.

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

IE 4850 Engineering Economy Cr. 3
Economic analysis of engineering projects. Selection of appropriate financial parameters (e.g., interest rates) and methods of analysis for depreciation, tax considerations, and use of accounting data for comparison among investment options. 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 Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of 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, Spring/Summer.
Prerequisites: IE 4260 with a minimum grade of C- (may be taken concurrently), IE 4310 with a minimum grade of C- (may be taken concurrently), IE 4330 with a minimum grade of C- (may be taken concurrently), IE 4420 with a minimum grade of C- (may be taken concurrently), IE 4560 with a minimum grade of C- (may be taken concurrently), 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 Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering.

IE 4990 Directed Study Cr. 1-4
Supervised study and instruction in a field selected by the student. Offered Intermittently.
Restriction(s): Enrollment limited to students with a class of Senior; enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Computer Science, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment limited to students in the College of Engineering.
Repeatable for 4 Credits

IE 4991 Undergraduate Internship Cr. 1-2
The objective is to prepare students for roles in industrial and systems engineering by providing students with the opportunity to gain professional experience while engaging in rigorous classroom academics. Students who select this course can only perform work relevant to industrial engineering, therefore, some jobs may not be eligible for internship credit; the work must support the BSIE curriculum. Offered Every Term.
Restriction(s): Enrollment limited to students with a class of Junior or Senior.
Repeatable for 3 Credits

IE 5490 Creative Problem Solving in Design and Manufacturing Cr. 3
Concepts of laws of natural development of engineering systems. Algorithm for inventive (creative) problem-solving (AIPS-85). Creative use of physical and geometrical effects in design of mechanical and manufacturing systems. Concepts of strength, stiffness, vibratory effects, reliability in mechanical design. Offered Yearly.
Equivalent: ME 5470, SYE 5470

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.

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 6010 IoT and Edge AI Programming Cr. 3
Learn sensor programming on an embedded device; use Wi-Fi, Bluetooth and MQTT to implement data streaming, remote control, and multi-device networking; explore the IoT data processing life cycle which includes capturing, cloud storage, and data analysis; develop and deploy machine learning models for use in mobile and edge computing environments. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students.

IE 6040 Simulation in Robotics Using ROS Cr. 3
Robotic systems are increasingly used for various tasks and applications. The applications include transportation safety, search and rescue, space exploration, and military operations, to name a few. ROS, the Robot Operating System, is an open-source framework used to direct the robots to perform tasks. ROS provides a software infrastructure for people who are interested in building and using robots. This framework is commonly used by people to share and collaborate on code and common ideas. Offered Winter.

IE 6125 Human Factors Engineering Cr. 3
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.

IE 6210 Applied Engineering Statistics Cr. 3
An applied 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 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 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.
Prerequisite: IE 6210 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

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 6290 Nonparametric Statistics Cr. 3
The focus is on standard nonparametric procedures useful for the analysis of experimental data. One-sample, two-sample, matched pairs, one-way layout, and two-way layout procedures are covered. Tests for lack of independence, tests of randomness, and goodness-of-fit tests are also covered. Applications are emphasized, but theory is not completely neglected. State-of-the-art software for exact nonparametric inferences is to be used throughout the semester. Offered Spring/Summer.
Prerequisite: IE 6210 with a minimum grade of B
Restriction(s): Enrollment is limited to Graduate level students.

IE 6310 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 6315 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

IE 6325 Supply Chain Management Cr. 3
Supply chain management and logistics is unique and, to some degree, represents a paradox because it is concerned with one of the oldest and also the most newly discovered activities of business. Supply chain system activities - communication, inventory management, warehousing, transportation, facility location, and production - have been performed since the start of commercial activity. It is difficult to visualize any product that could reach a customer without logistical support. Yet, it is only over the last decade that firms have started focusing on logistics and supply chain management as a source of competitive advantage. Logistics and supply chain management today represents a great challenge as well as a tremendous opportunity for most firms. Another term that has appeared in business jargon recently is demand chain. From our perspective, we will use the phrases logistics management, supply chain management, and demand chain management interchangeably. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.

IE 6405 Integrated Product Development Cr. 3
Product development process: product architectures, concurrent engineering. Integration of marketing, design, and manufacturing functions for product development. How such processes are designed to account for various manufacturing and other business constraints to ensure that customer needs are met. Offered Fall.
Restriction(s): Enrollment limited to students in the College of Engineering.
Equivalent: AET 5600, EVE 5600

IE 6420 CAD/CAM Cr. 3
This course aims to provide students with an in-depth introduction to CAD/CAM and computer-aided process planning. Students will have the scientific foundations for understanding the issues and technologies of modern CAD/CAM and related design and modeling activities. The course covers the major topics of CAD/CAM by learning fundamental theory and modern CAD/CAM software. It will provide an integrated view of engineering so that students may gain a complete view of product design, modeling, and manufacturing. Offered Winter.

IE 6422 Flexible Manufacturing Systems Cr. 3
Flexible manufacturing systems are a highly automated group technology machine cell, consisting of a group of processing stations, interconnected by an automated material handling and storage system, and controlled by an integrated computer system. The analysis and design of flexible manufacturing systems will be covered, including: FMS control and communication architecture, FMS material handling architecture, flexibility analysis, and computer-integrated manufacturing (CIM). Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students.

