

## INDUSTRIAL ENGINEERING • IE

- 1002 Industrial Engineering Fundamentals (3)** Design; introduction to computers; description of the profession.
- 2060 Introduction to the Use of Computers (3)** Prereq.: *eligibility to take MATH 1550 or equivalent; and credit or registration in IE 1002.* 2 hrs. lecture; 3 hrs. lab. Principles of digital programming; application of subroutines; application of electronic computers to typical engineering problems; OS operation, Microsoft Office, and Groupware.
- 3201 Principles of Engineering Economy (3)** Planning economy studies for decision making, including considerations of rate of return, cost and yield studies, depreciation and tax relationships, increment costs, replacement, and introduction to multivariate alternative studies.
- 3302 Engineering Statistics (3)** Prereq.: *Grade of C or better required in MATH 1552 and PHYS 2102 or CSC 2259.* Probability, discrete and continuous distributions, functions of random variables, estimation theory, tests of hypotheses including goodness-of-fit and independence.
- 3520 Supply Chain Logistics I (3)** Prereq.: *IE 1002, MATH 2090, and grade of C or better in IE 3302.* Introduction to resources and systems; Logistics resource optimization: linear programming; Logistics network and flow problems; transportation problems, shortest path and vehicle routing, maximum flow problems; Project and resources management, and operations sequencing and resource scheduling.
- 4362 Advanced Engineering Statistics (3)** Prereq.: *grade of C or better in IE 3302.* Linear regression and correlation, curvilinear regression, analysis of variance, and factorial experiments.
- 4425 Information Systems Engineering (3)** Prereq.: *IE 2060.* 2 hrs. lecture; 3 hrs. lab. Analysis and design of information systems; projects relating comprehensive computer systems to typical industrial and service applications; ethics and professionalism.
- 4426 Distributed Information Systems Engineering (3)** Prereq.: *IE 4425 or equivalent.* 2 hrs. lecture; 3 hrs. lab. Interfacing programs to databases; analysis and development of client-server applications in industrial and business settings; interfacing databases and industrial applications to the Internet; analysis, design, and implementation of industrial and business networks.
- 4453 Quality Control & Six Sigma (3)** Prereq.: *grade of C or better in IE 3302.* Principles and practice of quality assurance and control; theory of statistical sampling and control and related economic analysis; Quality Systems; Six Sigma principles and practice.
- 4461 Human Factors Engineering (3)** Prereq.: *senior standing or consent of department.* 2 hrs. lecture; 3 hrs. lab. Human performance in human-machine systems, including information processing, display and control design, workplace design, and environmental effects on worker performance.
- 4462 Safety Engineering (3)** Occupational safety and health and accident prevention management; design and implementation of safety programs; cost analysis; control of hazardous physical and environmental conditions.
- 4463 Fundamentals of Industrial Hygiene Engineering (3)** Prereq.: *senior standing.* Basic principles of chemical hazards, air contamination, ionizing and nonionizing radiation, sound and vibration, and thermal stresses; theoretical foundation and application of theory in the control of occupational health hazards.
- 4465 Biomechanics for Engineers (3)** See BE 4323.
- 4466 Human Computer Interaction (3)** Prereq.: *IE 2060 or equivalent.* Systems approach to the identification, design, analysis, and development of human-operated information processing systems; applications to practical problems in industry, military, health systems, and education.
- 4470 Knowledge-Based Systems in Engineering (3)** Prereq.: *IE 4425 or equivalent computer experience.* 2 hrs. lecture; 3 hrs. lab. Tools and techniques of knowledge-based expert systems as applied to engineering problems; expert systems theory; systems building tools; state-of-the-art engineering expert systems.
- 4480 Manufacturing Automation (3)** Prereq.: *IE 3201 and ME 3633.* 2 hrs. lecture; 3 hrs. lab. Application of computer-based control system techniques to manufacturing automation; programming of numerically controlled machine tools using Compact II and APT; robotics with multidegree of freedom linkages; NC programming using CAD/CAM; computer-automated part programming.
- 4485 Systems Integration in Manufacturing (3)** Prereq.: *IE 2060, ME 3633, EE 2950.* 2 hrs. lecture; 3 hrs. lab. Principles and application of information technologies to monitoring, control, and integration of manufacturing operations at all levels within the organization.
- 4490 Engineering Maintenance Management (3)** Prereq.: *IE 1002, 3302, and credit or registration in IE 4425.* Design, operation, and monitoring of a system to efficiently control maintenance costs; maintenance organization and systems, preventive maintenance, maintenance planning and scheduling, maintenance work measurement, labor performance measures, and spare parts.
- 4516 Plant and Systems Design (3)** Prereq.: *IE 3201; grade of C or better in IE 3520; CM 2141; and senior standing in College of Engineering.* Machine loading, assembly balancing techniques, design of physical-manufacturing systems, integrating materials-handling systems into the plant, design of plant service systems, site and plant location, and projects involving plant design using optimization techniques; ethics and professionalism.
- 4520 Supply Chain Logistics II (3)** Prereq.: *grade of C or better in IE 3520.* Production logistics: forecasting, aggregate production, inventory systems, and materials requirement planning; lean supply system and supply chain management; warehousing and distribution systems; supply chain information technologies, and government policies/regulations.
