

# ISEN - INDUST & SYSTEMS ENGR

## ISEN 602 Applications of Random Processes

**Credits 3. 3 Lecture Hours.** Introduction to probability and random processes as a basis for studying topics in industrial engineering and operations research. **Prerequisites:** ISEN 609; STAT 212 or STAT 601.

## ISEN 608 Industrial Case Analysis

**Credits 3. 3 Lecture Hours.** Practice in applications of principles to the solution of actual case problems involving broad management decisions. **Prerequisite:** Approval of instructor; also taught at Qatar campus.

## ISEN 609 Probability for Engineering Decisions

**Credits 3. 3 Lecture Hours.** Introduction to probability and stochastic processes for characterization of uncertainty in engineering decisions. **Prerequisite:** Approval of instructor.

## ISEN 613 Engineering Data Analysis

**Credits 3. 3 Lecture Hours.** Selected topics in probability and data analysis for quality in engineering problems; measurement principles, data collection and data analysis to solve quality engineering problems; introduction to courses in the assurance sciences-reliability, maintainability, quality control and robust design.

## ISEN 614 Advanced Quality Control

**Credits 3. 3 Lecture Hours.** Advanced methods applied to quality control and anomaly detection; classical treatments and recent developments in statistical process control; evaluation, design and maintenance of quality control programs; focus on monitoring and root cause identification. **Prerequisite:** STAT 212 or STAT 601.

## ISEN 615 Production and Inventory Control

**Credits 3. 3 Lecture Hours.** Model development for inventory management and for production planning; production control models for line balancing, lot sizing, dispatching, scheduling, releasing, kitting, MRP and just-in-time with treatment of flexible manufacturing and assembly. **Prerequisites:** ISEN 620; ISEN 609.

## ISEN 616 Design and Analysis of Industrial Experiments

**Credits 3. 3 Lecture Hours.** Fundamental theory, concepts and procedures required for industrial experimental design, statistical data analysis, and model building, with emphasis on engineering formulations and applications; one-factor experiments with and without restrictions on randomization, treatment comparison procedures, Latin and other squares, factorial experiments, full and fractional two-level factorial experiments, blocking in factorial designs, response surface methodologies and introduction to Taguchi methods. **Prerequisite:** STAT 212 or STAT 601.

## ISEN 617 Quantitative Models for Supply Chain Coordination

**Credits 3. 3 Lecture Hours.** Concepts, complexities, and models pertaining to supply chain management and relation of those to recent practical initiatives; includes channel coordination models, supply chain contracting, and vendor-managed, inventory models.

## ISEN 619 Analysis and Prediction

**Credits 3. 3 Lecture Hours.** Data-mining methods and data-driven models; statistical model building and parameter estimation for Markov processes; sampling of dynamic systems with random disturbances; on-line identification algorithms; design of time-series control charts for process monitoring; multivariate analysis; applications using real data. **Prerequisite:** ISEN 609.

## ISEN 620 Survey of Optimization

**Credits 3. 3 Lecture Hours.** Theory and numerical methods for deterministic linear and nonlinear optimization; topics include linear programming, unconstrained-nonlinear optimization, constrained-nonlinear optimization, Lagrange and K-K-T conditions, and numerical algorithms. **Prerequisite:** MATH 304 or MATH 311.

## ISEN 621 Heuristic Optimization

**Credits 3. 3 Lecture Hours.** Focus on heuristic optimization methods that search beyond local optima; includes neighborhood search methods and advanced search strategies such as genetic algorithms, simulated annealing, neural networks, tabu search, and greedy randomized adaptive search procedures. **Prerequisites:** ISEN 620 or ISEN 622 or approval of instructor.

## ISEN 622 Linear Programming

**Credits 3. 3 Lecture Hours.** Development of the mathematics and algorithms associated with linear programming; convex sets and cones, polyhedral sets, duality theory, sensitivity analysis, simplex, revised simplex and dual simplex methods; also covered are bounded variables, column generation, decomposition, integer programming; computer assignment. **Prerequisite:** MATH 304.

## ISEN 623 Nonlinear and Dynamic Programming

**Credits 3. 3 Lecture Hours.** Understanding of algorithms for nonlinear optimization; development of optimality conditions and different types of algorithms for unconstrained and constrained problems; formulation and solution of many types of discrete dynamic programming problems. **Prerequisite:** MATH 304.

## ISEN 625 Simulation Methods and Applications

**Credits 3. 2 Lecture Hours. 3 Lab Hours.** Fundamental methodologies of simulation modeling; random number and variate generation, statistical analysis of model output, and discrete event modeling using a commercial simulation language. **Prerequisite:** STAT 212 or STAT 601.

## ISEN 627 Engineering Analysis for Decision Making

**Credits 3. 3 Lecture Hours.** Principles and application of techniques in analysis of decision processes involving engineering systems under uncertainty; areas of utility and information theory as related to quantification of information for decision-making. **Prerequisites:** ISEN 609; STAT 601 or approval of instructor.

