INDUSTRIAL ENGINEERING & MANAGEMENT (IEM)

IEM 2903 Introduction to Manufacturing and Service Systems
Prerequisites: ENGR 1111; MATH 2144.
Description: Introduction to definition, design, operation, and improvement of systems that produce goods and services. Case studies featuring classical and contemporary issues in industrial engineering and management. Issues include system effectiveness and efficiency in meeting customer needs, demands and expectations. Introduction to computer-aided tools useful in documentation, analysis, and modeling within contemporary organizations.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Undergraduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 3103 Probability and Statistics for Engineers I
Prerequisites: MATH 2153.
Description: An introduction to key concepts and results in probability, random variables, discrete and continuous distributions, mathematical expectations, and joint probability distributions that support applications in industrial engineering and management.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Undergraduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 3303 Manufacturing Processes
Prerequisites: ENGR 1322 and ENSC 3313.
Description: Manufacturing processes used to transform new materials including metals and non-metals into finished goods. Traditional and nontraditional manufacturing processes. Introduction to CAD/CAM. Basic process selection. Metrology and measurement fundamentals.
Credit hours: 3
Contact hours: Lecture: 2 Lab: 3
Levels: Undergraduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Industrial Engr & Mgmt

IEM 3403 Collaborative Engineering Project Management
Prerequisites: Junior standing.
Description: Engineering management and group issues involved in project planning, implementation and topics addressed include project management methodologies and software; teamwork structures, processes, and collaborative technologies; process management, leadership and other team roles.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Undergraduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 3503 Engineering Economic Analysis
Prerequisites: MATH 2153.
Description: Development and use of time value of money models. Bases for comparison of alternatives, including present worth, annual worth, rate of return and payout period methods. Decision-making among independent, dependent, capital-constrained and unequal-life projects. Replacement, breakeven and minimum cost analyses. Depreciation and depletion methods and their effect on corporate income taxes, leading to after-tax cash flow analysis. Introduction to financial reports.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Undergraduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 3513 Economic Decision Analysis
Prerequisites: MATH 2123.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Undergraduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 3523 Engineering Cost Information and Control Systems
Prerequisites: MATH 2144.
Description: Introduction to basic accounting concepts and operating characteristics of accounting systems relevant to engineering analysis and decision making. Principles of financial and managerial accounting, activity based costing, taxes and depreciation. Emphasis on interpretation and use of accounting information for decision-making.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Undergraduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 3703 Probability and Statistics for Engineers II
Prerequisites: IEM 3103.
Description: An introduction to key concepts and results in statistics, including confidence intervals and hypothesis tests for the mean and the variance, analysis of variance, linear regression, correlation, goodness of fit tests and categorical data analysis that support applications in industrial engineering and management.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Undergraduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt
IEM 3813 Work Design, Ergonomics, and Human Performance  
**Description:** Evaluation and design of work systems and processes employing humans. Emphasis on simultaneously achieving high productivity and employee health, safety and satisfaction.  
**Credit hours:** 3  
**Contact hours:** Lecture: 2 Lab: 3  
**Levels:** Undergraduate  
**Schedule types:** Lab, Lecture, Combined lecture and lab  
**Department/School:** Industrial Engr & Mgmt  
**IEM 4010 Industrial Engineering Projects**  
**Prerequisites:** Consent of school head  
**Description:** Special undergraduate projects and independent study in industrial engineering. Offered for variable credit, 1-3 credit hours, maximum of 6 credit hours.  
**Credit hours:** 1-3  
**Contact hours:** Other: 1  
**Levels:** Undergraduate  
**Schedule types:** Independent Study  
**Department/School:** Industrial Engr & Mgmt  
**IEM 4013 Operations Research**  
**Prerequisites:** MATH 3013.  
**Description:** Introduction to operations research, analytics, and mathematical optimization with an emphasis on topics in linear, integer, and network optimization. Effective model formulation and software solution of strategic, tactical and operational problems encountered in manufacturing, and service industries. Covers the simplex method, duality theory, sensitivity analysis, branch-and-bound, network simplex, and Dijkstra’s algorithm. Previously offered as IEM 4014.  
