Industrial Engineering  
(INEG)

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Head of the Department  
4207 Bell Engineering Center  
479-575-3156

Industrial Engineering Website (http://www.ineg.uark.edu)

The mission of the industrial engineering department at the University of Arkansas is to be a nationally competitive, student-centered industrial engineering program serving Arkansas and the world through undergraduate and graduate studies and leading-edge research programs.

Industrial engineers are concerned with improving organized activity. The physical arrangement of people, equipment, and material significantly influences the effectiveness of any organization – whether the organization is industrial, governmental, or commercial.

Today’s industrial engineers develop applications of new processing automation and control technology; install data processing systems, performance measures and standards, job evaluation and wage and salary programs; research new products and product applications; devise ways to improve productivity through application of technology and human factors; select operating processes and methods to accomplish a given task using proper tools and equipment; design facilities, management systems, operations procedures, storage systems; improve allocation of resources, planning and control systems for distribution of goods and services, production, inventory, quality and plant maintenance; enhance plant environment and the quality of working life; evaluate reliability and quality performance; implement office systems, procedures, and policies; analyze complex business problems through operations research; conduct long-range organization studies, plant location surveys, system effectiveness studies; and study potential markets for goods and services, raw material sources, labor supply, energy resources, financing and taxes.

Industrial engineers integrate engineering skills with mathematics and computer science tools, providing systematic ways to maximize productivity and quality while minimizing time and cost.

The goal of the Industrial Engineering Undergraduate Program at the University of Arkansas is to prepare men and women for professional careers and graduate studies in Industrial Engineering. We provide a foundation in mathematics, science, humanities and social sciences, engineering science, and engineering design to produce Industrial Engineers with the intellectual, technical, and professional competence to develop, implement, and manage industrial engineering solutions to complex problems in industry, government, and society.

The program’s objectives have been developed to address the needs of the industrial engineering constituencies and to be consistent with and supportive of the department’s mission and programmatic goals. The IE program educational objectives represent and describe the expected accomplishments of graduates resulting from participation within the program within the first few years after graduation. The program’s objectives have been developed to address the needs of departmental constituencies and to be consistent with and support the mission and programmatic goals.

Within 3-5 years of graduation, graduates of the U of A undergraduate program in industrial engineering will have:

1. Successfully applied core industrial engineering knowledge and skills for industrial or public sector organizations.
2. Successfully pursued advanced professional degrees, graduate studies in industrial engineering, professional training, or engineering certification.
3. Demonstrated professional and intellectual growth as managers and leaders in industrial engineering, society, and their communities.

Requirements for B.S. in Industrial Engineering

The total graduation requirement in industrial engineering is 126 hours. For further information please visit the departmental website (http://www.ineg.uark.edu).

Humanities/Social Science Electives

Although any elective included on the approved University Core humanities/social science list may be selected, PSYC 2003 General Psychology (ACTS Equivalency = PSYC 1103) is recommended for industrial engineers.

Science Electives

The approved list of science electives is available in the industrial engineering departmental office.

Technical Electives

The purpose of technical electives is to provide students with the opportunity to expand their education within a particular area of interest. The approved list of technical electives is available in the industrial engineering department. At least 12 hours must be selected from INEG courses.

Each student is responsible for his or her technical elective program. Students may seek specific advice on technical elective selections from their adviser. Courses satisfying technical elective requirements cannot fulfill more than one industrial engineering degree requirement.

A minimum of 18 credit hours from the approved technical elective course list must be taken to satisfy technical elective requirements within the Industrial Engineering program. At least 12 of these 18 credit hours must be chosen from INEG courses. No more than 3 of these credits may be based in individual/independent study, no more than 3 of these credits may be based in honors thesis, and no more than 3 of these credits may be based in cooperative education.

Approved Technical Elective Course List

1. Any BENG, BIOL, BMEG, CHEG, CHEM, CVEG, CSCE, ELEG, GNEG, INEG, MATH, MEEG, and PHYS course that is at the 3000 level or above and not required for the B.S.I.E. is approved.