## ISEN 630 Human Operator in Complex Systems

**Credits 3. 3 Lecture Hours.** Basic understanding of the theory and practice of human factors engineering; topics presented within the framework of humans as functioning systems and their requirements when incorporated in hardware and software systems.

## ISEN 631 Cognitive Systems Engineering

**Credits 3. 3 Lecture Hours.** Analyze how artifacts, displays, social interaction and factors such as stress, time pressure, competing demands and uncertainty affect human cognitive functions such as perception, attention, memory, decision-making and problem-solving in joint human-machine systems; user-centered design techniques, research and evaluation methods introduced and applied to a design project. **Prerequisites:** ISEN 635, ISEN 430/ISEN 630, or approval of instructor.

## ISEN 632/AERO 636 Human Factors Engineering for Aerospace Designs

**Credits 3. 3 Lecture Hours.** Physiological and psychophysiological issues encountered in aviation and space environments and their effect on human cognitive and physical performance; survey methods for human workload and performance evaluations; apply human-systems design principles to an aerospace design project. **Prerequisites:** Graduate classification or approval of instructor. **Cross Listing:** AERO 636/ISEN 632.

## ISEN 633 Biomechanics of Work

**Credits 3. 3 Lecture Hours.** Mechanical behavior of the human musculoskeletal system and component tissues during physical activity; fundamental biomechanical concepts, principles, tools and methods for the measurement of human physical attributes, evaluation of human mechanical capabilities and modeling of human musculoskeletal system; application of concepts to improve performance or prevent injuries during daily activities. **Prerequisite:** ISEN 630 or approval of instructor; graduate classification.

## ISEN 634 Human Performance Modeling

**Credits 3. 3 Lecture Hours.** Examination of models of the human as an information processor and exploration of advanced theory on human cognition; situational awareness and workload responses of humans in complex tasks, description of cognitive task performance and modeling of user behavior in specific applications using task analysis and cognitive performance modeling methods, e.g., goals, operators, methods, and selection rules (GOMS), keystroke-level model (KLM), critical path method GOMS (CPM-GOMS); introduction of advanced computational approaches to human behavior modeling including executive process-interactive control (EPIC), adaptive control of thought-rational (ACT-R), and queueing network-model human processor (QN-MHP); development of computational cognitive models of human performance using different software tools (e.g., CogTool, Cogulator) to evaluate an existing interface. **Prerequisite:** Graduate classification; ISEN 330 or ISEN 630 or approval of instructor.

## ISEN 635 Human Information Processing

**Credits 3. 3 Lecture Hours.** Perceptual and cognitive issues as related to the design of man-machine systems; perception, central processes, decision making and other performance aspects of the human component as an information processor. **Prerequisite:** ISEN 430 or approval of instructor.

## ISEN 636 Large-Scale Stochastic Optimization

**Credits 3. 3 Lecture Hours.** Introduction to models, theory and computational methods for large-scale stochastic optimization including decomposition-coordination algorithms for stochastic programming such as generalized Benders decomposition and resource-price directive methods; emphasis on practical algorithm implementation and computational experimentation. **Prerequisites:** ISEN 620 or ISEN 622, STAT 610 and CSCE 602 or approval of instructor.

## ISEN 637 Stochastic Dynamic Programming

**Credits 3. 3 Lecture Hours.** Methodologies for stage-wise stochastic-decision processes; includes finite-horizon models, infinite-horizon discounted total cost models, and average cost models; applications of methods to various situations. **Prerequisites:** ISEN 609 and ISEN 622, or approval of the instructor.

## ISEN 640 Systems Thinking and Analysis

**Credits 3. 3 Lecture Hours.** Introduction to the systems thinking process and the fundamental considerations associated with the engineering of large-scale systems, or systems engineering. **Prerequisite:** MATH 304 or approval of instructor.

## ISEN 641 Systems Engineering Methods and Frameworks

**Credits 3. 3 Lecture Hours.** Concepts, methodology, methods and tools for discovery, definition, analysis, design, creation, and sustainment of systems involving information, physical, and human elements; architecture modeling methods include IDEF/UPDM; systems engineering frameworks include DoDAF/MoDAF, and Zachman; analysis tools include executable architectures to assess consistency, interoperability and performance. **Prerequisites:** MATH 304 or approval of instructor.

## ISEN 645 Lean Engineering

**Credits 3. 3 Lecture Hours.** Introduces the principles of lean thinking in modern manufacturing systems; philosophical, managerial and organizational requirements studied; lean manufacturing quantitative modeling methodologies, lean manufacturing cell design and case study analysis. **Prerequisites:** ISEN 609 or approval of instructor.

## ISEN 658 Principles of Manufacturing Processes

**Credits 3. 3 Lecture Hours.** Focus on understanding the physical principles of manufacturing processes using theory, analytical and numerical techniques; application of physics-based theory to specific industrial manufacturing applications and case studies; includes solid mechanics and plastic deformation with application to deformation and cutting processes; application of fluid flow and rheology in polymer processing and casting; analysis of thermal effects and transient heat transfer problems in tribology, cutting and additive manufacturing processes.