**Credit hours:** 3  
**Contact hours:** Lecture: 3  
**Levels:** Graduate, Undergraduate  
**Schedule types:** Lecture  
**Department/School:** Industrial Engr & Mgmt  
**IEM 4020 Undergraduate Engineering Practicum**  
**Prerequisites:** Consent of IEM adviser, admission to the Professional School of Industrial Engineering and Management and satisfactory completion of at least 12 hours of IEM 3000- or IEM 4000-level courses.  
**Description:** Professionally supervised experience in real life problem solving involving industrial projects for which the student assumes a degree of professional responsibility. Activities approved in advance by the instructor. May consist of full- or part-time engineering experience, on-campus or in industry, or both, either individually or as a responsible group member. Periodic reports both oral and written required as specified by the adviser. Offered for variable credit, 1-3 credit hours, maximum of 4 credit hours.  
**Credit hours:** 1-3  
**Contact hours:** Other: 1  
**Levels:** Undergraduate  
**Schedule types:** Independent Study  
**Department/School:** Industrial Engr & Mgmt  
**IEM 4103 Quality Control**  
**Prerequisites:** IEM 3703.  
**Description:** Performance excellence in an enterprise, including relationships between industrial engineering and quality control. Statistical quality control concepts to measure, monitor, diagnose, and improve performance at the enterprise level, the operational level, and the project level. Quantitative and qualitative quality tools to solve problems and capture opportunities for improvement.  
**Credit hours:** 3  
**Contact hours:** Lecture: 3  
**Levels:** Graduate, Undergraduate  
**Schedule types:** Lecture  
**Department/School:** Industrial Engr & Mgmt  
**IEM 4113 Industrial Experimentation**  
**Prerequisites:** IEM 3703.  
**Description:** Analytical methods for the purpose of process improvement. Experimental designs including single, blocked and multiple factors. Introduction to fractional factorial designs, central composite designs, and Taguchi robust designs. Data collection, analysis, and interpretation, including graphical methods, confidence intervals, and hypothesis tests. Multiple linear regression analysis methods. Industrial applications.  
**Credit hours:** 3  
**Contact hours:** Lecture: 3  
**Levels:** Graduate, Undergraduate  
**Schedule types:** Lecture  
**Department/School:** Industrial Engr & Mgmt  
**IEM 4163 Service Systems and Processes**  
**Prerequisites:** IEM 3103, IEM 3503, IEM 4613.  
**Description:** Design and analysis of service systems and processes from the perspective of industrial engineering and engineering management. Application of basic industrial engineering principles and tools applied to service systems. Basics of service quality and productivity, including metrics, measurement and improvement.  
**Credit hours:** 3  
**Contact hours:** Lecture: 3  
**Levels:** Undergraduate  
**Schedule types:** Lecture  
**Department/School:** Industrial Engr & Mgmt  
**IEM 4203 Facilities and Material Handling System Design**  
**Prerequisites:** IEM 4713.  
**Description:** Design principles and analytical procedures for determining facility location and location of physical assets within a facility. Introduction to material-handling concepts, technologies and methods. Considerations include production processes, product volume, material flow and information flows.  
**Credit hours:** 3  
**Contact hours:** Lecture: 3  
**Levels:** Graduate, Undergraduate  
**Schedule types:** Lecture  
**Department/School:** Industrial Engr & Mgmt  
**IEM 4413 Industrial Organization Management**  
**Prerequisites:** IEM 2903, Senior standing.  
**Description:** Issues, concepts, theories and insights of engineering management and applications emphasizing effective performance.  
**Credit hours:** 3  
**Contact hours:** Lecture: 3  
**Levels:** Graduate, Undergraduate  
**Schedule types:** Lecture  
**Department/School:** Industrial Engr & Mgmt
IEM 4613 Production Planning and Control Systems
Prerequisites: IEM 4013.
Description: Concepts of planning and control for production and control systems. Design of operation planning and control systems. Techniques used in demand forecasting, operations planning, inventory control, scheduling, and progress control.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Graduate, Undergraduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 4623 Supply Chain Management
Prerequisites: IEM 4013.
Description: Introducing basic concepts and methods in supply chain management. Developing managerial insights into supply chain strategies in the global economy. Measuring supply chain performance under dynamic market conditions. May not be used for graduate credit with IEM 5763.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Graduate, Undergraduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 4713 Systems Simulation Modeling
Prerequisites: IEM 3703 and IEM 4013.
Description: Simulation of discrete-event systems, including problem formulation, translation to a computer model, and use of a model for problem solution as well as concepts of random variable selection and generation, model validation and statistical analysis of results.
Credit hours: 3
Contact hours: Lecture: 2 Lab: 3
Levels: Graduate, Undergraduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Industrial Engr & Mgmt

