INDUSTRIAL ENGINEERING (IE)

Subject-area course lists indicate courses currently active for offering at the University of Louisville. Not all courses are scheduled in any given academic term. For class offerings in a specific semester, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm).

500-level courses generally are included in both the undergraduate- and graduate-level course listings; however, specific course/section offerings may vary between semesters. Students are responsible for ensuring that they enroll in courses that are applicable to their particular academic programs.

Course Fees

Some courses may carry fees beyond the standard tuition costs to cover additional support or materials. Program-, subject- and course-specific fee information can be found on the Office of the Bursar website (http://louisville.edu/bursar/tuitionfee/).

IE 515. Operations Research Methods 3 Units
Term Typically Offered: Fall Only
Prerequisite(s): ENGR 330 or MATH 325.
Description: Formulation and solution of basic models in operations research. Topics to be covered include applications of linear and nonlinear programming; transportation and assignment problems, and network flows models.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 516. Stochastic Operations Research 3 Units
Term Typically Offered: Spring Only
Prerequisite(s): IE 360 or equivalent.
Description: A selection of the probabilistic topics of operations research are included: queuing, renewal and Markov processes, simulation, decision analysis.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 525. Project Management 3 Units
Term Typically Offered: Fall, Spring, Summer
Prerequisite(s): Admission in IE or EM program or instructor permission.
Description: Use of CPM, PERT, precedence diagramming, resource allocation heuristics, and other techniques for planning, managing, and controlling engineering projects involving research and development, production, maintenance, and construction. Computer procedures and codes for analyzing complex project networks will be covered.
Note: Cross-listed with EM 525.