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 products 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.

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 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 6530 Global Automotive Marketing Strategy Cr. 3
Over the course of the term, we will examine the various steps necessary in order to develop, design, and analyze a marketing plan. We will cover strategic issues of specific interest to the automotive industry. Offered Every Other Spr/Sum.
Restriction(s): Enrollment limited to students in the MS in Engineering Management program.

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 6570 Engineering Leadership and Management Cr. 3
This course is intended for students in the off-campus Engineering Management Master's Program. It provides students with a global perspective on engineering leadership. It investigates leadership at multiple levels - individual, organizational and societal - and it explores multiple contexts including different organizational cultures, countries and virtual teamwork. Topics covered include the leader's role in developing and changing organizational culture and leadership differences across cultures. Participants explore issues surrounding global leadership competencies such as leading virtually, the new ways of work, leading innovation, workforce diversity and ethics. They also assess their own cultural intelligence. Offered Yearly.

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 6620 Lean Six Sigma Capstone Cr. 3
Covers extended aspects of Lean and Six Sigma, both the Six Sigma process improvement, that is, Define-Measure-Analyze-Improve-Control (DMAIC), and Lean operation principles and tools. The course also covers Design for Six Sigma and its utilization earlier in Product Development (PD). We extend the DMAIC process steps with DFSS's IDOV (Identify, Design, Optimize, Verify) process steps that cover the earlier PD phases. Offered Spring/Summer.
Prerequisite: IE 6611 with a minimum grade of B-
Restriction(s): Enrollment is limited to Graduate level students.

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 Fall, Spring/Summer.
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 discusses 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 Intermittently.
Prerequisite: BME 5010 with a minimum grade of B-
Restriction(s): Enrollment is limited to Graduate level students.
Equivalent: BME 7100, ECE 7100, ME 7100

IE 7220 Advanced Statistical Methods Cr. 3
Statistics is the science to collect, descript, 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 Experiment Design and Reliability for the Automotive Industry Cr. 3
The course is a combination of experiment design/analysis and reliability methods commonly used in the automotive engineering including but not limited to: one-factor experiments, two factor experiments, factorial and fractional designs, optimization, failure distribution analysis, accelerated life data analysis, and life data regression analysis. Offered Every Other Year.
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 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, Bender's 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 Stochastic Processes Cr. 3
Fundamental understanding of various probability models from applied and theoretical perspectives. Topics include: probability review, Markov chains, Poisson process, continuous time Markov chains, queuing 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
Neural networks and other machine learning techniques for tackling intricate pattern recognition challenges and crafting proficient decision support systems. Delve into foundational concepts, including dimensionality reduction, feature selection, clustering, function approximation, pattern recognition, and forecasting. Course structure centered around hands-on assignments and projects. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students.
Course Material Fees: $50

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 limited to students with a class of Candidate Masters; enrollment is limited to Graduate level students.
Repeatable for 10 Credits

IE 8920 Decision and Risk Analysis for Research Cr. 3
The course will focus on complex decisions that involve tradeoffs amongst objectives or are made in the face of uncertainty. This is a practical business and engineering course, specifically intended to develop and improve decision making for managers and executives. Course lectures will focus on decision tools and their application. Interactive class discussions will follow the course lectures and case study presentations. Offered Every Other Winter.
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 students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET; enrollment is limited to Graduate level students.

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 students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET; enrollment is limited to Graduate level students.

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 Every Other Fall.
Restriction(s): 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; enrollment is limited to Graduate level students.

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 students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET; enrollment is limited to Graduate level students.

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 students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET; enrollment is limited to Graduate level students.

IE 8950 Data Science and Statistics Cr. 3
Data Science and Statistics is a course designed for working executives with a focus on real-world case studies. It explores prerequisites for successful transformation of firms into digital enterprises and also covers core topics surrounding effective application of statistics and data science for analytics and decision making. The course also surveys promising developments in machine learning and AI. Offered Every Other Spr/Sum.
Restriction(s): 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; enrollment is limited to Graduate level students; enrollment limited to students in the College of Engineering.

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 students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET; enrollment is limited to Graduate level students; enrollment limited to students in the College of Engineering.

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 students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET; enrollment is limited to Graduate level students; enrollment limited to students in the College of Engineering.

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 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; enrollment is limited to Graduate level students; enrollment limited to students in the College of Engineering.

IE 8970 Global Leadership and Strategy for Engineering Management Cr. 3
To provide insight, concepts and tools for those times when, executives are called upon, as leaders of technical organizations, to influence and develop business strategy in the global context including issues related to technology, innovation, business model change, and industry disruption. Offered Every Other Fall.
Restriction(s): Enrollment is limited to students with a major, minor, or concentration in Industrial Engineering GET or Industrial Engineering GET; enrollment is limited to Graduate level students.

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 limited to students in the PhD in Engineering program; enrollment is limited to Graduate level students.
Repeatable for 99 Credits

IE 8999 Master's Thesis Research and Direction Cr. 1-8
Offered Every Term.
Restriction(s): Enrollment limited to students with a class of Candidate Masters; enrollment is limited to Graduate level students.
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.
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: $416.08
Repeatable for 0 Credits