IEM 4723 Information Systems Design and Development
Description: Information systems development methodologies, modeling methods and software tools for the design and development of information systems. Different phases of system design and implementation. Data modeling using entity-relationship diagrams and process modeling using data flow diagrams, IDEF0 and IDEF3. Introduction to enterprise resource planning systems and their use within different enterprise functional units.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Graduate, Undergraduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 4913 Senior Design Projects
Prerequisites: Terminal semester only; IEM majors only.
Description: Student teams work on professional-level engineering projects selected from a wide range of participating organizations. Projects are equivalent to those normally experienced by beginning professionals and require both oral and written reports. Normally taken during student’s last semester of undergraduate work. Additional flat fee of $80.00 applies.
Credit hours: 3
Contact hours: Lecture: 1 Lab: 4
Levels: Undergraduate
Schedule types: Lab, Lecture, Combined lecture and lab
Department/School: Industrial Engr & Mgmt

IEM 4931 Industrial Engineering and Management Seminar
Prerequisites: Senior standing.
Description: Designed to orient seniors to their professional work environment. Topics include placement procedures, resume construction, interviewing skills, professional dress, graduate school, professional societies and registration, personal management of time and money, and job-related expectations. Taught by senior faculty; utilizes outside speakers.
Credit hours: 1
Contact hours: Lecture: 1
Levels: Undergraduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 4953 Industrial Assessment and Improvement
Prerequisites: Senior standing and consent of instructor.
Description: Plant assessment and improvement-based concepts, strategies, and tools for manufacturing operations. Emphasis is on small to medium-sized manufacturing operations. Issues include energy, water, waste, quality, and productivity analysis across the organization from a systems perspective. Justification of improvement projects and measurement of results.
Credit hours: 3
Contact hours: Other: 1
Levels: Undergraduate
Schedule types: Independent Study
Department/School: Industrial Engr & Mgmt

IEM 4990 Selected Topics in Industrial Engineering and Management
Prerequisites: Consent of instructor.
Description: Study of selected contemporary topics in industrial engineering and management, including operations research; quality; manufacturing systems; engineering management; enterprise systems and supply chains; facilities, energy, and environmental management. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.
Credit hours: 1-6
Contact hours: Other: 1
Levels: Graduate
Schedule types: Independent Study
Department/School: Industrial Engr & Mgmt

IEM 5003 Probability and Statistics for Engineers
Prerequisites: STAT 4033 or IEM 3103.
Description: Probability and statistical topics and methods used in various areas of industrial engineering including random numbers, probability theory, conditional probabilities, parameter estimation, confidence intervals, hypothesis testing, and regression models.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 5007 Industrial Engineering and Management Seminar
Prerequisites: IEM 3103.
Description: Designed to orient seniors to their professional work environment. Topics include placement procedures, resume construction, interviewing skills, professional dress, graduate school, professional societies and registration, personal management of time and money, and job-related expectations. Taught by senior faculty; utilizes outside speakers.
Credit hours: 1
Contact hours: Lecture: 1
Levels: Undergraduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 5008 Industrial Engineering and Management Seminar
Prerequisites: IEM 3103.
Description: Designed to orient seniors to their professional work environment. Topics include placement procedures, resume construction, interviewing skills, professional dress, graduate school, professional societies and registration, personal management of time and money, and job-related expectations. Taught by senior faculty; utilizes outside speakers.
Credit hours: 1
Contact hours: Lecture: 1
Levels: Undergraduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt
IEM 5010 Industrial Engineering Projects
Prerequisites: Consent of school head and approval of major adviser.
Description: Special graduate projects and independent study in industrial engineering. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.
Credit hours: 1-6
Contact hours: Other: 1
Levels: Graduate
Schedule types: Independent Study
Department/School: Industrial Engr & Mgmt