For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 540. Robots and Manufacturing Automation 3 Units
Term Typically Offered: Fall, Spring, Summer
Prerequisite(s): IE 360.
Description: Computer aided manufacturing; robot programming, implementation, application, and computer control; research trends; social impacts.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 541. Simulation 3 Units
Term Typically Offered: Fall Only
Prerequisite(s): IE 240, IE 250, and IE 360.
Description: The use of discrete event simulation to analyze systems. Topics include Monte Carlo techniques, sampling from and identifying stochastic distributions, estimating performance measures from simulation outputs, validation methods, and SIMIO simulation language.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 560. Probability and Statistics for Engineers 3 Units
Term Typically Offered: Fall, Spring, Summer
Prerequisite(s): ENGR 102 OR (Calc I AND graduate status).
Description: Engineering applications using probability, random variables, distribution functions, confidence intervals, estimation and hypothesis testing.
Note: Students cannot receive credit for both IE 360 and IE 560.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 561. Developing Decision Support Systems with Excel 3 Units
Term Typically Offered: Fall, Spring
Prerequisite(s): IE 250.
Description: This course teaches the fundamentals of computer programming using Excel’s macro language, Visual Basic for Applications (VBA), as the language of instruction. The course starts by teaching students to simplify and extend code generated by Excel’s macro recorder and then builds on that base toward developing applications that analyze information and enhance decision making. This course also provides an introduction to the concepts and methods of Decision Science, which involves the application of mathematical modeling and analysis to management problems. It also provides a foundation for modeling with VBA in Excel.
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
<th>Term Typically Offered</th>
<th>Prerequisite(s)</th>
<th>Description</th>
<th>Note</th>
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<tbody>
<tr>
<td>IE 563</td>
<td>Experimental Design in Engineering</td>
<td>3</td>
<td>Spring, Summer</td>
<td>IE 360 OR IE 560</td>
<td>Design of engineering experiments and projects using theory of least squares, analysis of variance, randomized blocks, factorial experiments, nested designs, split plot designs and logistic regression techniques. Covers a combination of analysis by hand and using Minitab statistical software.</td>
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<tr>
<td>IE 580</td>
<td>Introduction to Human Factors Engineering and Ergonomics</td>
<td>3</td>
<td>Fall Only</td>
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<tr>
<td>IE 581</td>
<td>Advanced Topics in Human Factors Engineering</td>
<td>3</td>
<td>Fall, Spring, Summer</td>
<td>IE 580</td>
<td>The main goal of this course is to introduce students to the study of human cognitive and physical abilities and limitations, and application of that knowledge to engineering design. This course will demonstrate how the application of the human factors and ergonomics principles can improve the design of systems involving the interaction of humans with tools, technology, and the work environment.</td>
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<td>IE 585</td>
<td>Usability Engineering</td>
<td>3</td>
<td>Spring Only</td>
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<td>IE 590</td>
<td>Special Topics in Industrial Engineering</td>
<td>1-6</td>
<td>Fall, Spring, Summer</td>
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<td>A theoretical and/or experimental investigation of an industrial engineering design topic. For class offerings for a specific term, refer to the Schedule of Classes (<a href="http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm">http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm</a>)</td>
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<tr>
<td>IE 600</td>
<td>Additive Manufacturing Processes</td>
<td>3</td>
<td>Fall Only</td>
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<td>This course introduces students to additive manufacturing, also known as rapid prototyping or 3D printing, processes. An overview of all additive manufacturing processes is provided. Projects are used to develop in-depth knowledge in key applications of additive manufacturing. Design project gives students an opportunity to apply their knowledge to the design and/or re-design of a component. Students cannot receive credit for both IE 600 and IE 400. For class offerings for a specific term, refer to the Schedule of Classes (<a href="http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm">http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm</a>)</td>
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<td>IE 601</td>
<td>Additive Manufacturing Structure Design</td>
<td>3</td>
<td>Fall Only</td>
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<td>This course focuses on the overview of design issues in additive manufacturing (AM), including the design of structures, materials and processes. The students are expected to gain in-depth understanding of the design issues with current AM technologies. Hands-on projects will be assigned that gives the students the opportunity of understanding the design issues and applying the knowledge to the design of functional parts and assemblies. For class offerings for a specific term, refer to the Schedule of Classes (<a href="http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm">http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm</a>)</td>
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<tr>
<td>IE 602</td>
<td>Graduate Internship in Industrial Engineering</td>
<td>1</td>
<td>Pass/Fail</td>
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<td>Internship provides supervised professional experience in industry at the graduate level. Students will engage in a Community-Based Learning (CBL) project with an external partner in order to enhance understanding and application of academic content.</td>
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<tr>
<td>IE 600</td>
<td>Additive Manufacturing Processes</td>
<td>3</td>
<td>Fall Only</td>
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<td>IE 610</td>
<td>Foundations of Optimization I</td>
<td>3</td>
<td>Spring, Summer</td>
<td>IE 515</td>
<td>Formulation and solution of applicable optimization models for linear, integer, and network problems. Efficient algorithmic methods and use of computer modeling languages and systems. For class offerings for a specific term, refer to the Schedule of Classes (<a href="http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm">http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm</a>)</td>
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<tr>
<td>IE 611</td>
<td>Discrete Optimization</td>
<td>3</td>
<td>Spring, Summer</td>
<td>IE 515</td>
<td>A study of the techniques and applications of discrete optimization, especially as related to integer and dynamic programming. For class offerings for a specific term, refer to the Schedule of Classes (<a href="http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm">http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm</a>)</td>
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IE 614. Foundations of Optimization II  3 Units  
Prerequisite(s): ENGR 330 and IE 610.  
Description: Formulation and solution of applicable optimization models for nonlinear, stochastic programming, robust optimization and convex problems. Efficient algorithmic methods and use of computer modeling languages and systems.  
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 615. Exact and Heuristic Algorithms for Optimization  3 Units  
Term Typically Offered: Fall Odd Years  
Prerequisite(s): CSE 120 (or equivalent previous permission of the instructor) and IE 515 (or basic knowledge of linear programming, duality theory and integer programming).  
Description: This course is a survey of the most common search methods for optimization problems. We will focus on exact methods (including: Exhaustive Search, Branch and Bound, Column Generation, Decomposition methods), and on heuristic methods (including, Random search, Greedy Search, Local Search, Simulated Annealing (SA), Greedy Randomized Adaptive Search (GRASP), Genetic Algorithms (GA)). Both combinatorial and continuous optimization problems will be considered, with emphasis on combinatorics.  
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 621. Facility Location and Layout  3 Units  
Term Typically Offered: Fall Only  
Prerequisite(s): IE 240.  
Description: Design and layout of industrial facilities, facility location, space requirement, flow charts, relationships diagrams, material handling, quantitative layout techniques, production line balancing, and computer programs for layout planning.  
Note: Cross-listed with IE 421.  
Note: Students cannot receive credit for both IE 621 and IE 421.  
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 625. Production and Inventory Control  3 Units  
Term Typically Offered: Spring Only  
Prerequisite(s): IE 240 and IE 360.  
Description: Topics include the context of inventory management and production planning decisions, economic order quantities, heuristics and models for probabilistic and time-varying demand patterns, coordinated replenishment systems, and aggregate planning.  
Note: Students cannot receive credit for both IE 425 and IE 625.  
Note: Cross-listed with IE 425.  
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 629. Quality Control  3 Units  
Term Typically Offered: Spring Only  
Prerequisite(s): IE 240 and IE 360.  
Description: Developing an effective total quality control (TQC) system: integrating the quality development, maintenance, and improvement efforts of an organization; control charts, process capability, value engineering, product liability prevention, and computer control.  
Note: Students cannot receive credit for both IE 629 and IE 430.  
Note: Cross-listed with IE 430.  
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 630. Advanced Production Systems Design  3 Units  
Prerequisite(s): IE 421, IE 425, IE 430.  
Description: This course is organized around the principles of Lean Manufacturing Engineering. Topics include lean manufacturing, including value, value stream, flow, pull and continuous improvement. Improvement and efficiency are facilitated through a study of factory dynamics, the influence of variability, and "Push and Pull" production systems.  
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 631. Advanced Quality Control  3 Units  
Prerequisite(s): IE 425, IE 515, IE 541.  
Description: Advanced techniques for quality improvement and process control are investigated; these include advanced techniques of SPC, trouble shooting and diagnostics and Taguchi methods of experimental design.  
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 634. Case Studies in Production and Industrial Engineering  3 Units  
Prerequisite(s): IE 425, IE 515.  
Description: Case studies illustrate the application of industrial engineering techniques to the design of production systems, the control of construction projects, and health care delivery systems.  
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 640. Applied Systems Analysis  3 Units  
Prerequisite(s): IE 360, IE 370, IE 515.  
Description: Problem formulation, data collection, alternative design generation, design evaluation, specification, and implementation for large scale systems.  
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 642. Statistical Methodology in Simulation  3 Units  
Prerequisite(s): IE 360 and IE 541.  
Description: Discrete simulation modeling, input probability distributions, random variate generators, output data analysis, validation, variance reduction, experimental design and optimization.  
For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)
IE 643. Analysis for Decision Making
Prerequisite(s): IE 360 and IE 515.
Description: The role of decision analysis in design; techniques for multicriteria decision analysis; systematic creativity in design. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 650. Material Flow Systems Design
Prerequisite(s): IE 515.
Description: Material handling and equipment concepts; computerized plant layout; problem formulation; requirements definition; queuing; location analysis; conveyor theory; simulation; developing and evaluating alternative systems; systems implementation. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 655. Supply Chain Engineering
Term Typically Offered: Fall Only
Prerequisite(s): IE 425 or IE 625.
Description: This course is designed to offer a balanced coverage on concept survey, analytics and modeling for operations and engineering in supply chain and logistics systems. Emphasis will be on analysis of strategic, tactical and operational supply chain problems including inventory decisions, revenue operations & modeling, distribution & network design, supply contracts and coordination among supply chain partners. Other related topics to be covered include various critical concepts and strategies such as risk pooling, information sharing, and the role of information systems in supply chain engineering. Note: Students cannot receive credit for both IE 655 and IE 455.