Exceptions are:
   a. GNEG 3801 is not approved.
   b. GNEG 3811 is approved only if the student has completed at least three semesters of GNEG 3811.
   c. CVEG 4513 is not approved if the student is also seeking technical elective credit for INEG 4443.
d. MATH 3013 and MATH 3133 are not approved.
e. PHYS 3603, PHYS 4103, and PHYS 4203 are not approved.

2. Courses at the 3000 level or above that are explicitly listed (not part of a blanket statement like “… 3000-to-4000-level …”) in the Catalog of Studies under Minors for Non-Business Students (http://catalog.uark.edu/undergraduatecatalog/collegesandschools/samwaltongeorgebusiness/minors) are approved. Exceptions are:
   a. ISYS 3393 is not approved if the student is also seeking technical elective credit for INEG 4683

3. Courses at the 3000 level or above that are explicitly listed on the Sustainability Minor Courses website (http://sustainability.uark.edu/academics/minor) under Natural, Managed, or Built Systems are approved.

4. Additional approved courses are CSCE 2014, EXSC 3153, and EXSC 3353.

Industrial Engineering B.S.I.E.
Eight-Semester Degree Program

The following section contains the list of courses required for the Bachelor of Science in Industrial Engineering degree and a suggested sequence. Not all courses are offered every semester, so students who deviate from the suggested sequence must pay careful attention to course scheduling and course prerequisites. Students wishing to follow the eight-semester degree plan should see the Eight-Semester Degree Policy (http://catalog.uark.edu/undergraduatecatalog/academicregulations/eightsemesterdegreecompletionpolicy) in the Academic Regulations chapter for university requirements of the program.

At least 12 hours of technical electives must be selected from INEG courses.

### First Year

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Fall</th>
<th>Units</th>
<th>Spring</th>
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</thead>
<tbody>
<tr>
<td>MATH 2554</td>
<td>Calculus I (ACTS Equivalency = MATH 2405)</td>
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<tr>
<td>CHEM 1103</td>
<td>University Chemistry I (ACTS Equivalency = CHEM 1414 Lecture)</td>
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<td>PHYS 2054</td>
<td>University Physics I (ACTS Equivalency = PHYS 2034)</td>
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<td>GNEG 1111</td>
<td>Introduction to Engineering I</td>
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<td>ENGL 1013</td>
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<td>Freshman Science Elective</td>
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<tr>
<td></td>
<td>HIST 2003 History of the American People to 1877 (ACTS Equivalency = HIST 2113)</td>
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<td>HIST 2013 History of the American People, 1877 to Present (ACTS Equivalency = HIST 2123)</td>
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<td>GNEG 1121 Introduction to Engineering II</td>
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<td>ENGL 1023 Composition II (ACTS Equivalency = ENGL 1023)</td>
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### Second Year

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<tr>
<td>INEG 2001</td>
<td>Industrial Engineering Seminar</td>
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<tr>
<td>INEG 2103</td>
<td>Introduction to Industrial Engineering</td>
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<td>INEG 2313</td>
<td>Applied Probability and Statistics for Engineers I</td>
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<td>INEG 2413</td>
<td>Engineering Economic Analysis</td>
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<td>MATH 2574</td>
<td>Calculus III (ACTS Equivalency = MATH 2603)</td>
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<td>INEG 2403</td>
<td>Industrial Cost Analysis</td>
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<td>INEG 2333</td>
<td>Applied Probability and Statistics for Engineers II</td>
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<td>MATH 2584</td>
<td>Elementary Differential Equations</td>
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<td>MEEG 2303</td>
<td>Introduction to Materials</td>
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<td>CSCE 2004</td>
<td>Programming Foundations I</td>
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### Third Year

