Industrial Engineering (INEG)

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Department of Industrial Engineering website (http://industrial-engineering.uark.edu)

Degrees Conferred:
M.S.E.M. in Engineering Management (http://catalog.uark.edu/graduatecatalog/programsofstudy/engineering-management-emgt/) (EMGT)
M.S.I.E. in Industrial Engineering (INEG)
M.S.O.A. in Operations Analytics (http://catalog.uark.edu/graduatecatalog/programsofstudy/operationsanalyticsopan/) (OPAN)
M.S.O.M. in Operations Management (http://catalog.uark.edu/graduatecatalog/programsofstudy/operationsmanagementopmg/) (OPMG)

Ph.D. in Engineering (INEG)

Graduate Certificates Offered:

Engineering Management (http://catalog.uark.edu/graduatecatalog/programsofstudy/engineering-management-emgt/) (EMGTGC)
Engineering Management Analytics (http://catalog.uark.edu/graduatecatalog/certificates/engineering-management-analytics/) (EMGAGC)
Homeland Security (http://catalog.uark.edu/graduatecatalog/certificates/homelandsecurity/) (OMHSGC)
Lean Six Sigma (http://catalog.uark.edu/graduatecatalog/certificates/leansixsigma/) (OMLSGC)
Project Management (http://catalog.uark.edu/graduatecatalog/programsofstudy/project-management-ompm/) (OMPMGC)

Graduate Microcertificates Offered:

Advanced Air Mobility Autonomous Operations (http://catalog.uark.edu/graduatecatalog/certificates/advancedairmobilityautonomousoperations/) (OMAMGM)
Analytics for Operations Managers (http://catalog.uark.edu/graduatecatalog/certificates/analyticsoperationsmanagers/) (OMOAGM)
Decision Support for Operations Managers (http://catalog.uark.edu/graduatecatalog/certificates/decisionsupportoperationsmanagers/) (OMDSGM)
Leading Operational Change (http://catalog.uark.edu/graduatecatalog/certificates/landingoperationalchange/) (OMLCGM)
Systems Engineering Analytics (http://catalog.uark.edu/graduatecatalog/certificates/systemsengineeringanalyticsgmc/) (EMSAGM)
Systems Engineering and Engineering Management (http://catalog.uark.edu/graduatecatalog/certificates/systemsengineeringmanagementgmc/) (EMSEGM)

Program Description: A critical component of all graduate-level work is 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.

M.S.I.E. in Industrial Engineering

Application to the Graduate Program: Follow the procedures outlined by the Graduate School.

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 6000V 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 5130V 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 40000-level courses may be taken for graduate credit.
6. Attendance at INEG graduate seminar is required of all graduate students in Industrial Engineering.

Accelerated M.S.I.E. Degree

High-achieving current undergraduate students seeking a B.S.I.E. degree at the University of Arkansas who choose to pursue graduate studies in INEG may participate in the accelerated M.S.I.E. program. Eligible students may take up to 12 credit hours of graduate degree credit and apply them towards both their bachelor's degree and their M.S.I.E. degree, provided those credits meet degree requirements for both the bachelor's degree and the M.S.I.E. The total of 12 credit hours

of graduate courses taken as an undergraduate student must be taken during the final 12 month period of their undergraduate degree.

Once fully admitted to the M.S.I.E. program, students request that up to 12 hours of 50000-level or above courses taken in the final 12-month period of their undergraduate degree count toward their graduate degree, if these courses were taken on the Fayetteville campus of the University of Arkansas. Students then take an additional 18 credit hours of approved INEG graduate-level courses (including INEG 6000V or INEG 5130V) in order to complete their M.S.I.E. degree.

Industrial engineering undergraduate students interested in the accelerated M.S.I.E. degree should apply to the program prior to starting the second-to-last semester of their undergraduate program. To be eligible, students must have a 3.5 cumulative GPA or higher and submit the normal application materials required by the graduate school for the M.S.I.E. degree program.

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

Ph.D. in Industrial Engineering

Application to the Graduate Program: Follow the procedures outlined by the Graduate School.

In addition to the requirements of the Graduate School and those established by the College of Engineering for all doctoral graduates, the following requirements have been established for INEG doctoral graduates:

1. A minimum of 72 semester hours of graduate-level credit beyond the bachelor's degree.
2. A minimum of 42 semester hours of graduate-level credit beyond the master's degree of which a minimum of 21 semester hours shall be approved graduate level courses and a minimum of 21 semester hours of dissertation hours (INEG 7000V).
3. Students admitted with a B.S. degree must complete their initial 30 semester hours out of the 72 total at the 5000-level or above, with the remaining 42 semester hours subject to the rule stated in paragraph 2 above.
4. Ph.D. students in Industrial Engineering must pass a Qualifier Exam over a subset of topics in Industrial Engineering determined by the student's Doctoral Advisory Committee. Students may fail the exam once and retake it. Students who fail the exam twice will be dismissed from the Ph.D. program.

