

# Industrial and Systems Engineering and Engineering Management

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**Chair:** Paul D. Collopy, Professor

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## Mission

To provide integrated, applications-oriented education and research programs in the areas of Industrial Engineering, Systems Engineering, and Engineering Management to support the needs of students and organizations in the Huntsville area and beyond.

## Degrees

**Master of Science in Engineering** (Engineering Management, Industrial Engineering, Systems Engineering concentrations)

**Master of Science in Operations Research**

**Doctor of Philosophy in Industrial Engineering** (with Engineering Management, Industrial Engineering, Operations Research, and Systems Engineering majors)

The Department of Industrial and Systems Engineering and Engineering Management offers major options and associated minors in the subject areas of Operations Research, Industrial Engineering, Systems Engineering, and Engineering Management. All students are encouraged to tailor their graduate programs with a blend of theory and applications. ISEEM faculty are actively involved in research programs, which affords graduate students opportunities for coursework and research inquiry in the areas described above. Please contact the ISEEM Department (256.824.6256) or visit the ISEEM homepage at <http://www.uah.edu/iseem> for further details.

## Industrial and Systems Engineering, MSE & MSOR

### Additional Admission Requirements

The requirements for admission for graduate study in an ISEEM program conform to the policies of the School of Graduate Studies and the College of Engineering. In addition, the MSE Engineering Management and Systems Engineering Options require two years of engineering work experience.

### General Requirements

Students pursuing an MSE option or the MSOR under ISEEM must follow the requirements for either Plan I (Thesis Option) or Plan II (Non-Thesis Option). Both plans require 24 semester hours of approved graduate coursework. Plan I requires a minimum of 6 semester hours of thesis work and the successful completion of the thesis as approved by the supervisory committee. Plan II requires an additional 6 semester hours of approved graduate coursework.

### MSE Concentrations

The **MSE-Engineering Management Concentration** was developed to meet the needs of practicing engineers who find themselves performing engineering management functions without the benefit of formal management education. The Engineering Management Concentration is designed to build upon the mathematical and analytical expertise gained from both a formal engineering education and professional experience. The Engineering Management curriculum emphasizes the application of the management function in the technological setting, while recognizing the basic and applied sciences in engineering systems.

The **MSE-Industrial Engineering Concentration** is offered for engineers who possess a bachelor's degree in a traditional engineering discipline and who have the desire to broaden their engineering problem solving skills. This is accomplished by providing them with a better understanding of traditional and contemporary problem solving skills in the areas of operation research, quality control, computer integrated manufacturing, and simulation. The program is applications-oriented and can be tailored to fit the individual needs of the student.

The **MSE-Systems Engineering Concentration** is offered for engineers with a bachelor's degree in a traditional engineering area who desire to broaden their background into systems oriented aspects of engineering. Methods of systems design, cost-benefit analysis, decision making and trade studies, and systems modeling provide students with knowledge and skills to supplement their baccalaureate engineering program.

### MS Operations Research

The MS in Operations Research Option is for individuals who desire to broaden their background into operations research. Courses in the curriculum include linear programming, optimization, queueing, Markov processes, and systems modeling.

## Industrial and Systems Engineering, PhD.

The PhD in Industrial Engineering offers majors in Engineering Management, Industrial Engineering, Operations Research, or Systems Engineering. The content of these programs can vary to suit the needs and goals of the student.

### Additional Admission Requirements

The requirements for admission for graduate study in an ISEEM program conform to the policies of the School of Graduate Studies and the College of Engineering. In addition, the PhD in Industrial Engineering majors of Engineering Management and Systems Engineering Options require five years of engineering work experience.

### General Requirements and Exams

Students pursuing a PhD option under ISEEM must complete 48 semester hours of approved graduate coursework beyond the bachelor's degree. A maximum of six hours of Master's Thesis credit may be included in the 48 semester hour requirement. A Program of Study must be submitted to the student's supervisory committee for review and approval.

The PhD program in the ISEEM Department has a Preliminary Examination requirement under which students must achieve a 4.0 GPA in their four principal core courses. If courses fail to meet the GPA requirement, they may be retaken until the requirement is met.

After completing the coursework on the Program of Study, students will complete a Comprehensive Exam that either contains both written and oral portions, or, at the option of the student's committee, is based on writing a journal article.