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<tr>
<td>INEG 3623</td>
<td>Simulation</td>
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<td>ELEG 3903</td>
<td>Electric Circuits and Machines</td>
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<td>Fine Arts (from University/State Core List)</td>
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<td>Technical Elective 3</td>
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<td>INEG 3714</td>
<td>Work Methods and Ergonomics</td>
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<tr>
<td>INEG 3613</td>
<td>Introduction to Operations Research</td>
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<td>INEG 3513</td>
<td>Manufacturing Processes</td>
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<td>Selection one option from the following:</td>
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<td>ECON 2143 Basic Economics: Theory and Practice</td>
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<td>ECON 2013 Principles of Macroeconomics (ACTS Equivalency = ECON 2103) &amp; ECON 2023 Principles of Microeconomics (ACTS Equivalency = ECON 2203)</td>
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<td>Technical Elective</td>
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<td>MEEG 2003 Statics</td>
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<td><strong>Year Total:</strong></td>
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### Fourth Year

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<td>INEG 4433</td>
<td>Systems Engineering and Management</td>
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<td>INEG 4553</td>
<td>Production Planning and Control</td>
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<td></td>
<td>Two Technical Elective 3</td>
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<td>Social Science (from University/State Core List)</td>
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<td>INEG 4911</td>
<td>Industrial Engineering Capstone Experience I</td>
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<td>INEG 4923</td>
<td>Industrial Engineering Capstone Experience II</td>
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<td>Two Technical Electives 3</td>
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<td></td>
<td>Humanities (from University/State Core List)</td>
<td>3</td>
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<tr>
<td></td>
<td>Social Science (from University/State Core List)</td>
<td>3</td>
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<tr>
<td><strong>Year Total:</strong></td>
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<td>16</td>
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Total Units in Sequence: 126

1. CHEM 1123/CHEM 1121L University Chemistry II or PHYS 2074 University Physics II
2. If the student selected CHEM 1123/CHEM 1121L as their freshman science elective then this course must be PHYS 2074 University Physics II; otherwise see the approved list of IE science electives.
3. The purpose of technical electives is to provide students with the opportunity to expand their education along lines of particular interest to them. The approved list of technical electives is available in the industrial engineering department. At least 12 hours must be selected from INEG courses.
4. Although any elective included on the humanities/social science list may be selected, PSYC 2003 General Psychology is recommended for industrial engineers.
5. The approved list of science electives is available in the industrial engineering departmental office.

Minor in Data Analytics
Requirements for the minor in Data Analytics: The minor requires completion of 15-17 credits of coursework, including:

One course from Applied Statistics and Math Modeling group

- INEG 2333 Applied Probability and Statistics for Engineers II
- ELEG 3143 Probability & Stochastic Processes
- STAT 2023 Biostatistics
- STAT 3013 Introduction to Probability

Two courses from the Computing and Informatics group

- CSCE 2004 Programming Foundations I
- CSCE 2104 Programming Foundations II
- INEG 4833 Introduction to Database Concepts for Industrial Engineers
- ISYS 2263 Principles of Information Systems
- STAT 4003 Statistical Methods
- STAT 4003L Statistics Methods Laboratory

Two courses from the Analytics group

- ECON 4743 Introduction to Econometrics
- ECON 4753 Forecasting
- ISYS 4193 Business Analytics and Visualization
- ISYS 4293 Business Intelligence
- STAT 4333 Analysis of Categorical Responses

Total Hours: 15-17

Cassady, Richard, Ph.D., M.S.I.S.E., B.S.I.S.E. (Virginia Polytechnic Institute and State University), Professor, 2000.

Chaovalitwongse, Wanpracha Art, Ph.D., M.S. (University of Florida), B.Eng. (King Mongkut Institute of Technology, Ladrkrabang, Thailand), Professor, 2016.

Chimka, Justin Robert, Ph.D., M.S.I.E., B.S.I.E. (University of Pittsburgh), Associate Professor, 2002.


Geunes, Joseph Patrick, Ph.D., M.B.A. (Pennsylvania State University), B.S.E.E. (Drexel University), Professor, 2016.

Liao, Haitao, Ph.D., M.S., M.S.I.S.E. (Rutgers University), B.S.E.E. (Beijing Institute of Technology), Professor, 2015.

Liu, Xiao, Ph.D. (National University of Singapore), B.S.M.E. (Harbin Institute of Technology, China), Assistant Professor, 2017.