- 4530 Lean Manufacturing Systems (3)** Prereq.: *IE 2060, 3520 and credit or registration in IE 4362.* 2 hrs. lecture; 3 hrs. lab. Principles of Lean Manufacturing Systems; Queuing Theory and Analysis; Measurement and Assessment-Industrial Process Mapping, Workflow Analysis; Improvement Activities-Process and Operational Variability Reduction, Resource Reduction, Work-in-Process Reduction, Waste Reduction, Zero Inventory and Just-in-time Production Systems; Design for Lean Manufacturing; Material and Shop Floor Flow Control; Simulation Modeling and Analysis of Lean Systems.
- 4540 Reliability Engineering (3)** Prereq.: *IE 3302.* Reliability in design; reliability models; reliability assessment during pre-production development and testing; and special problems in maintenance, spare parts, and Markov processes.
- 4599 Industrial Engineering Senior Design Project (3)** Prereq.: *IE 4425, 4453, 4516, 4520, 4530 and ME 3633; consent of department.* Must be taken during the last semester of the undergraduate program. For December graduates, must be taken in fall semester immediately prior to graduation; for spring or summer graduates, must be taken in the spring semester immediately prior to graduation. Students not meeting this requirement will be dropped from the course. Application of previous industrial engineering courses in a comprehensive design project; preparation for the FE exam in industrial engineering.
- 4785 Special Topics in Industrial Engineering (1-3)** Prereq.: *senior standing and consent of department.* May be taken for a max. of 6 hrs. of credit when topics vary. Two sections may be taken concurrently if topics vary. Topics in industrial engineering not sufficiently covered in other undergraduate courses.
- 7201 Advanced Engineering Economy (3)** Prereq.: *IE 3201 or equivalent.* Engineering economic analysis, multiple projects and constraints, utility in project selection, preference ordering theory, and capital equipment pricing theory.
- 7211 Project Engineering (3)** Prereq.: *IE 3201 or equivalent.* Large-scale engineering construction or development projects from schematic to online condition.
- 7382 Probability Theory in Engineering (3)** Prereq.: *IE 4362 or equivalent.* Random variables and their functions; transformation of random variables; sets of random variables and random sequences; expectation, special distributions, random processes, discrete and continuous Markov processes, birth and death processes, and waiting line theory.
- 7408 Industrial Systems Simulation (3)** Prereq.: *IE 4530 or equivalent.* Design and analysis of simulation models for industrial systems including advanced techniques for random number generation, random variate generation, design and analysis of simulation experiments, and variance reduction techniques.
- 7425 Advanced Information Systems Engineering (3)** Prereq.: *IE 4425 or equivalent.* 2 hrs. lecture; 3 hrs. lab. Advanced concepts of information systems engineering with emphasis on middleware architectures/technologies for integrating databases; design issues and methodology for developing and implementing distributed information systems; and design and implementation of data-warehouses and online analytical processing (OLAP) systems.
- 7453 Advanced Quality Control (3)** Prereq.: *IE 4453 or equivalent.* Advanced procedures of statistical quality control, statistical analysis of quality control data, economic aspects of quality assurance, human element in quality control, and relationship of quality control to productivity and to ability of American products to compete in world markets.
- 7461 Ergonomics in Work Design (3)** Prereq.: *IE 4461 or equivalent.* 2 hrs. lecture; 3 hrs. lab. Introduction to anthropometry, functional anatomy and physiology, and their application in work design and task assessment.
- 7463 Industrial Hygiene Engineering (3)** Prereq.: *IE 4463 or equivalent or consent of instructor.* Evaluation and control of industrial environments; noise and vibration, industrial illumination, radiation, thermal stresses, air quality and contamination; design of ventilation systems.
- 7464 Work Physiology (3)** Prereq.: *IE 4461 or equivalent.* Study of worker's physiological responses (cardiovascular, pulmonary, muscular) to work applicable to task design and evaluation, employee selection and placement, and work-rest scheduling.
- 7465 Occupational Biomechanics (3)** Prereq.: *IE 4461 or equivalent.* 2 hrs. lecture; 3 hrs. lab. Principles of biomechanics applied to human movement; applications to work systems such as manual materials handling and tool design.
- 7466 Human Interaction with Computers (3)** Prereq.: *IE 4461 or IE 4466 or equivalent.* Ergonomics of the use of interactive computer systems; general characteristics and requirements of people-oriented computer systems from the perspective of different disciplines and tasks, e.g., text editing.
- 7467 Cognitive Ergonomics and Work Environments (3)** Prereq.: *IE 3302 and 4461; or equivalent.* Topics in cognitive ergonomics relating to information processing, visual and auditory displays, and aspects of the work environment such as noise, socio-technical systems, and psychosocial factors. Application to various work settings including construction, healthcare, and the service sector.
- 7470 Artificial Intelligence Manufacturing Systems (3)** Prereq.: *IE 4425 or equivalent.* Application of artificial intelligence tools and techniques to computer integrated manufacturing systems including maintenance, product design, process planning, factory scheduling and control, robotics, and intelligent warehouse systems.
- 7480 Automation and Computer-Aided Manufacturing (3)** Prereq.: *IE 3201 and MATH 1552; or equivalent.* Automated flow-line production, numerical control, industrial robots, computer-aided manufacturing, process monitoring and control, group technology, flexible manufacturing systems, and material requirements planning.
- 7540 Advanced Reliability Engineering (3)** Prereq.: *IE 4540 or equivalent.* Analysis of reliability, maintainability, and availability of large production facilities; applications to a variety of manufacturing environments.