## ISEN 659 Modeling and Analysis of Manufacturing Systems

**Credits 3. 3 Lecture Hours.** Analytical models applied to the description, design operation and control of manufacturing processes and systems; includes serial assembly, jobshops, FMS and cellular manufacturing configurations. **Prerequisites:** ISEN 609.

## ISEN 660 Risk Engineering

**Credits 3. 3 Lecture Hours.** Fundamental concepts, techniques, and applications of risk assessment and risk management for engineering systems; current industry practices for risk assessment of industrial facilities using qualitative and quantitative approaches are demonstrated through exercises and case studies from diverse engineering fields.

**Prerequisites:** Graduate classification. **Cross Listing:** CHEN 660 and SENG 660.

## ISEN 661 Network-Based Planning and Scheduling Systems

**Credits 3. 3 Lecture Hours.** Fundamental theory, mathematical modeling, and algorithms of network flow models including shortest path models maximum flow and cost minimization models; out-of-kilter algorithm; pure and generalized network specializations of the primal simplex method; introduction to multi-commodity networks. **Prerequisite:** ISEN 620 or 622.

## ISEN 662 Production Economics

**Credits 3. 3 Lecture Hours.** Develop an understanding of the analytical and empirical techniques required to conduct an analysis of the magnitude and the sources of productivity change; programming and regression approaches to analyze industries include manufacturing, energy, and service systems. **Prerequisites:** ISEN 303 and ISEN 620 or approval of instructor.

## ISEN 663 Engineering Management Control Systems

**Credits 3. 3 Lecture Hours.** Integration of human relations, planning and control concepts, systems analysis and design, and principles of management oriented toward engineering functions within an organization; organizational design and administration as they impact along the product life cycle, i.e., research, design, development, production and use.

## ISEN 665/SYEN 645 Management of Engineering Systems

**Credits 3. 3 Lecture Hours.** Theory and practice of leadership and management in engineering organizations; focus on both "hard" skills (systems engineering process, project management, planning, forecasting and financial analysis) and "soft" skills (leadership styles, motivation, teamwork, managing creative people, navigating informal networks); science and technology policy, economic implications of engineering and technology. **Prerequisite:** Graduate classification. **Cross Listing:** SYEN 645/ISEN 665.

## ISEN 667 Engineering Economy

**Credits 3. 3 Lecture Hours.** Fundamental concepts and advanced techniques of engineering economic analysis; evaluation of alternative capital investments considering income taxes, depreciation and inflation; discounted cash flow analysis of competing projects, break-even analysis and determination of rate of return on investment; risk and uncertainty in engineering analysis. **Prerequisite:** ISEN 303 or approval of instructor; also taught at Qatar campus.

## ISEN 668 Integer Programming

**Credits 3. 3 Lecture Hours.** Formulation principles and general approaches for solving integer (and mixed, integer linear) programs including preprocessing, cutting plane methods, branch and bound, branch and cut, branch and price, and Lagrange relaxation; classical problem structures with special-purpose solution algorithms; fundamental theory of polyhedra, methods to generate valid inequalities and computational complexity. **Prerequisite:** ISEN 620 or ISEN 622.

## ISEN 671 Human Error and Resilient System Design

**Credits 3. 3 Lecture Hours.** Variables that influence human performance including cognitive, behavioral and physical factors are examined and discussed; case studies from a variety of industries and domains are employed to illustrate the identification and causes of human errors; system design strategies for reducing the likelihood of error occurrence and mitigating error consequences are practically applied to real design cases from industry, military and government agencies. **Prerequisites:** Graduate classification; approval of instructor; ISEN 330 or ISEN 630.

## ISEN 681 Seminar

**Credit 1. 1 Lecture Hour.** Opportunity to present research in a professional atmosphere; presentations are not restricted to thesis or problem research; acquaints the student with departmental research activities and procedures in documenting research.

## ISEN 684 Professional Internship

**Credits 1 to 16. 1 to 16 Other Hours.** On-the-job training under supervision of practicing engineers in settings appropriate to professional objectives. May be repeated for credit. **Prerequisite:** Approval of committee chair and department head.

## ISEN 685 Directed Studies

**Credits 1 to 12. 1 to 12 Other Hours.** Special topics not within scope of thesis research and not covered by other formal courses. **Prerequisite:** Graduate classification in industrial engineering.

## ISEN 689 Special Topics in...

**Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 4 Lab Hours.** Selected topics in an identified area of industrial engineering. May be repeated for credit. **Prerequisite:** Approval of instructor.

## ISEN 691 Research

**Credits 1 to 23. 1 to 23 Other Hours.** Research in industrial engineering field; content and credit dependent upon needs of individual student.

## ISEN 692 Professional Study

**Credits 1 to 9. 1 to 9 Other Hours.** Approved professional study or project. May be taken more than once, but not to exceed 4 hours of credit toward a degree. Must be taken on a satisfactory/unsatisfactory basis. **Prerequisite:** Approval of instructor.