Milburn, Ashlea R., Ph.D. (Georgia Institute of Technology), M.S.I.E. (Virginia Polytechnic Institute and State University), B.S.I.E. (University of Arkansas), Assistant Professor, 2010.


Needy, Kim LaScola, Ph.D. (Wichita State University), P.E., M.S.I.E., B.S.I.E. (University of Pittsburgh), Professor, 2008.

Nurre, Sarah, Ph.D., M.Eng., B.S. (Rensselaer Polytechnic Institute), Assistant Professor, 2015.

Parnell, Gregory S., Ph.D. (Stanford University), M.S. (University of Southern California), M.I.S.E., B.S.M.E. (University of New York at Buffalo), Research Professor, 2013.

Pierson, Harry A., Ph.D. (The Ohio State University), M.S.E.M., B.S.M.E. (University of Missouri, Rolla), Assistant Professor, 2014.


Pohl, Letitia, Ph.D. (University of Arkansas), M.S.S.E. (Air Force Institute of Technology), B.S.M.E. (Tulane University), Clinical Assistant Professor, 2013.

Rainwater, Chase E., Ph.D. (University of Florida), B.S.I.E. (University of Arkansas), Associate Professor, 2009.

Rossetti, Manuel D., Ph.D., P.E., M.S.I.S. (The Ohio State University), B.S.I.E. (University of Cincinnati), Professor, 1999.

Sullivan, Kelly M., Ph.D. (University of Florida), M.S.I.E., B.S.I.E. (University of Arkansas), Assistant Professor, 2012.

White, John A., Ph.D. (The Ohio State University), M.S.I.E. (Virginia Polytech Institute and State University), B.S.I.E. (University of Arkansas), Distinguished Professor, 1997.

Zhang, Shengfan, Ph.D., M.I.E. (North Carolina State University), B.M. (Fudan University, Shanghai), Assistant Professor, 2011.

Courses
INEG 2001. Industrial Engineering Seminar. 1 Hour.
Overview of the Department of Industrial Engineering: faculty and their backgrounds and interests, staff and the services they provide, facilities, curricular requirements, extracurricular opportunities, post-graduate opportunities.

INEG 2103. Introduction to Industrial Engineering. 3 Hours.
Introduction to the technical content of industrial engineering and the use of computing in the solution of traditional industrial engineering problems. Computer tools include spreadsheets, programming, and mathematical analysis software. Corequisite: Lab component.

INES 2313. Applied Probability and Statistics for Engineers I. 3 Hours.
Applications to engineering problems of probability theory, discrete and continuous random variables, descriptive statistics, single-population point and interval estimation, single-population hypothesis testing, goodness-of-fit testing, and contingency table testing. Corequisite: Lab component. Prerequisite: MATH 2564.

INES 2313H. Honors Applied Probability and Statistics for Engineers I. 3 Hours.
Applications to engineering problems of probability theory, discrete and continuous random variables, descriptive statistics, single-population point and interval estimation, single-population hypothesis testing, goodness-of-fit testing, and contingency table testing. Corequisite: Lab component. Prerequisite: MATH 2564. This course is equivalent to INEG 2313.
INEG 2333. Applied Probability and Statistics for Engineers II. 3 Hours.
Applications to engineering problems of two-population point and interval estimation, two-population hypothesis testing, linear regression, correlation, design of experiments, analysis of variance, and nonparametric statistics. Introduction to statistical quality control. Prerequisite: INEG 2313.

INEG 2403. Industrial Cost Analysis. 3 Hours.
Use of accounting information for planning and control with emphasis on the engineering viewpoint; introduction to general accounting procedures; principles of cost accounting and other aspects of production costs; budgeting, depreciation, taxes, distribution of profits, securities, sources of corporate capital, interpretation of financial statements, and other related topics. Laboratory required. Corequisite: Lab component.

INEG 2413. Engineering Economic Analysis. 3 Hours.
Economic aspects of engineering, including current economic problems and the treatment of estimates when evaluating alternative courses of action. Methods of selection and replacement of equipment and break-even points of operation; desirability of new processes or projects where asset life, rate of return on investment, and first, fixed, differential, marginal, and sunk costs must be considered. Corequisite: Drill component. Prerequisite: MATH 2554.

