Program Description:
A critical component of all graduate-level work is the scholarly activity through the completion of substantive research. These activities take place through the completion of doctoral dissertations, master’s theses, and master’s research projects. The department encourages the completion of master’s theses, particularly for those students holding assistantship appointments. Research areas of concentration at both the master’s and doctoral levels include the following: artificial intelligence/expert systems, computer assisted processes, computer integrated manufacturing, financial engineering, engineering administration, facilities analysis/design, human factors/ergonomics, manufacturing automation/robotics, material handling, operations research, productivity measurement/analysis, production control/scheduling, quality control/reliability, and health care/transportation logistics.

Primary Areas of Faculty Research:
Automation and robotics; economic decision analysis; electronics manufacturing; engineering and quality management; ergonomics, human factors and safety; health care; manufacturing and transportation logistics; material handling and warehousing systems; operations research; quality, reliability, maintainability; and scheduling.

Application to the Graduate Program:
Follow the procedures outlined by the Graduate School. To receive full consideration for assistantships and other financial aid, applications must be received before February 1.

Prerequisites to the M.S.I.E. Degree Program:

1. There are no prerequisites for students with an undergraduate degree from an ABET-accredited industrial engineering program.

2. For students with a degree other than an ABET-accredited industrial engineering degree, prerequisite courses may be required.

Requirements for the Master of Science in Industrial Engineering Degree:
In addition to the requirements of the Graduate School, the following departmental requirements must be satisfied by candidates for the M.S.I.E. degree:

1. Candidates who present a thesis are required to complete a minimum of 24 graduate credit hours plus six hours of INEG 600V Master’s Thesis.

2. Candidates who present a project are required to complete a minimum of 27 graduate credit hours plus three hours of INEG 513V Master’s Research Project and Report.

3. Candidates who do not present either a thesis or project are required to complete 30 semester hours of course work.

4. Candidates must successfully complete a master’s oral examination that is conducted by the candidate’s committee.

5. Courses Taken for Graduate Credit: A limited number of 4000-level courses may be taken for graduate credit.

6. Attendance at INEG graduate seminar is required of all graduate students in Industrial Engineering.

Students should also be aware of Graduate School requirements with regard to master’s degrees (http://catalog.uark.edu/graduatecatalog/degreerequirements/#mastersdegreetext).

Courses
INEG 4223. Occupational Safety and Health Standards (Irregular). 3 Hours.
Survey of existing and proposed standards by examining fundamental physical, economic, and legal bases. Performance vs. specific standards. Enforceability and data collection. National consensus and promulgation process. Includes a computer-based design project. Prerequisite: INEG 2313.

INEG 4323. Quality Engineering and Management (Irregular). 3 Hours.
Provides the student with complete coverage of the functional area of “Quality Assurance” ranging from the need for such a function, how it works, techniques utilized, and managerial approaches for insuring its effectiveness. Prerequisite: INEG 2333.
Studies of human cognition in work settings in order to enhance performance of
cognitive tasks through an understanding of cognitive processes (e.g., attention,
perception errors, decision making, workload) required of operators in modern
industries. Emphasis lies on how to (re)design human-machine interfaces and
cognitive artifacts so that human well-being and system performance are optimized
in work environments. Prerequisite: CSCE 2004.

INEG 4423. Advanced Engineering Economy (Irregular). 3 Hours.
Preparation of feasibility studies, including cost estimation, risk and uncertainty,
sensitivity analysis and decision making. Effects of taxes, depreciation and financing
costs on cash flows. Prerequisite: INEG 2413.

INEG 4433. Systems Engineering and Management (Fa). 3 Hours.
Overview of the fundamental concepts underlying the management of engineering.
Reviews the engineering decision process within the life cycle. Examines
implementation of basic management functions in technical organizations and
development of strategy tools within a complex organization. Prerequisite:
INEG 2403.

INEG 4443. Project Management (Irregular). 3 Hours.
Analysis of the strategic level of project management including planning, organizing,
and staffing for successful project execution. Professional creativity, motivation,
leadership, and ethics are also explored. At the tactical level, project selection,
control, and systems management are analyzed. Systems development and
decision support tools for project management are studied. Prerequisite: Senior
standing.

INEG 4453. Productivity Improvement (Irregular). 3 Hours.
Analysis of common productivity problems. Development of skills required to
diagnose problems; measure productivity; develop improvement strategies; and
provide for the implementation and maintenance of productivity measurement and
improvement systems. Prerequisite: Senior standing.

INEG 4533. Application of Machine Vision (Sp). 3 Hours.
Automated machine vision applied to assembly and inspection tasks traditionally
performed by human operators: development of application by acquiring image,
processing image data, analyzing image and transmitting results; application
analysis, selection and economics. Laboratory required. Corequisite: Lab
component. Prerequisite: Senior standing.