After passing the Comprehensive exam, students will prepare a dissertation proposal to satisfy the Qualifying Examination requirement. Upon completion of the Qualifying Examination, students have five years to complete and defend a research dissertation, which is then approved by the supervisory committee, College Dean, and Graduate Dean.

## Foundation Courses

Outstanding students (3.5 GPA) from other technical fields may gain admittance to the College of Engineering MSE and PhD graduate programs by completing the following courses, or equivalents as approved by the ISEEM Faculty. Applicants who have passed the Fundamental of Engineering Exam (FE) may substitute the exam for the courses.

Code	Title	Semester Hours
<b>Mathematics</b>		
MA 171	CALCULUS A	4
MA 172	CALCULUS B	4
MA 201	CALCULUS C	4
MA 238	APPL DIFFERENTIAL EQUATIONS	3
MA 244	INTRO TO LINEAR ALGEBRA	3
<b>Science</b>		
PH 111	GEN PHYSICS W/CALCULUS I	3
PH 112	GEN PHYSICS W/CALC II	3
CH 121	GENERAL CHEMISTRY I	3
<b>Engineering</b>		
EE 213	ELECTRICAL CIRCUIT ANALYSIS I	3
MAE 271	STATICS	3
MAE 310	FLUID MECHANICS I	3
ISE 321	ENGINEERING ECONOMY	3
MAE 341	THERMODYNAMICS I	3
ISE 390	PROB & ENGR STATISTICS I	3
Total Semester Hours		45

## Online Learning

Several engineering graduate programs are available to qualified graduate students through the College of Engineering Online Learning program. The Industrial and Systems Engineering and Engineering Management (ISEEM) department has options of the MSE degree available to students who cannot attend on-campus classes. The ISEEM Department also has options of the departmental PhD program available by online learning. For information about the availability of other Online Learning programs, contact the Online Learning Office at 256.824.7391.

## Master's Programs in Industrial and Systems Engineering and Engineering Management

- Industrial and Systems Engineering, MSE (<http://catalog.uah.edu/grad/colleges-departments/engineering/industrial-systems-engineering-and-engineering-management/industrial-systems-engineering-mse>)
- Industrial and Systems Engineering, MSOR (<http://catalog.uah.edu/grad/colleges-departments/engineering/industrial-systems-engineering-and-engineering-management/industrial-systems-engineering-msor>)
- Engineering Management (<http://catalog.uah.edu/grad/colleges-departments/engineering/industrial-systems-engineering-and-engineering-management/engineering-management>)

## Doctoral Program in Industrial Engineering

- Industrial and Systems Engineering, PhD (<http://catalog.uah.edu/grad/colleges-departments/engineering/industrial-systems-engineering-and-engineering-management/industrial-systems-engineering-phd>)

### ISE 502 - INDUSTRIAL & ORGANIZA PSY

Semester Hours: 3

Application of basic principles of learning, motivation, and perception to typical industrial and organizational problems.

### ISE 503 - HUMAN FACTORS PSYCHOLOGY

Semester Hours: 3

Study of human performance in human-technology-environment systems. Consideration of human capabilities and limitations as related to controls and displays, and the role of human cognition in decision-making and training effectiveness.

### ISE 523 - INTR STATISTICAL QUALITY CONTR

Semester Hours: 3

This course introduces statistical theory and techniques to control quality of manufacturing products. This course will provide a solid foundation in Statistical Quality Control (SQC). The Six Sigma methodology is also introduced in this course. Students can take the certification exam to earn a Green Belt in Six Sigma.

### ISE 526 - DESIGN/ANALY OF EXPERIMENT

Semester Hours: 3

Advanced topics in statistical experiments with emphasis on design aspect. Confounding, fractional replication, factorial and nested design.

### ISE 530 - MANUF SYS & FACILITIES DESIGN

Semester Hours: 3

Overview of modern manufacturing systems design with emphasis on facility location and plant layout. Includes classical systems, just-in-time systems, basic principles of integrated manufacturing systems design, as well as analysis of process flow, process productivity, and available space to determine plant layout. Includes laboratory exercises.

### ISE 533 - PRODUCTION/INVENTORY CONTR SYS

Semester Hours: 3

Inventory models including classical optimal economic order quantity models, manufacturing resource planning (MRP) systems, master production scheduling, material requirements planning, and purchase order control. Emphasis on manufacturing system revision, continuous process improvement, and the implementation of lean principles.