IE 657. Models for Design and Analysis of Logistical Systems
Prerequisite(s): IE 425, IE 515.
Description: This modeling oriented course for the design, analysis and operation of logistical systems includes topics such as inventory control, transportation, distribution network design, and supply chain management. Both deterministic as well as stochastic models are studied. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 660. Reliability and Maintainability
Prerequisite(s): IE 360.
Description: Design, development, and test techniques required to assure the reliability and maintainability of new systems. Design of maintenance programs for new and existing systems. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 662. Predictive Analytics for Decision Making I
Term Typically Offered: Fall Only
Prerequisite(s): IE 560 (Probability and Statistics) or similar course.
Description: This course will prepare students with various predictive analytics methods for manufacturing, healthcare, etc., which will be illustrated in examples. Different data types from real-world examples will be shown. Subsequently, it will be demonstrated how the predictive analytics methods can be used for better decision making. The methods will be implemented in non-programming based standard software such as Matlab, Excel, and Minitab. Note: Students cannot receive credit for both IE 662 and IE 462.

IE 663. Predictive Analytics for Decision Making II
Term Typically Offered: Spring Only
Prerequisite(s): IE 462 or IE 662 or similar; Experience with Python; IE 560 (Prob&Stats) or similar course.
Description: This course provides an introduction to several classical and state-of-the-art machine learning methods and their applications for engineers. Fundamentals of linear model and shallow neural networks, multilayer perceptrons, and deep neural networks will be covered. Modern convolutional neural networks (CNN, including AlexNet, NiN, GoogleNet, ResNet, DenseNet), recurrent neural networks (RNN, including GRU, LSTM, Bi-LSTM, Transformer), and optimization techniques will be discussed with engineering examples implemented in Python. Note: Students cannot receive credit for both IE 663 and IE 463.