Graduate Faculty

Cassady, Richard, Ph.D., M.S.I.S.E., B.S.I.S.E. (Virginia Polytechnic Institute and State University), University Professor, 2000, 2019.
Chimka, Justin Robert, Ph.D., M.S.I.E., B.S.I.E. (University of Pittsburgh), Associate Professor, 2002, 2009.
Curry, Robert, Ph.D. (Clemson University), M.S.I.S.E. (University of Florida), B.S.I.E. (University of Arkansas), Assistant Professor, 2023.
Eksioglu, Sandra, Ph.D. (University of Florida), M.S.E.M.S. (Mediterranean Agronomic Institute of Chania), B.S.B.A. (University of Tirana), Professor, Hefley Professor in Logistics and Entrepreneurship, 2019.
Liao, Haitao, Ph.D., M.S., M.S.I.S.E. (Rutgers University), B.S.E.E. (Beijing Institute of Technology), Professor, John and Mary Lib White Endowed Systems Integration Chair, 2015.
Liu, Xiao, Ph.D. (National University of Singapore), B.S.M.E. (Harbin Institute of Technology, China), Assistant Professor, 2017.
Melton, Kerry D., Ph.D. (Oklahoma State University), M.S.I.E., B.S.I.E. (University of Arkansas), Teaching Associate Professor, 2013, 2023.
Milburn, Ashlea B., Ph.D. (Georgia Institute of Technology), M.S.I.E. (Virginia Polytechnic Institute and State University), B.S.I.E. (University of Arkansas), Associate Professor, John L. Imhoff Chair in Industrial Engineering, 2010, 2018.
Nachtmann, Heather, Ph.D., M.S.I.E., B.S.I.E. (University of Pittsburgh), Professor, Earl J. and Lillian P. Dyess Endowed Chair in Engineering, 2000, 2013.
Needy, Kim LaScola, Ph.D. (Wichita State University), P.E., M.S.I.E., B.S.I.E. (University of Pittsburgh), Professor, 2008.
Parnell, Gregory S., Ph.D. (Stanford University), M.S. (University of Southern California), M.E.I.S.E. (University of Florida), B.S. (University of New York at Buffalo), Professor of Practice, 2013.
Paulus, David, Ph.D. (Colorado State University), M.S.I.E, B.S.M.E. (University of Tennessee), Professor of Practice, 2023.
Pohl, Edward A., Ph.D., M.S.R.E. (University of Arizona), M.S.S.E. (Air Force Institute of Technology), M.S.E.M. (University of Dayton), B.S.E.E. (Boston University), Professor, Twenty-First Century Professorship in Engineering, 2004, 2013.
Pohl, Letitia, Ph.D. (University of Arkansas), M.S.S.E. (Air Force Institute of Technology), B.S.M.E. (Tulane University), Teaching Associate Professor, 2013, 2021.
Rainwater, Chase E., Ph.D. (University of Florida), B.S.I.E. (University of Arkansas), Professor, Twenty-First Century Professorship in Engineering, 2009, 2021.
Rossetti, Manuel D., Ph.D., P.E., M.S.I.E. (The Ohio State University), B.S.I.E. (University of Cincinnati), University Professor, 1999, 2022.
Schubert, Karl, Ph.D. (University of Arkansas), M.S.Ch.E. (University of Kentucky), B.S.Ch.E (University of Arkansas), Professor of Practice, 2016.
Shen, Haoming, Ph.D. (University of Michigan, Ann Arbor), M.S.E.E., M.S.M. (University of Michigan, Ann Arbor), B.S.E.E. (Xi'an Jiatong University), Assistant Professor, 2023.
Sullivan, Kelly M., Ph.D. (University of Florida), M.S.I.E., B.S.I.E. (University of Arkansas), Associate Professor, 2012, 2019.
Zhang, Shengfan, Ph.D., M.I.E. (North Carolina State University), B.M. (Fudan University, Shanghai), Associate Professor, John L. Imhoff Chair in Industrial Engineering, 2011, 2020.

Courses

INEG 5130V. Master's Research Project and Report. 1-6 Hour.
Required course for students electing the report option. (Typically offered: Fall, Spring and Summer)

INEG 5140V. Special Topics in Industrial Engineering. 1-3 Hour.
Consideration of current industrial engineering topics not covered in other courses. Prerequisite: Graduate standing. (Typically offered: Irregular) May be repeated for up to 6 hours of degree credit.

INEG 5150V. Individual Study in Industrial Engineering. 1-3 Hour.
Opportunity for individual study of advanced subjects related to a graduate industrial engineering program to suit individual requirements. Prerequisite: Graduate standing. (Typically offered: Fall, Spring and Summer)

INEG 51603. Introduction to Modern Statistical Techniques for Industrial Applications. 3 Hours.
This application-oriented course is driven by real problems arising from industry and focuses on problem solving using both modern and classic statistical methods. For both senior undergraduate and graduate students, the main goal of this course is to provide a comprehensive introduction to those most popular statistical learning methods and tools (such as R and Apache Spark) which are widely used in industry today. For graduate students, this course will also cover the fundamental theory behind some of the methodologies. Students will not receive graduate degree credit for both INEG 4100V with the same title, and INEG 51603. (Typically offered: Spring)

INEG 52503. Leadership Principles and Practices. 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 42503 and INEG 52503/OMGT 52503. (Typically offered: Fall)
This course is cross-listed with OMGT 52503.