INEG 2812H. Honors Industrial Engineering Research Experience I. 2 Hours.
Introduction to the research of the faculty of the Department of Industrial Engineering for the purpose of matching students with an undergraduate research advisor. Development of skills in using electronic resources to conduct background research on individuals and topics in the industrial engineering academic community. Prerequisite: Instructor consent and honors standing.

INEG 3513. Manufacturing Processes. 3 Hours.
This course focuses on the manufacturing processes that impart geometry and properties to engineering materials including casting, metalworking, machining, joining, heat treatment, and polymer processes. Process selection and analysis, design-for-manufacturing principles, cost estimation, and selection of process parameters are covered. Lab component covers communication of manufacturing specifications via engineering drawings. Prerequisite: MEEG 2303. Corequisite: Lab component.

INEG 3613. Introduction to Operations Research. 3 Hours.
Introduction to modeling and analysis of deterministic operations design and planning problems using formal optimization algorithms and software. Identification and formulation of appropriate applications, linear programming, sensitivity, network flows/transporation/assignment problems, shortest paths, and integer linear programming. Prerequisite: INEG 2103 and MATH 2574.

INEG 3623. 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. Corequisite: Drill component. Pre- or Corequisite: INEG 2333. Prerequisite: INEG 2413 and CSCE 2004.

INEG 3623H. Honors 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. Corequisite: INEG 2333 and drill component. Prerequisite: INEG 2413 and CSCE 2004. This course is equivalent to INEG 3623.

INEG 3714. Work Methods and Ergonomics. 4 Hours.
Ways of designing jobs, machines, operations and work environments so they are compatible with human capacities and limitations. Work methods topics include methods analysis, time studies, work sampling and learning curves. Cognitive and physical capabilities and limitations of humans are addressed through the study of human information processing, motor control theory, anthropometry, biomechanics, work physiology and manual material handling. Design of controls and displays, hand tools and workstations, along with work related musculoskeletal disorders. Laboratory required. Corequisite: Lab component. Pre- or Corequisite: INEG 2333.

INEG 3812H. Honors Industrial Engineering Research Experience II. 2 Hours.
Development of an undergraduate research proposal. Introduction to the peer review process. Examination of conference travel, nationally-competitive award, and graduate fellowships. Emphasis on technical communication skills. Prerequisite: INEG 2812H and honors standing.

INEG 400VH. Honors Thesis. 1-3 Hour.
For Honors College students majoring in Industrial Engineering only. Prerequisite: Honors college students only and instructor consent.

INEG 410V. Special Topics in Industrial Engineering. 1-3 Hour.
Consideration of current industrial engineering topics not covered in other courses. Prerequisite: Senior standing. May be repeated for up to 3 hours of degree credit.

INEG 410VH. Honors Special Topics in Industrial Engineering. 1-3 Hour.
Consideration of current industrial engineering topics not covered in other courses. Prerequisite: Senior standing. May be repeated for up to 3 hours of degree credit. This course is equivalent to INEG 410V.

INEG 411V. Individual Study in Industrial Engineering. 1-3 Hour.
Individual study and research on a topic mutually agreeable to the student and a faculty member. Prerequisite: Instructor consent.

INEG 411VH. Honors Individual Study in Industrial Engineering. 1-3 Hour.
Individual study and research on a topic mutually agreeable to the student and a faculty member. Prerequisite: Instructor consent and honors candidacy. This course is equivalent to INEG 411V.

INEG 4223. Occupational Safety and Health Standards. 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 4223H. Honors Occupational Safety and Health Standards. 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. This course is equivalent to INEG 4223.

INEG 4253. 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 4253 and INEG 5253/OMGT 5253. Prerequisite: Instructor consent.
INEG 4253H. Honors 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 4253 and INEG 5253/OMGT 5253. Prerequisite: Honors standing and instructor consent. This course is equivalent to INEG 4253.