IE 665. Supply Chain Engineering
Term Typically Offered: Fall Only
Prerequisite(s): IE 425 or IE 625.
Description: This course is designed to offer a balanced coverage on concept survey, analytics and modeling for operations and engineering in supply chain and logistics systems. Emphasis will be on analysis of strategic, tactical and operational supply chain problems including inventory decisions, revenue operations & modeling, distribution & network design, supply contracts and coordination among supply chain partners. Other related topics to be covered include various critical concepts and strategies such as risk pooling, information sharing, and the role of information systems in supply chain engineering. Note: Students cannot receive credit for both IE 655 and IE 455.

IE 670. Advanced Engineering Economy
Prerequisite(s): IE 370.
Description: Inflation; cost of capital; revenue requirements; uncertainty and risk; propagation of errors; Hillier's results; simulation; capital budgeting. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm)

IE 682. Quality of Care and Patient Safety
Term Typically Offered: Fall Only
Description: This course provides students an overview of the healthcare system and the different types of healthcare delivery, as well as factors that determine quality of care. This course also exposes students to tenets of patient safety from a human factors engineering perspective. Students will learn models of patient safety and incident analysis tools, including Root Cause Analysis (RCA) and Healthcare Failure Mode and Effects Analysis (HFMEA). Note: Students cannot receive credit for both IE 682 and IE 482.
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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<th>Prerequisite(s)</th>
<th>Grading Basis</th>
<th>Description</th>
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</table>
| IE 684     | Health IT and Clinician Support                  | 3     |                                 |                     | **Term Typically Offered:** Spring Only  
**Description:** This course provides students an overview of various types of health information technology (IT) systems, as well as strategies, methods, and tools used to support the work and health of clinicians. This course also exposes students to applied tools and guidelines of the design and evaluation of health IT systems. Students will learn to use software to prototype high-fidelity, interactive user interfaces, and to conduct human factors evaluation on health IT systems based on the FDA guidelines. Documentation of such design and evaluation process will also be practiced with the semester project. **Note:** Students cannot receive credit for both IE 684 and IE 484. |
| IE 690     | Master of Science Thesis in Industrial Engineering| 1-6   | Department Chair permission      | Pass/Fail           | **Grading Basis:** Pass/Fail  
**Prerequisite(s):** Department Chair permission required.  
**Description:** Research on MS thesis project. Grade shall be deferred by the major professor until evaluation of the thesis by the student's committee. Grade on pass-fail basis by the examining committee. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm) |
| IE 693     | Independent Study in Industrial Engineering       | 1-12  |                                 |                     | **Description:** Opportunity for the student, under the supervision of a sponsoring faculty member, to pursue individualized study related to research or practice that is not included in regular courses in the curriculum. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm) |
| IE 694     | Advanced Topics in IE                            | 1-6   | Consent of instructor            |                     | **Prerequisite(s):** Consent of instructor.  
**Description:** An advanced course in Industrial Engineering topics not covered by regularly scheduled courses. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm) |
| IE 697     | MEng Thesis in Industrial Engineering            | 1-8   |                                 |                     | **Description:** A candidate for the Master of Engineering degree, specializing in the field of industrial engineering, is required to perform a study, design, or investigation under the direction of a faculty member. A written thesis is required to be presented orally and submitted to the faculty for approval. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm) |
| IE 699     | Industrial Engineering Master's Degree Project   | 3     | Instructor permission required   |                     | **Prerequisite(s):** Instructor permission required.  
**Description:** The Industrial Engineering MEng or MS student carries out an engineering project under the supervision of a faculty mentor, prepares an acceptable written report, and presents a seminar on the project. **Note:** Cross-listed with EM 699. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm) |
| IE 700     | Dissertation Research in Industrial Engineering  | 1-18  | Department Chair permission      | Pass/Fail           | **Grading Basis:** Pass/Fail  
**Prerequisite(s):** Department Chair permission required.  
**Description:** Research on dissertation project. Grade will be deferred by the major professor until evaluation of the dissertation by the student's committee. Graded on a Pass/Fail basis by the examining committee. For class offerings for a specific term, refer to the Schedule of Classes (http://htmlaccess.louisville.edu/classSchedule/setupSearchClassSchedule.cfm) |