The industrial engineer is a broadly-trained integration engineer, concerned with enabling complex systems to function effectively. Managing the inventory of a production facility, for example, involves issues of production and stockpiling policy, manufacturing equipment, human resources, customer demand, and supplier relationships. The industrial engineer must understand the interaction of the components of a system, and coordinate the flow of materials and information to effectively manage the operation. The industrial engineer plays an important role in defining information needs and developing strategies for decision-making based on incomplete knowledge. However, the skills of the industrial engineer have much greater application than to traditional production environments. In a growing service sector of the economy including health care delivery, public safety, air transportation, and banking, for example, issues of resource management, scheduling, quality of service, and systems design are important.

Traditionally, the manufacturing engineer was responsible for developing the process capability to realize the output of design engineering. Today the boundary between design and manufacturing engineering is becoming blurred; both groups work together in teams to assure the soundness of design and production capability. The manufacturing engineer must have an understanding of the design process, but the manufacturing engineer’s special expertise is the knowledge of the production process.

Today’s production is computer-based and provides flexibility through computer control. The manufacturing engineer is responsible for designing and implementing the cells and production lines which become the basic units of manufacturing. Increasingly, such production units are becoming parts of an integrated factory system, not simply islands of automation. The manufacturing engineer must understand the multi-layered control architecture of the integrated factory, and the computer-based technologies which enable it.

The Department maintains laboratories in systems simulation, computer-aided manufacturing, human systems, and concurrent engineering design.

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YANG, QINGYU: Ph.D., M.S., University of Iowa; B.S. University of Science and Technology of China; Associate Professor

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 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 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.
Prerequisite: BE 1500 with a minimum grade of C- and ME 2420 with a minimum grade of C- and 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 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: $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 is 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 acceptance sampling procedures. Procedures for measurement of statistical quality control including process capability, control charts, and acceptance sampling procedures. Offered Winter.
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 is 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.
Prerequisite: IE 3120 with a minimum grade of C- and IE 4850 with a minimum grade of C- and IE 4310 with a minimum grade of C-
Restriction(s): Enrollment is 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 is 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 queuing 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 (PMLP) 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 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 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.

IE 4850 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 Irregularly.
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 5100 Quantitative Physiology Cr. 4
Basic principles of human physiology presented from the engineering perspective. Bodily functions, their regulation and control discussed in quantitative terms and illustrated by mathematical models where feasible. Offered Fall, Winter.
Equivalent: BME 5010, CHE 5100, ECE 5100, ME 5100

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 Irregularly.

IE 6000 Digital Automation Cr. 4
Fundamentals of digital control and logic; integration and automation solution technologies (barcode systems, vision systems, etc.): data acquisition. Offered 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 6180 Biomedical Instrumentation Cr. 4
Engineering principles of physiological measurements, signal conditioning equipment, amplifiers, recorders and transducers. Recent advances in instrumentation. Offered Winter.
Prerequisites: BME 5020 with a minimum grade of C and ECE 3300 with a minimum grade of C or BME 5010 with a minimum grade of C or BMS 6550 with a minimum grade of C
Equivalent: BME 6480, ECE 6180, ME 6180

IE 6210 Applied Engineering Statistics Cr. 4
Analysis of variability in engineering decision making; data analysis, probabilistic models, hypothesis testing, regression and analysis of variance. No credit after IE 4250. Offered Fall, Winter.
Prerequisite: BE 2100 with a minimum grade of C-

IE 6220 Value Engineering Cr. 4
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. 4
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.
Prerequisite: BE 2100 with a minimum grade of C-
IE 6270 Engineering Experimental Design Cr. 4  
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

IE 6310 Lean Operations and Manufacturing Cr. 2  
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.

IE 6405 Integrated Product Development Cr. 4  
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 is limited to Graduate or Undergraduate level students; enrollment limited to students in the College of Engineering.  
Equivalent: AET 5600, EVE 5600

IE 6420 Computer Aided Manufacturing and Lab Cr. 4  

IE 6425 Product Lifecycle Management and Sustainable Design Cr. 4  
Introduction to modern principles, practices, and applications of PLM and sustainable design. Offered Winter.

IE 6430 Computer Simulation Methods Cr. 2  
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. Offered Fall, Winter.  
Prerequisite: IE 6310 (may be taken concurrently) 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 Biannually (Fall).  
Prerequisites: IE 3120 with a minimum grade of C- and IE 4850 with a minimum grade of C-

IE 6442 Facilities Design and Materials Flow Cr. 2  
Plant location theory, analysis of models of plant location. Models for determining plant size and time phasing. Design of manufacturing warehouse and material handling facilities. Use of analytical and computer-aided methods in the facilities design process. Offered 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. 2  
Introduction to the engineering and analysis of systems with process focus. Offered Fall.  
Restriction(s): Enrollment limited to students in the College of Engineering.

IE 6510 Information Systems for the Manufacturing Enterprise Cr. 2  
Methods for information flow modeling. Information needs of global manufacturer: design, testing, manufacture, and delivery. Partnership relation to suppliers via information. Offered Fall.

IE 6520 Negotiating in an IE Environment Cr. 2  
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 Biannually (Spr/Sum).  
Restriction(s): Enrollment is limited to Graduate level students.

IE 6560 Deterministic Optimization Cr. 4  
Introduction to philosophy of operations research. Formulation of linear program models and their solutions. Duality and sensitivity analysis. The transportation model. Introduction to probabilistic modeling and applications of queuing models. Network models decision theory. Offered for graduate credit only. Offered Fall, Winter.  
Restriction(s): Enrollment is limited to Graduate level students.

IE 6610 Introduction to Six Sigma Cr. 4  
For the working engineer who requires exposure to basic concepts of 6-Sigma and its work applications. Offered Winter, Spring/Summer.

IE 6840 Project Management Cr. 1-4  
Principles of successful project management including: time and cost management, risk analysis, human resource management. Consideration of both operational and conceptual issues. Introduction to project management tools. Offered Winter.

IE 6850 Manufacturing Strategies Cr. 2  
Strategic approach to the management of manufacturing including: relationship to corporate strategy, operationalizing manufacturing concepts, impact of new technology and manufacturing concepts, impact of new technology and manufacturing as a competitive resource; case-studies approach. Offered Yearly.

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