### ISE 537 - ELECTRONICS MANUF PROCESSES

Semester Hours: 3

Current concepts, facilities, and technology utilized in the manufacture of electronic components and products. Includes printed wiring board fabrication and component mounting methods, automation, quality and reliability, product testing, and economic issues.

### ISE 539 - SELECTED TOPICS/ISE

Semester Hours: 1-3

### ISE 547 - INTRO TO SYSTEMS SIMULATION

Semester Hours: 3

Philosophy and elements of digital discrete-event simulation. Emphasis on modeling and analysis of stochastic systems, including probabilistic models, output analysis, and use of simulation software.

ISE 623 - ENGR ECON ANALYSIS

Semester Hours: 3

This course is designed for graduate students in industrial engineering, systems engineering and engineering management. This course involves mathematical models for expenditure analysis under uncertainty; investment decision criteria; capital planning and budgeting; and decisions involving expansion, acquisitions, replacement, and disinvestment.

ISE 624 - HUMAN FACTORS IN SYS DESIGN

Semester Hours: 3

Psychological, physiological, and anthropometric requirements for human beings and the integration of these requirements into the design of tools, machines, and systems.

ISE 626 - INTRO OPERATIONS RESEARCH

Semester Hours: 3

Philosophy and methodology of operations research. Includes linear programming, game theory, sequencing, and networks.

ISE 627 - ENGINEERING SYSTEMS

Semester Hours: 3

Development of a systems-scientific framework for the integration of systems theory, systems thinking, systems engineering, and systems management. Emphasis is on the conception, design, and management of systems to accommodate complex environments.

ISE 630 - COMPUTER INTEGRATED MANUFACT

Semester Hours: 3

In-depth analysis of integrated manufacturing/computer integrated manufacturing. Reviews the tools, concepts, and enabling technologies necessary to integrate the physical, information, and managerial aspects of a manufacturing enterprise.

ISE 635 - LINEAR PROGRAMMING

Semester Hours: 3

Application of linear programming to complex allocation problems. Methods for determining maximum or minimum of objective functions whose variables are subject to constraints. Simplex methods, degeneracy, modified simplex, transportation problems, flows, goal programming, and sensitivity analysis.

ISE 637 - SYSTEMS MODELING & ANALYSIS

Semester Hours: 3

System analysis and modeling of large complex systems using systems engineering fundamentals. Life cycle simulations developed as a focus for the multidisciplinary analysis integration using computational systems engineering techniques including probability, statistics, design of experiments, response surfaces, and optimization. State of the art software tools will be used for simulation development.

ISE 638 - ENGINEERING RELIABILITY

Semester Hours: 3

Methodology of reliability prediction including application of discrete and continuous distribution models. Reliability estimation, reliability logic diagrams, life testing, and reliability demonstrations.

ISE 639 - SELECTED TOPICS/ISE

Semester Hours: 1-6

ISE 641 - ADVANCED QUALITY CONTROL

Semester Hours: 3

This capstone course uses advanced statistical quality tools such as autocorrelated data, multi-variate quality controls charts, response surface methodology, ridge analysis, and evolutionary operations (EVOP). Advanced Six Sigma concepts will be taught and students will have the opportunity to earn a Black Belt in Six Sigma upon successful completion of the certification exam and an acceptable project.

ISE 647 - ADVANCED SYSTEM SIMULATION

Semester Hours: 3

Methods and procedures for simulation of large and complex systems. Discrete increment, continuous time and combined models. Comparison of discrete-event simulation languages. Model verification and validation. Statistical inference. Input data collection and analysis, output analysis, and comparison of alternatives.

## ISE 670 - INTEGRATED PRODUCT &amp; PROC DES

Semester Hours: 3

This capstone course incorporates curriculum materials to support an integrated products and process design process. Particular attention is devoted to multifunctional teams and their value in promoting the concept of life-cycle engineering. Provides experience with tools and technologies that support the IPPD philosophy.

## ISE 690 - STATISTICAL METHODS FOR ENGR

Semester Hours: 3

Application of statistics for estimation and inference using parametric and nonparametric methods. Descriptive statistics, sampling distributions, point and interval estimates, tests of hypotheses, ANOVA, and linear regression.