INEG 4553. Production Planning and Control (Fa). 3 Hours.
Strategy and competition, forecasting, aggregate planning, inventory control subject
to known demand, inventory control subject to uncertain demand, supply chain
management, push and pull production control systems, and operations scheduling.
Pre or Corequisite: INEG 3613. Prerequisite: INEG 2333.

INEG 4583. Renewable Energy: Green Power Sources (Sp). 3 Hours.
Current developments in renewable energy from a green power source where
energy considered for use in residential, small businesses, and industrial complexes.
Prerequisite: Senior standing.

INEG 4733. Industrial Ergonomics (Irregular). 3 Hours.
Provides background and experience in measurement and evaluation of human
performance as it pertains to the working environment. The physical, physiological
and psychological capabilities of the tasks they are to perform. Laboratory projects
required. Prerequisite: INEG 4723 and INEG 2333.

INEG 4833. Introduction to Database Concepts for Industrial Engineers
(Irregular). 3 Hours.
An introduction to the basic principles of database modeling and technologies for
industrial engineers. Coverage includes analyzing user requirements, representing
data using conceptual modeling techniques (e.g., UML, ERD), converting conceptual
models to relational implementations via database design methodologies, extracting
data via structured query language processing, and understanding the role of
database technology in industrial engineering application areas such as inventory
systems, manufacturing control, etc. The application of a desktop database
application such as Access will be emphasized. Prerequisite: CSCE 2004.

INEG 5123. Industrial Engineering in the Service Sector (Irregular). 3 Hours.
Review of the development of industrial engineering into the service sector, e.g.,
health care systems, banking, municipal services, utilities, and postal service.
Emphasizes those principles and methodologies applicable to the solutions of
problems within the service industries. Prerequisite: Graduate standing.
This course is cross-listed with OMGT 5133.

INEG 513V. Master's Research Project and Report (Sp, Su, Fa). 1-6 Hour.
Required course for students electing the report option.

INEG 514V. Special Topics in Industrial Engineering (Irregular). 1-3 Hour.
Consideration of current industrial engineering topics not covered in other courses.
Prerequisite: Graduate standing. May be repeated for up to 6 hours of degree credit.

INEG 515V. Individual Study in Industrial Engineering (Sp, Su, Fa). 1-3 Hour.
Opportunity for individual study of advanced subjects related to a graduate industrial
engineering program to suit individual requirements. Prerequisite: Graduate
standing.

INEG 5243. Automated Manufacturing (Irregular). 3 Hours.
Introduction to manufacturing processes and concurrent engineering in the
electronics industry. Survey of electronics components and products and the
processes of fabrication and assembly. Principles of design, productivity, quality,
and economics. Emphasis on manufacturability.

INEG 5253. Leadership Principles and Practices (Fa). 3 Hours.
The course is designed to expose students to multiple approaches to leadership in a
wide variety of settings. Leadership styles, the knowledge areas and competencies
expected of today’s leaders, the challenges leaders face, the historical and
philosophical foundations of leadership, the relationships among leadership
theory, leadership practice, and the moral-ethical aspects of leadership are among
the topics covered in the course. A number of respected regional, national, and
international leaders share “lessons learned” in their leadership journeys. Plus, a
number of highly regarded leadership books and case studies on leadership are
read and discussed. Students may not receive credit for INEG 4253 and INEG 5253/
OMGT 5253.
This course is cross-listed with OMGT 5253.

INEG 5263. Engineering Statistics (Fa). 3 Hours.
A graduate level engineering statistics course covering functions of random
variables, properties and distributions of random samples, theory of statistical
inference, and rationales of testing hypotheses and constructing confidence
intervals. Prerequisite: MATH 2574 and INEG 2313.

INEG 5313. Engineering Applications of Probability Theory (Fa). 3 Hours.
Introduction to probability, discrete random variables, continuous random variables,
multiple random variables, sequences of Bernoulli trials. Applications of these topics
from inventory, reliability, quality control.

INEG 5323. Engineering Applications of Stochastic Processes (Sp). 3 Hours.
Renewal processes, Poisson processes, discrete-time Markov chains, continuous-
time Markov chains. Applications of these topics from inventory, reliability, quality
control, queueing.
INEG 5333. Design of Industrial Experiments (Irregular). 3 Hours.
Statistical analysis as applied to problems and experiments in engineering and industrial research; experiment design and analysis; probability; and response surface analysis. Prerequisite: INEG 2313 or equivalent.

INEG 5343. Advanced Quality Control Methods (Irregular). 3 Hours.
Acceptance sampling by attributes; single, double, sequential, and multiple sampling plans; sampling plans; sampling plans of Department of Defense; acceptance sampling by variables; Bayesian acceptance sampling; rectifying inspection for lot-by-lot sampling; control charts; special devices; and procedures. Prerequisite: INEG 2313.