INEG 4323. Quality Engineering and Management. 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.

INEG 4343. Cognitive Ergonomics. 3 Hours.
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 4383. Risk Analysis for Transportation and Logistics Systems. 3 Hours.
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. Prerequisite: INEG 2313 and INEG 4553.

INEG 4423. 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. Prerequisite: INEG 2413.

INEG 4423H. Honors 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. Prerequisite: INEG 2413. This course is equivalent to INEG 4423.

INEG 4433. 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. Prerequisite: INEG 2403.

INEG 4433H. Honors 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. Prerequisite: INEG 2403. This course is equivalent to INEG 4433.

INEG 4443. Project Management. 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 4443H. Honors Project Management. 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. This course is equivalent to INEG 4443.

INEG 4453. Productivity Improvement. 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. 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 4543. Facility Logistics. 3 Hours.
The design and analysis of efficient logistics systems at the facility level, with an emphasis on distribution facilities. Unit load, break bulk, crossdock and order fulfillment centers and their component systems and software. Automated and manual systems. Corequisite: Lab component. Prerequisite: INEG 2413 and INEG 3613.

INEG 4553. Production Planning and Control. 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 4563. 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; future trends. Significant out-of-class programming assignments to solve common industrial automation problems. Corequisite: Lab component. Prerequisite: Senior standing.

INEG 4583. Renewable Energy: Green Power Sources. 3 Hours.
Current developments in renewable energy from a green power source where electricity, heating and fuel supply can be obtained other than typical energy sources. Technical and economical feasibilities and economic analyses of renewable energy considered for use in residential, small businesses, and industrial complexes. Prerequisite: Senior standing.

INEG 4593. Manufacturing Systems. 3 Hours.
This course is designed to highlight the major topics in manufacturing systems. Different manufacturing models and metrics are emphasized. This course also introduces classification, general terminology, technical aspects, economics, and analysis of manufacturing systems. Corequisite: Lab component. Prerequisite: INEG 3513 or graduate standing.

INEG 4633. Transportation Logistics. 3 Hours.
Quantitative aspects of transportation and logistics involving analysis and optimization. Topics include: facility location analysis, network design, network flow and transportation modeling, vehicle routing, fleet sizing, driver assignment, and supply chain issues (logistics demand, role of inventory in the network, role of technology, etc.). Prerequisite: INEG 2333 and INEG 3613.
INEG 4683. Decision Support in Industrial Engineering. 3 Hours.
Reinforcing important computer programming methods using industrial engineering-based applications. Students will utilize Microsoft Excel and Visual Basic for Applications to develop custom solutions to challenging industrial engineering problems. Emphasis on computational proficiency and computing productivity in a spreadsheet-based setting. Prerequisite: CSCE 2004 and INEG 2313.

INEG 4733. Industrial Ergonomics. 3 Hours.
Gives 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 4812H. Honors Industrial Engineering Research Experience III. 2 Hours.
Completion of an undergraduate research thesis. Introduction to the identification of outlets for dissemination of industrial engineering research. Introduction to the process of identifying opportunities for future extensions of completed research. Prerequisite: INEG 3812H and honors standing.

INEG 4833. 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. Prerequisite: CSCE 2004.

INEG 4911. Industrial Engineering Capstone Experience I. 1 Hour.
Develop a written and oral proposal for a comprehensive project for an industrial sponsor. Conduct background research, data collection, and preliminary analysis using industrial engineering tools; define objectives, performance measures, and deliverables; identify and schedule required tasks. Pre- or Corequisite: INEG 2001, INEG 3613, INEG 3623, INEG 3714 or INEG 3723, INEG 4433, and INEG 4553.

INEG 4923. Industrial Engineering Capstone Experience II. 3 Hours.
Develop a written and oral report for a comprehensive project for an industrial sponsor. Complete identified tasks and measure success in achieving defined objectives using industrial engineering tools; create and document deliverables. Students must have successfully completed INEG 4911 in the immediately prior semester. Pre- or Corequisite: INEG 3513. Prerequisite: INEG 3613, INEG 3623, and INEG 4911.