IEM 5013 Introduction to Optimization
Prerequisites: IEM 4013 or equivalent.
Description: Introduction to mathematical optimization with an emphasis on linear, integer, network, and convex optimization. Effective formulation techniques, basic mathematical and algorithmic concepts, and software solution of large-scale problems arising in the practice of operations research, industrial and systems engineering, management sciences, and analytics.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 5020 Graduate Engineering Practicum
Prerequisites: Consent of IEM adviser and satisfactory completion of 12 hours of IEM 5000- or IEM 6000-level courses.
Description: Professionally supervised experience in real-life problem solving involving projects for which the student assumes a degree of professional responsibility. Activities approved in advance by the instructor and must reflect graduate level analysis. May consist of full or part-time engineering experience, on-campus or in industry, or both, either individually or as a responsible group member. Periodic reports, both oral and written, required as specified by the adviser. Offered for variable credit, 1-3 credit hours, maximum of 3 credit hours.
Credit hours: 1-3
Contact hours: Other: 1
Levels: Graduate
Schedule types: Independent Study
Department/School: Industrial Engr & Mgmt

IEM 5030 Engineering Practice
Prerequisites: Approval of adviser.
Description: Professionally supervised experience in a real-life problem involving authentic projects for which the student assumes a degree of professional responsibility. Activities must be approved in advance by the student's adviser. May consist of full or part-time engineering experience, on-campus or in industry, or both, either individually or as a responsible group member. Periodic reports, both oral and written, required as specified by the adviser. Offered for variable credit, 1-9 credit hours, maximum of 12 credit hours.
Credit hours: 1-9
Contact hours: Other: 1
Levels: Graduate
Schedule types: Independent Study
Department/School: Industrial Engr & Mgmt

IEM 5063 Network Optimization
Prerequisites: IEM 5013 or equivalent.
Description: Network flows and combinatorial optimization models and algorithms with an emphasis on mathematical and algorithmic fundamentals. Covers basics of graph theory, algorithmic analysis, and complexity theory. Covers Classical Algorithms for shortest paths, minimum spanning trees, max-flow and min-cut, min-cost flows; P versus NP, traveling salesman problem, local search, metaheuristics, Christofides algorithm. Previously offered as IEM 6013.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 5103 Breakthrough Quality
Prerequisites: IEM 4103, IEM 4113 and IEM 5003.
Description: Structured, systematic approach and advanced statistical and modeling tools to achieve breakthrough improvement across all areas of an enterprise. Rigorous application, integration, and betterment of strategies and tools for improving or redesigning products and processes such that performance gains are noticeably higher or quicker than those achieved under traditional incremental improvement approaches.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 5113 Strategic Quality Leadership
Prerequisites: STAT 4013 and IEM 5003.
Description: Quality-related strategies. Critical elements that differentiate high performing organizations from their competitors. Delivering value to customers. Quality leadership, strategic planning, customer value, learning organizations, knowledge management, quality systems and business results.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 5123 Service Quality
Prerequisites: STAT 4013 or equivalent.
Description: Theory and application of service quality, including characteristics of services (intangibility, heterogeneity, perishability and inseparability of production and consumption), dimensions of service quality, measurement methodologies for service quality and improvement methodologies for service quality. Certification and accreditation processes for service industries.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt
IEM 5133 Stochastic Processes
Prerequisites: MATH 2233, MATH 3013, and IEM 5003 or STAT 5123.
Description: Definition of stochastic processes, probability structure, mean and covariance function, the set of sample functions. Renewal processes, counting processes, Markov chains, birth and death processes, stationary processes and their spectral analyses. Same course as STAT 5133 & MATH 5133.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 5143 Reliability and Maintainability
Prerequisites: STAT 4033 and IEM 5003.
Description: Probabilistic failure models of components and systems. Detailed study of reliability measures, and static and dynamic reliability models. Classical and Bayesian reliability testing for point and interval estimation of exponential and Weibull failures. Reliability optimization through allocation and redundancy. Fundamentals of maintainability. Previously offered as IEM 6113.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 5203 Facility Location, Warehousing and Freight Transportation
Prerequisites: IEM 4013, IEM 4203 and IEM 5003.
Description: Analytical models for single and multi facility location problems. Algorithms for network location problems including the median, center and covering problems. A discussion of storage location policies such as dedicated, randomized and class-based and their relationship to the warehouse layout problem. Analysis and design of warehouse material handling systems. Introduction to warehouse management systems, freight movement modeling and transportation infrastructure planning.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 5350 Industrial Engineering Problems
Prerequisites: IEM 4413 or equivalent industrial experience.
Description: A detailed investigation into one area of industrial engineering with a required written report. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.
Credit hours: 1-6
Contact hours: Other: 1
Levels: Graduate
Schedule types: Independent Study
Department/School: Industrial Engr & Mgmt