INEG 5373. Repairable Systems Modeling (Irregular). 3 Hours.
Applications of probability, statistics, simulation and optimization to problems related to 1) modeling the performance of repairable equipment; 2) designing optimal inspection and maintenance policies for repairable equipment; and 3) optimizing the allocation of maintenance resources.

Fundamentals of modeling risk, analyzing risk, and managing risk in a variety of industrial and government decision-making settings. Risk measurement and model building, uncertainty quantification, and multi-objective trade-offs. Credit cannot be earned for both INEG 4383 and INEG 5383.

INEG 5393. Applied Regression Analysis for Engineers (Irregular). 3 Hours.
Present concepts and applications to introduce statistical tools for discovering relationships among variables. Focus on fitting and checking linear and nonlinear regression models. Practical tools for engineers.

Overview of cost estimation techniques and methodologies applied to manufacturing and service organizations. Accomplished through detailed analysis of the cost estimation development process and various cost estimation models. Topics include data collection and management, learning curves, activity based costing, detailed and parametric estimation models, and handing risk and uncertainty. Prerequisite: INEG 2313.
This course is cross-listed with OMGT 5433.

INEG 5433. Decision Models (Irregular). 3 Hours.
Focus on quantitative decision models for technical and managerial problems for private and public organizations. Topics include shareholder value, stakeholder value, Value-Focused Thinking, axioms of decision analysis, decision making challenges, decision traps, cognitive biases, decision processes, decision framing, influence diagrams, value hierarchy structuring, designing creative alternatives, singe objective models, multiobjective additive value model, swing weights, sensitivity analysis, portfolio decision models with binary linear programming, probability elicitation, Bayes Law, decision trees, Monte Carlo simulation, expected value, dominance (deterministic and stochastic), tomando diagrams, value of information, risk preference, utility models, expected utility, and communicating analysis insights. Prerequisite: INEG 2313.
This course is cross-listed with OMGT 5443.

INEG 5523. Topics in Automated Systems (Irregular). 3 Hours.
To understand current developments in applications of flexible automation to industrial processes. Robotics, machine vision and other sensors, human machine interface, AML/2 and V+ programming languages.

INEG 5533. Network Optimization in Transportation Logistics (Sp). 3 Hours.
Focus on quantitative modeling and analysis of network optimization problems and their application in logistics system design and operation. Topics include network design and routing and location analysis, with emphasis on the application of both exact and heuristic solution techniques for large-scale instances of such problems. Prerequisite: INEG 5613.

INEG 5543. Distribution Center Design & Operations (Irregular). 3 Hours.
To introduce the student to the field of facility logistics, as applied to distribution centers (DCs). The fundamental areas of facility design and operations (material handling systems) will be covered. Prerequisite: INEG 5613.

INEG 5563. Industrial Robotics (Fa). 3 Hours.
An interdisciplinary treatment of industrial robotics; manipulator anatomy, control, and programming; end-of arm tooling; sensors & sensing; system integration and safety; current research topics. Graduate-level lab assignments and examinations. Significant literature review and writing assignments. Not open to students with credit for INEG 4563. Prerequisite: Graduate standing or instructor consent.

INEG 5613. Introduction to Optimization Theory (Fa). 3 Hours.
A graduate level introduction to the foundational rationales of numerical optimization methods including linear programming, integer programming, network flows, and discrete dynamic programming. Model formulation and tractability, search strategies, characterization of optimal solutions, duality and sensitivity, outcome justification. Prerequisite: Graduate standing.

INEG 5623. Analysis of Inventory Systems (Irregular). 3 Hours.
Elements of production and inventory control, economic lot size models, price breaks models using Lagrangian method, deterministic dynamic inventory model, probabilistic one-period and multi-period models, zero and positive lead time models, and continuous review models. Prerequisite: INEG 5313.

INEG 5643. Optimization Theory II (Irregular). 3 Hours.
Classical optimization theory, Lagrangian and Jacobian methods, Kuhn-Tucker theory and constraint qualification, duality in nonlinear problems; separable programming, quadratic programming, geometric programming, stochastic programming, steepest ascent method, convex combinations method, SUMT, Fibonacci search, and golden section method. Prerequisite: INEG 5613.

INEG 5653. Modeling and Analysis of Semiconductor Manufacturing (Irregular). 3 Hours.
Introduction to front end of semiconductor manufacturing process, wafer processing. Topics include an introduction to wafer processing, factory and equipment capacity modeling, automated material handling, simulation, cost modeling, and production scheduling. Prerequisite: INEG 2313.