**7541 Linear Programming Algorithms (3)** Prereq.: IE 3520 or equivalent. Optimization of linear objective functions subject to linear constraints; vector spaces, convex analysis, polyhedral sets; matrix versions of simplex, revised simplex, bounded variables; duality theory and primal-dual simplex algorithms; postoptimal and parametric analysis; decomposition, and cutting plane algorithms.

**7551 Queuing Theory (3)** Prereq.: IE 3520 or equivalent. Fundamentals of queuing processes, transient and limiting behavior, measures of effectiveness; birth and death processes, single and multi-server queues, priorities, balking, batch arrivals, and services; matrix representation of certain queuing systems; applications, statistical inference, design and control of queues.

**7561 Programming Methods in Operations Research (3)** Prereq.: IE 3520 or equivalent. Aspects of advanced programming methods for unconstrained and constrained problems; development of goal, zero-one, gert, and multiple objective programming with application to industrial processes and planning.

**7565 Metaheuristics (3)** Prereq.: IE 3520 or equivalent. Introduction of the principles, algorithms, and real world applications of metaheuristic algorithms including projection based methods such as simulated annealing, tabu search, variable neighborhood search, guided local search, iterated local search, and population based methods such as particle swarm optimization, differential evolution, ant colony optimization, genetic algorithm, and evolutionary programming.

**7640 Equipment Failure Analysis and Prevention (3)** Prereq.: credit or registration in IE 4540 or equivalent. Analysis, monitoring, and prevention of failures in mechanical equipment; failure mechanisms; mechanical failure analysis techniques; Weibull failure analysis techniques; and failure management.

**7722, 7723 Special Topics in Industrial Engineering (3)** Special topic courses in specialized areas such as design and analysis of complex production systems, supply-chain control, maintenance, quality control, reliability, ergonomics and human-computer interaction, information systems, safety and construction management.

**7724 Independent Study in Industrial Engineering (1-3)** Prereq.: Consent of department. May be taken for a max. of 6 sem. hrs. of credit. Independent study in specialized areas such as design and analysis of complex production systems, supply-chain control, maintenance, quality control, reliability, ergonomics and human-computer interaction, information systems, safety and construction management.

**7761 Production Planning and Control (3)** Prereq.: IE 4520 or 3520 or equivalent. Deterministic and probabilistic inventory models, static and dynamic models for production planning; multi-stage, multi-echelon production systems; sequencing and scheduling; line balancing and workforce scheduling.

**7762 Supply Chain Systems (3)** Prereq.: IE 3520 or 4520, or equivalent. Components in supply chain systems; product life-cycle modeling, rotational production and supply, integrated component supply systems, multi-source supplier and buyer systems, just-in-time supply chain systems, warehousing and distribution systems, supply transportation system, and information technology for supply chain systems.

**7765 Lean Production Systems (3)** Prereq.: IE 3520 or 4520, or equivalent. Principles and components of lean production systems; industrial process mapping, workflow analysis; resource reduction; market characterization, logistics information and error propagation; reduction of work-in-process, waster reduction, zero inventory and just-in-time production systems; material flow control; process and operational variability reduction; role of buffers and process stabilization.

**7768 Sequencing and Scheduling (3)** Prereq.: IE 3520 or 4520 or equivalent. Measures of scheduling; deterministic models for single and parallel machines, job shops, flow shops, and open shops; stochastic scheduling models for machines, job shops, flow shops, and open shops; computational complexity and industrial applications.

**7771 Design of Manufacturing Systems (3)** Prereq.: IE 3520 or 4520 or equivalent. Principles in modeling, analysis, design, and operations; mass production, cellular manufacturing, machine location and layout, job routing and loading strategy; material handling and storage/retrieval systems.

**8000 Thesis Research (1-12 per sem.)** "S"-"U" grading.

**8900 Pre-dissertation Research (1-9)** May be repeated for credit.

**9000 Dissertation Research (1-12 per sem.)** "S"-"U" grading.

---