IEM 5413 Managing the Engineering and Technical Function
Prerequisites: IEM 4413 or equivalent industrial experience.
Description: Advanced study of engineering entrepreneurship in the technical organization including: new product evaluation and selection, technology commercialization process, business plan preparation, intellectual property, patent search and discovery, new enterprise development, market analysis, and capital investment procurement strategies.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 5503 Financial and Advanced Capital Investment Analysis
Prerequisites: IEM 3503, IEM 4013, STAT 4033 or IEM 3103 or equivalent.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 5603 Project Management
Prerequisites: IEM 4413 or equivalent.
Description: A systems approach to planning, organizing, scheduling and controlling projects. The behavioral and quantitative aspects of project management. Importance of working with personnel as well as technology. Project management software utilized.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt

IEM 5613 Integrated Manufacturing Control Systems
Prerequisites: IEM 4613.
Description: Advanced treatment of planning and control philosophies and techniques for manufacturing and production systems. Approaches focusing on demand-driven control and achieving competitive advantage through manufacturing. Material requirements planning, capacity planning, shop floor control, master scheduling, production planning and demand management. Just-in-time and the theory of constraints.
Credit hours: 3
Contact hours: Lecture: 3
Levels: Graduate
Schedule types: Lecture
Department/School: Industrial Engr & Mgmt
IEM 5633 Advanced Production and Inventory Control  
**Prerequisites:** IEM 5013 and IEM 5763.  
**Description:** Advanced concepts and quantitative techniques used in production planning and inventory control, including static and dynamic scheduling of machines and cells, deterministic and stochastic inventory control, multi-echelon supply chain management, demand forecasting, and revenue management.  
**Credit hours:** 3  
**Contact hours:** Lecture: 3  
**Levels:** Graduate  
**Schedule types:** Lecture  
**Department/School:** Industrial Engr & Mgmt

IEM 5703 Discrete System Simulation  
**Prerequisites:** IEM 5003.  
**Description:** Discrete-event systems via computer simulation models. Model building and the design and analysis of simulation experiments for complex systems. Application to a variety of problem areas. Use of simulation languages and related software tools.  
**Credit hours:** 3  
**Contact hours:** Lecture: 3  
**Levels:** Graduate  
**Schedule types:** Lecture  
**Department/School:** Industrial Engr & Mgmt

IEM 5723 Data, Process and Object Modeling  
**Prerequisites:** Graduate standing or consent of instructor.  
**Description:** Logical and physical models in the analysis, design and improvement of enterprise systems. Structured and object-oriented analysis and design techniques. Data modeling using entity-relationship diagrams and IDEF1x. Data normalization techniques. Process modeling using data flow diagrams, IDEF0, IDEF3, and Petri nets. Object modeling using the unified modeling language (UML).  
**Credit hours:** 3  
**Contact hours:** Lecture: 3  
**Levels:** Graduate  
**Schedule types:** Lecture  
**Department/School:** Industrial Engr & Mgmt