INEG 52603. Engineering Statistics. 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. Prior knowledge of material equivalent to MATH 26004 and INEG 23303 is expected. (Typically offered: Fall)

INEG 53103. Engineering Applications of Probability Theory. 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. (Typically offered: Fall)

INEG 53203. Engineering Applications of Stochastic Processes. 3 Hours.
Renewal processes, Poisson processes, discrete-time Markov chains, continuous-time Markov chains. Applications of these topics from inventory, reliability, quality control, queueing. (Typically offered: Spring)

INEG 53303. Design of Industrial Experiments. 3 Hours.
Statistical analysis as applied to problems and experiments in engineering and industrial research; experiment design and analysis; probability; and response surface analysis. (Typically offered: Irregular)

INEG 53903. Applied Regression Analysis for Engineers. 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. (Typically offered: Irregular)

INEG 54203. Advanced Engineering Economy. 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. Graduate degree credit will not be given for both INEG 44203 and INEG 54203. (Typically offered: Irregular)

INEG 54303. Cost Estimation Models. 3 Hours.
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 handling risk and uncertainty. (Typically offered: Irregular)
This course is cross-listed with OMGT 54303.

INEG 54403. Decision Models. 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), tornado diagrams, value of information, risk preference, utility models, expected utility, and communicating analysis insights. (Typically offered: Irregular)
This course is cross-listed with EMGT 54403, OMGT 54403.

INEG 54503. Systems Engineering and Management. 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. Graduate degree credit will not be given for both INEG 44303 and INEG 54503. (Typically offered: Fall)

INEG 55303. Network Optimization in Transportation Logistics. 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 56103. (Typically offered: Spring)

INEG 55603. Industrial Robotics. 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. Prerequisite: Graduate standing or instructor consent. (Typically offered: Fall)

INEG 56103. Introduction to Optimization Theory. 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. (Typically offered: Fall)

INEG 56203. Analysis of Inventory Systems. 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 53103. (Typically offered: Irregular)

INEG 56803. Nonlinear Programming. 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. (Typically offered: Irregular)

INEG 56903. Heuristic Optimization. 3 Hours.
Theory and applications of methodological approaches explicitly addressed to heuristic or approximate optimization of integer and combinatorial models. Prerequisite: INEG 56103. (Typically offered: Irregular)

INEG 58003. Simulation. 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 36204 and INEG 58003. Corequisite: Drill component. (Typically offered: Irregular)

INEG 58103. Introduction to Simulation. 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. (Typically offered: Irregular)

INEG 58203. Systems Simulation I. 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. (Typically offered: Irregular)

INEG 58303. Introduction to Database Concepts for Industrial Engineers. 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. (Typically offered: Irregular)

INEG 6000V. Master's Thesis. 1-9 Hour.
Master's Thesis. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.

INEG 61103. Linear Optimization. 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 56103. (Typically offered: Fall)

INEG 6140V. Special Topics for Doctoral Students in Industrial Engineering. 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. (Typically offered: Irregular) May be repeated for up to 6 hours of degree credit.

INEG 63103. Network Optimization. 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 61103. (Typically offered: Fall)

INEG 63203. Advanced Stochastic Processes. 3 Hours.
This course prepares Ph.D. students with advanced topics in probability and stochastic processes, with a focus on deriving and analyzing probability and stochastic models, and theorem proving in related topics. Contents include review of probability theorems, limit and convergence theorems, generating functions, Poisson processes, renewal theory, discrete and continuous Markov chains, and other advance topics. Prerequisite: INEG 53103 and INEG 53203. (Typically offered: Spring)

INEG 64403. Advanced Decision Analysis. 3 Hours.
The purpose of this course is to prepare the student to perform PhD and MS level research and analysis using advanced decision analysis concepts and techniques. The course topics include the history of decision analysis, foundations of decision analysis, structuring decision problems, assessing probabilities, probability management, Bayesian networks, utility, risk preference, risk analysis for engineering applications, intelligent adversary risk analysis, behavioral and organizational context for decision analysis, and major decision analysis applications. Prerequisite: INEG 54403. (Typically offered: Spring)

INEG 68203. Systems Simulation II. 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 52603 or (INEG 53103 and INEG 53203)), and (INEG 58203 or INEG 36204 or INEG 58003). (Typically offered: Irregular)

INEG 68403. Scheduling Theory and Algorithms. 3 Hours.
The course will cover the theory and solution methods for scheduling several tasks over time. Topics include terminology, measures of performance, single machine sequencing, flow shop scheduling, the job shop problem, and priority dispatching. Side constraints within scheduling, such as precedence, release dates, and due dates are addressed. Integer programming, dynamic programming, and heuristic approaches to various problems are also presented. Prerequisite: INEG 56103 or equivalent, computer programming proficiency, and exposure to proofs. (Typically offered: Irregular)

INEG 7000V. Doctoral Dissertation. 1-18 Hour.
Doctoral Dissertation. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.