

ISEN - INDUST & SYSTEMS ENGR

ISEN 601 Location Logistics of Industrial Facilities

Credits 3. 3 Lecture Hours. Selection of the optimal locations of industrial plants and distribution centers through analytical modeling of the costs of inventory storage, transportation, utilities, labor supply and other cost components. **Prerequisites:** ISEN 620.

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 603 Advanced Logistics

Credits 3. 3 Lecture Hours. Topics in logistics including measures of logistical systems performance, facilities location-allocation, production/distribution system design, transportation network design, vehicle routing; emphasis on mathematical modeling based on large scale integer programs and solution approaches for general network design problems. **Prerequisites:** ISEN 601, ISEN 622, ISEN 623, ISEN 668 or approval of instructor.

ISEN 605 Material Handling Systems

Credits 3. 3 Lecture Hours. Analysis and design of integrated material handling systems; automatic storage and retrieval of unit loads, and identifying and establishing boundary conditions on key parameters required to specify the desired system required for equipment vendors to design appropriate hardware. **Prerequisites:** ISEN 420; ISEN 416.

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 612 Design by Reliability

Credits 3. 3 Lecture Hours. Quantitative reliability analysis in engineering design; reliability methods applicable to risk based design, component reliability and degradation, static and dynamic system reliability modeling and analysis, life testing, stress/strength analysis, and fault tree analysis. **Prerequisites:** ISEN 609; STAT 414.

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 618 Stochastic Processes in the Assurance Sciences

Credits 3. 3 Lecture Hours. Stochastic processes necessary to deal with advanced problems in reliability, maintainability and other related areas. **Prerequisite:** ISEN 602.

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 624 Applied Distribution and Queueing Theory

Credits 3. 3 Lecture Hours. Queueing theory and its applications; single and multiple channels, priorities, balking, batch arrivals and service, and selected non-Markovian topics. **Prerequisite:** ISEN 609 or ECEN 646.

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 629 Engineering Optimization

Credits 3. 3 Lecture Hours. Develops a modern framework for studying nonlinear programming problems using convex analysis; convex sets and cones, separating hyperplanes, sub-differentiability, conjugate transforms, duality theory and parametric analysis; applications of the principles and methods will be studied. **Prerequisite:** ISEN 623; **corequisite:** MATH 409.

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 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 638 Polyhedral Theory and Valid Inequalities

Credits 3. 3 Lecture Hours. Advanced knowledge of polyhedral theory and valid inequalities for (mixed) integer programming; introduction to fundamental concepts in polyhedral theory and several approaches to generation of valid inequalities; includes state-of-the-art advancements and current avenues of research. **Prerequisite:** ISEN 668.

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 643/CVEN 654 Strategic Construction and Engineering Management

Credits 3. 3 Lecture Hours. Strategic and systems perspectives applied to construction and engineering management projects, organizations, and industries; system dynamics methodology to model construction and engineering systems; understanding drivers of performance; feedback and high leverage points for performance improvement. **Prerequisite:** Graduate classification or approval of instructor. **Cross Listing:** CVEN 654/ISEN 643.

ISEN 644/CVEN 644 Project Risk Management

Credits 3. 3 Lecture Hours. Identifies causes of risks in projects; discusses probabilistic description of risks and formulation of risk models; Bayesian methods for revising probabilities; qualitative and quantitative risk assessment; setting contingencies on budgets and schedules; risk mitigation and risk management; handling technological risk; Utility theory and game theory in management of risks. **Prerequisite (s):** STAT 601 or equivalent; graduate status in Engineering, approval of instructor. **Cross Listing:** CVEN 644.

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 650 Healthcare Delivery Systems Modeling and Analysis

Credits 3. 3 Lecture Hours. Challenges in modeling and analysis of healthcare systems; deterministic and stochastic approaches to model and analyze healthcare systems; existing and emerging policies in healthcare and effects on healthcare system models. **Prerequisite:** ISEN 609, ISEN 620, or approval of instructor.

ISEN 654 Manufacturing Systems Planning and Analysis

Credits 3. 3 Lecture Hours. The systems perspective of a computer integrated manufacturing system; manufacturing and its various levels and the planning and control of product movement through the production system in the context of using realtime control, multiprocessor systems, network architectures and databases. **Prerequisite:** ISEN 420.

ISEN 655 Control Issues in Computer Integrated Manufacturing

Credits 3. 3 Lecture Hours. Examines the nature of computer aided manufacturing systems with emphasis on control; an architecture for control of CAM systems is presented; control issues, problems and procedures to control CAM systems are studied and developed. **Prerequisite:** Approval of instructor.

ISEN 656 Virtual Manufacturing

Credits 3. 3 Lecture Hours. Focus on principles of virtual reality and 3-D graphics and their application in manufacturing, automation and simulation; virtual reality modeling, motion, collision detection and networking issues studied and developed. **Prerequisite:** 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 Quantitative Risk Analysis

Credits 3. 3 Lecture Hours. Fundamental concepts, techniques, and applications of quantitative risk analysis and risk-informed decision making for all engineering fields; practical uses of probabilistic methods are demonstrated in exercises and case studies from diverse engineering areas. **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 664 Principles of Scheduling

Credits 3. 3 Lecture Hours. Scheduling and sequencing for production, assembly, supply chain, logistics and service operations; relevant solution methods including algebraic, branch and bound, Lagrangian relaxation, facet generation, branch and price, heuristics and simulation; computational complexity issues. **Prerequisite:** ISEN 620 or ISEN 622 or approval of instructor.

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 669 Software Tools for Stochastic Decision Support Analysis

Credits 3. 3 Lecture Hours. Overview of stochastic decision analysis; focus on Palisade Corporation's Decision Tools Suite of Excel add-in macros; topics include sensitivity analysis of Excel models, decision tree construction and analysis, and simulation within Excel. **Prerequisite:** STAT 630 or equivalent and ISEN 667.

ISEN 670/SYEN 643 Theory of Socio-Technical Systems

Credits 3. 3 Lecture Hours. Philosophy, origins, theory, principles and methodologies of complex socio-technical systems; emphasis on holistic thinking for systems engineering; systems approach; cybernetics; complexity science; physical and biological systems; social, economic and political systems; network representations of systems; real-world decision-making; systems dynamics; emergent behavior; systems architecture; engineered systems today and in the future. **Prerequisite:** Graduate classification. **Cross Listing:** SYEN 643/ISEN 670.

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 673 Prescriptive Analytics for the Service Industry

Credits 3. 3 Lecture Hours. Models and methods based on operations research for predictive and prescriptive analytics applied to the service industry; emphasis on forecasting, decision-analysis, multi-objective optimization, revenue management and decision-making under uncertainty; applications include healthcare, hospitality, transportation, call-centers, data centers, electrical utilities, finance and retail. **Prerequisites:** Graduate classification; approval of instructor.

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.