IEM 5743 Information Systems and Technology  
**Prerequisites:** Graduate standing or consent of instructor.  
**Description:** For current and potential engineering and technology managers. Knowledge of information systems and technology to lead the specification, selection, implementation, and integration of information technology in manufacturing and service organizations. Management issues involved in the use of information technology in organizations.  
**Credit hours:** 3  
**Contact hours:** Lecture: 3  
**Levels:** Graduate  
**Schedule types:** Lecture  
**Department/School:** Industrial Engr & Mgmt

IEM 5763 Supply Chain Strategy  
**Prerequisites:** IEM 4613 or equivalents.  
**Description:** Supply chain strategy including the philosophical base of business practice and the analytical base of modeling. Supply chain strategy, including key objectives and financial considerations, supply chain dynamics, supply chain performance measurement, supply chain integration, characteristics of different supply chains and supply chain performance modeling.  
**Credit hours:** 3  
**Contact hours:** Lecture: 3  
**Levels:** Graduate  
**Schedule types:** Lecture  
**Department/School:** Industrial Engr & Mgmt

IEM 5813 Performance Measurement Systems  
**Prerequisites:** IEM 3813, IEM 4413 or equivalents.  
**Description:** Strategies and methods to define, measure, and apply individual, group- and organizational-level performance metrics in a variety of service and production contexts. Implementation and effective use of metrics. Measurement's role in a management system, managerial decision styles and preferences, operational definitions of performance, processes for identifying and applying metrics, performance measurement tools and techniques, data collection, portrayal of quantitative and qualitative information, and the role of computer technology in measurement system application.  
**Credit hours:** 3  
**Contact hours:** Lecture: 3  
**Levels:** Graduate  
**Schedule types:** Lecture  
**Department/School:** Industrial Engr & Mgmt

IEM 5953 Industrial Assessment and Improvement  
**Prerequisites:** Senior standing and consent of instructor.  
**Description:** Plant assessment and improvement-based concepts, strategies, and tools for manufacturing operations. Small to medium-sized manufacturing operations. Energy, water, waste, quality, and productivity analysis across the organization from a systems perspective. Justification of improvement projects and measurement of results.  
**Credit hours:** 3  
**Contact hours:** Lecture: 3  
**Levels:** Graduate  
**Schedule types:** Lecture  
**Department/School:** Industrial Engr & Mgmt