Poison axioms, pure birth and death model, queue disciplines (M/M/1) and (M/M/c) models, machine servicing model, Pollazek-Khintchine formula, priority queues, and queues in series. Markovian analysis of (GI/M/K) (M/G/1) models, and bulk queues. Reneging, balking, and jockeying phenomena. Transient behavior. Prerequisite: INEG 5313.

INEG 5683. Nonlinear Programming (Irregular). 3 Hours.
An introduction to the theory and methodology of nonlinear programming. Focus on engineering and management science applications of nonlinear optimization. Both single and multi-variable as well as unconstrained and constrained problems are addressed.

INEG 5693. Heuristic Optimization (Irregular). 3 Hours.
Theory and applications of methodological approaches explicitly addressed to heuristic or approximate optimization of integer and combinatorial models. Prerequisite: INEG 5613.

INEG 5803. Simulation (Irregular). 3 Hours.
The development and use of discrete-event simulation models for the analysis and design of systems found in manufacturing, distribution, and service contexts. Coverage includes conceptual modeling, model translation to computer form, statistical input models, random number generation and Monte Carlo methods, experimentation and statistical output analysis, and queuing analysis. Includes the use of modern computer simulation languages. Cannot receive credit for both INEG 3623 and INEG 5803. Corequisite: drill component.
INEG 5813. Introduction to Simulation (Irregular). 3 Hours.
Development and use of discrete-event simulation models for the analysis and
design of systems found in manufacturing, distribution, and service contexts.
Coverage includes conceptual modeling, model translation to computer form,
statistical input models, random number generation and Monte Carlo methods,
experimentation and statistical output analysis, and queuing analysis. For off-
campus, distance education students only.

INEG 5823. Systems Simulation I (Irregular). 3 Hours.
Random number generation, random variate generation, timekeeping in simulations,
discrete event modeling, construction of digital simulation models, statistical analysis
of simulation results, and analysis of simulation experiments utilizing a computer
programming language. Prerequisite: INEG 3623 or INEG 5803 or equivalent.

INEG 5843. Scheduling and Sequencing I (Irregular). 3 Hours.
An introduction to constructive algorithms and various operations research
approaches for solving sequencing and scheduling problems. The NP-completeness
of most scheduling problems leads to a discussion of computational complexity,
the use of heuristic solution methods, and the development of worst case bounds.
Prerequisite: INEG 3613 and computer programming proficiency.

INEG 600V. Master's Thesis (Sp, Su, Fa). 1-9 Hour.
Master's Thesis. May be repeated for degree credit.

INEG 6113. Linear Optimization (Fa). 3 Hours.
A precise treatment of linear programming. Theory of convex sets, linear
inequalities; development of the simplex method; duality theory; post optimality
application and interpretation. Variants of the simplex methods and interior-point
algorithms are discussed. Prerequisite: INEG 5613.

INEG 614V. Special Topics for Doctoral Students in Industrial Engineering
(Irregular). 1-3 Hour.
Consideration of current industrial engineering topics at the doctoral level that are
not covered in other courses. Prerequisite: PhD student in Industrial Engineering or
consent of the instructor. May be repeated for up to 6 hours of degree credit.

INEG 6213. Integer Programming (Sp). 3 Hours.
This course offers the theory needed to model and efficiently solve large-scale
binary, mixed and general integer programs. The tools needed to assess the
computational complexity of these problems will be fully studied. Additional topics
include the conceptual foundation required for the development of cutting plane,
branch-and-price, Lagrange relaxation and constraint programming approaches.
Implementation considerations specific to preprocessing, valid inequality generation
and solution methodology convergence will be emphasized. Prerequisite:
INEG 6113.

INEG 6313. Network Optimization (Fa). 3 Hours.
A theorem-proof based advanced study providing rigorous exposition of foundational
network optimization concepts including relevant optimization theory, algorithm
development techniques, complexity analysis, data structures, and important
applications. Prerequisite: INEG 6113.

INEG 6363. Generalized Linear Models (Irregular). 3 Hours.
Introduce the generalized linear model (GLM), inference, likelihood and diagnostics.
Apply log linear and logistic models. Develop techniques for growth curves, and
longitudinal and survival data. Cover spatial and normal linear models, and dynamic
GLM for dependent data.

Investigation of literature case studies; use of mathematical models to solve practical
problems; data collection and solution implementation. Students work in teams on
actual problems observed in industry and government. Prerequisite: INEG 3623,
INEG 5313 and INEG 5613.

INEG 6823. Systems Simulation II (Irregular). 3 Hours.
Advanced topics in computer simulation including experimental design, simulation
optimization, variance reduction, and statistical output analysis techniques applied to
discrete event simulation. Prerequisite: INEG 5823.

INEG 700V. Doctoral Dissertation (Sp, Su, Fa). 1-18 Hour.
Doctoral Dissertation. May be repeated for degree credit.