## ISE 696 - GRAD INTERN ISE ENGR

Semester Hours: 1-9

Active involvement in an engineering project in an engineering enterprise, professional organization, or government agency that has particular interest and relevance to the graduate student. Permission of ISE faculty member required.

## ISE 697 - INDUS &amp; SYSTEMS ENGR PROJECT I

Semester Hours: 3-9

Application oriented student project designed to show competence in Industrial and Systems Engineering.

## ISE 698 - IND &amp; SYSTEMS ENGR PROJECT II

Semester Hours: 3-9

Required each semester student is working and receiving direction on a master's thesis. Minimum of two semesters and 6 hours required for M.S.E. students. A maximum of 9 hours of credit is awarded upon successful completion of master's thesis.

## ISE 699 - MASTER'S THESIS

Semester Hours: 1-9

Required each semester student is working and receiving direction on a master's thesis. Minimum of two semesters and 6 hours required for M.S.E. students. A maximum of 9 hours of credit is awarded upon successful completion of master's thesis. The 1 hour option is only available to students who have successfully defended their thesis and submitted it for approval, but do not meet the deadlines for graduation in the semester submitted. Students may only use the 1 hour option once in their career.

## ISE 726 - SYSTEMS MODELING

Semester Hours: 3

The capstone course for the operations research option studies the philosophy and methodology for modeling probabilistic systems. Includes Markov processes, queueing theory, and inventory theory. Team project required.

## ISE 728 - OPTIMIZA METH OPER RES

Semester Hours: 3

Classical optimization theory with introduction to search techniques, the Jacobian, and Lagrangian methods. Kuhn-Tucker conditions, quadratic programming, geometric and dynamic programming, and several search procedures.

## ISE 729 - ADV NONLINEAR PROGRAM

Semester Hours: 3

Continuation of ISE 728 with emphasis on development and application of nonlinear programming algorithms. SUMT algorithm, Zoutendijk's method of feasible directions, Rosen's gradient method, and selected algorithms from current literature.

## ISE 730 - MULTI-CRITERIA DEC ANALY

Semester Hours: 3

Methods for analysis of management-decision problems involving multiple goals and constraints. Linear and nonlinear goal programming; risk programming and decision making in fuzzy environments.

## ISE 732 - INDUST FORECASTING/ANALY

Semester Hours: 3

Industrial forecasting methods. Simple forecasting models, multivariate regression, correlation, and spectral analysis, exponential smoothing, and Box-Jenkins forecasting.

ISE 734 - DECISION ANALYSIS

Semester Hours: 3

Decision making for systems engineering and engineering management, with an emphasis on applications to complex systems. Builds a rigorous foundation in decision making under uncertainty using expected utility theory. Topics include decision trees, value models, predictive models, preferences and bias.

ISE 735 - DISCRETE OPTIMIZATION

Semester Hours: 3

Integer programming and network analysis. Zero-one problem formulation and Balas method, cutting plane techniques, branch and bound, out-of-kilter algorithm, and special applications of integer programming.

ISE 738 - RELIAB/AVAILAB/MAINTAINA

Semester Hours: 3

In-depth application of decision theory and MIL-HDBK-217, and maintenance engineering techniques in order to achieve targeted reliability, availability and maintainability design goals.

ISE 739 - SELECTED TOPICS/ISE

Semester Hours: 1-6

ISE 741 - QUALITY ENGINEERING

Semester Hours: 3

Application of quality engineering techniques to the design and improvement of products and processes. Topics include: multivariate analysis, Taguchi methods, mixture experiments, and response surface analysis.

ISE 761 - EVOL THRY ENG MGMT/IND SYS ENG

Semester Hours: 3

Development of applicable engineering management or industrial and systems engineering theory using classical concepts, contemporary studies and practices at successful technology-based organizations.

ISE 767 - CONTEMPORARY APPL EM/ISE

Semester Hours: 3

Application of key qualitative and quantitative principles of engineering management or industrial and systems engineering to real-world case problems. Students work both in teams and as individuals to solve multidimensional problems which require an integrative point of view.

ISE 790 - ADV STATISTICAL APPLICATIONS

Semester Hours: 3

Continuation of ISE 690 with extension to regression models and nonparametric methods.

ISE 799 - DOCTORAL DISSERTATION

Semester Hours: 3-9

Required each semester student is enrolled and receiving direction on doctoral dissertation.