IEM 5990 Special Topics in Industrial Engineering and Management  
**Prerequisites:** Consent of instructor.  
**Description:** Study of selected contemporary topics in industrial engineering and management including operations research; quality and reliability; manufacturing systems; engineering management; enterprise systems and supply chains; facilities, energy, and environmental management. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.  
**Credit hours:** 1-6  
**Contact hours:** Other: 1  
**Levels:** Graduate  
**Schedule types:** Independent Study  
**Department/School:** Industrial Engr & Mgmt
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Prerequisites</th>
<th>Description</th>
<th>Credit hours</th>
<th>Contact hours</th>
<th>Contact hours:</th>
<th>Levels:</th>
<th>Schedule types:</th>
<th>Department/School:</th>
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<tbody>
<tr>
<td>IEM 6000</td>
<td>Doctoral Research and Dissertation</td>
<td>Approval of major adviser and advisory committee.</td>
<td>Independent research for PhD dissertation requirement under direction of a member of the Graduate Faculty. Offered for variable credit, 1-15 credit hours, maximum of 30 credit hours.</td>
<td>1-15</td>
<td>3 Other</td>
<td>Lecture: 3</td>
<td>Graduate</td>
<td>Independent Study</td>
<td>Industrial Engr &amp; Mgmt</td>
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<tr>
<td>IEM 6033</td>
<td>Linear Optimization</td>
<td>Concurrent Prerequisite IEM 5013 or consent of instructor.</td>
<td>Mathematical theory of linear optimization and the implications for algorithm development. Fundamentals of convex analysis, polyhedral sets, development of the simplex method, Farkas’ lemma, development of duality theory, sensitivity analysis, Dantzig-Wolfe decomposition, Benders decomposition, interior point algorithms. Previously offered as IEM 5033.</td>
<td>3</td>
<td>3</td>
<td>Lecture: 3</td>
<td>Graduate</td>
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<td>Industrial Engr &amp; Mgmt</td>
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<tr>
<td>IEM 6043</td>
<td>Nonlinear Optimization</td>
<td>IEM 5013 or consent of instructor.</td>
<td>Mathematical foundations of nonlinear optimization theory and algorithms. Introduction to convex analysis, local/global optima, optimality conditions, and their implications for model and algorithm development. Convex functions and generalizations, Fritz John and Karush-Kuhn-Tucker optimality conditions, constraint qualifications, Lagrangian duality and saddle point optimality conditions, gradient-based and quasi-Newton methods for unconstrained optimization. Previously offered as IEM 5043.</td>
<td>3</td>
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<td>Industrial Engr &amp; Mgmt</td>
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<tr>
<td>IEM 6053</td>
<td>Integer and Combinatorial Optimization</td>
<td>Concurrent prerequisites. IEM 5063, IEM 6033, or consent of instructor.</td>
<td>Theory, algorithms, and applications of discrete optimization. Binary, pure, and mixed-integer linear optimization formulations, relaxations; preprocessing, branch and bound, formulation strength, polynomial equivalence of separation and optimization; theory of polyhedra, convex hulls and facets, valid inequalities for pure and mixed-integer problems, lifting, perfect formulations, extended formulations. Previously offered as IEM 6023.</td>
<td>3</td>
<td>3</td>
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<td>Industrial Engr &amp; Mgmt</td>
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<tr>
<td>IEM 6063</td>
<td>Optimization Under Uncertainty</td>
<td>IEM 5013, IEM 6033, IEM 5003 or consent of instructor.</td>
<td>Introduction to concepts, principles, and techniques for optimization under uncertainty. Formulating two-stage stochastic linear and integer programs; sample average approximation and decomposition methods; conditional value-at-risk and chance-constrained optimization; robust linear optimization, robust conic optimization, and robust multi-stage optimization; distributionally robust and data-driven optimization.</td>
<td>3</td>
<td>3</td>
<td>Lecture: 3</td>
<td>Graduate</td>
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<td>Industrial Engr &amp; Mgmt</td>
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<tr>
<td>IEM 6110</td>
<td>Special Problems in Industrial Engineering</td>
<td>Consent of school head and approval of major adviser.</td>
<td>Special problems in industrial engineering and management under supervision of a member of the Graduate Faculty. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.</td>
<td>1-6</td>
<td>1 Other</td>
<td>Lecture: 3</td>
<td>Graduate</td>
<td>Independent Study</td>
<td>Industrial Engr &amp; Mgmt</td>
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<td>IEM 6903</td>
<td>IE&amp;M Doctoral Seminar</td>
<td>IEM 5013, IEM 6033, IEM 5003 or consent of instructor.</td>
<td>Introduction to concepts, principles, and techniques for optimization under uncertainty. Formulating two-stage stochastic linear and integer programs; sample average approximation and decomposition methods; conditional value-at-risk and chance-constrained optimization; robust linear optimization, robust conic optimization, and robust multi-stage optimization; distributionally robust and data-driven optimization.</td>
<td>3</td>
<td>3</td>
<td>Lecture: 3</td>
<td>Graduate</td>
<td>Lecture</td>
<td>Industrial Engr &amp; Mgmt</td>
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<tr>
<td>IEM 5003</td>
<td>Special Problems in Industrial Engineering</td>
<td>Concurrent prerequisites. IEM 5063, IEM 6033, or consent of instructor.</td>
<td>Special problems in industrial engineering and management under supervision of a member of the Graduate Faculty. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.</td>
<td>1-6</td>
<td>1 Other</td>
<td>Lecture: 3</td>
<td>Graduate</td>
<td>Lecture</td>
<td>Industrial Engr &amp; Mgmt</td>
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</tbody>
</table>
IEM 6990 Advanced Topics in Industrial Engineering and Management

Prerequisites: Consent of instructor.

Description: Advanced and emerging topics of interest to PhD-level students in Industrial Engineering and Management are discussed. Offered for variable credit, 1-6 credit hours, maximum of 18 credit hours.

Credit hours: 1-6
Contact hours: Other: 1
Levels: Graduate
Schedule types: Independent Study
Department/School: Industrial Engr & Mgmt