INDUSTRIAL AND SYSTEMS ENGINEERING (I SY E)

I SY E 1 – COOPERATIVE EDUCATION PROGRAM
1 credit.

Work experience which combines classroom theory with practical knowledge of operations to provide students with a background upon which to base a professional career in industry.

Requisites: Sophomore standing
Course Designation: Workplace - Workplace Experience Course
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

Learning Outcomes:
1. Identify and respond appropriately to real-life engineering ethics cases relevant to co-op work
   Audience: Undergraduate
2. Synthesize and apply appropriate technical education to real world technical work
   Audience: Undergraduate
3. Communicate effectively in writing and speaking with a range of audiences in the workplace, including those without disciplinary expertise
   Audience: Undergraduate
4. Develop professional and transferable habits like time management skills, collaborative problem-solving skills, and research skills for learning new information
   Audience: Undergraduate

I SY E 191 – THE PRACTICE OF INDUSTRIAL ENGINEERING
2 credits.

An introduction to industrial engineering subject matter areas, problem types, and design/analysis approaches, techniques, and methodologies. Special emphasis on formulation and design alternatives for problem solving.

Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2024

Learning Outcomes:
1. Define and explain common industrial engineering terminology
   Audience: Undergraduate
2. Give examples of career opportunities in industrial engineering
   Audience: Undergraduate
3. List the focus areas in industrial engineering and give a brief explanation of how each area uses industrial engineering principles
   Audience: Undergraduate
4. Give examples of problems in each area of industrial engineering
   Audience: Undergraduate
5. Identify professional and academic development resources available to industrial engineering students
   Audience: Undergraduate
6. Investigate an open-ended industrial engineering problem and think critically about how to solve it
   Audience: Undergraduate
7. Analyze small datasets using Microsoft Excel
   Audience: Undergraduate
I SY E 210 — INTRODUCTION TO INDUSTRIAL STATISTICS
3 credits.

Introduction to basic probability and statistical tools and methods from an industrial application perspective. Random variables and probability distributions; descriptive statistics; point estimates. Perform hypothesis testing, construct confidence intervals, and understand design of experiments in the context of motivating case studies. Regression and correlation analysis. Focus on applying statistical methods and tools to solve engineering problems. Use of Microsoft Excel to interpret and analyze data.

Requisites: (MATH 211, 217, or 221) or member of Engineering Guest Students

Repeatable for Credit: No

Last Taught: Spring 2024

Learning Outcomes: 1. Articulate the importance of statistics in engineering applications
Audience: Undergraduate

2. Summarize and describe data using descriptive statistics and graphical methods
Audience: Undergraduate

3. Perform basic statistical analysis on datasets
Audience: Undergraduate

4. Design simple experiments with data for the purpose of statistical analysis
Audience: Undergraduate

5. Use Excel to describe, analyze, graph, and interpret data
Audience: Undergraduate

6. Apply linear and multiple regression techniques
Audience: Undergraduate

7. Apply experiment and analysis techniques to areas of engineering such as Statistical Process Control
Audience: Undergraduate

8. Apply basic probability concepts such as random variables, independence, and probability distributions
Audience: Undergraduate

I SY E 312 — DATA MANAGEMENT AND ANALYSIS FOR INDUSTRIAL ENGINEERS
3 credits.

Fundamentals of data management and analysis. Formulating and solving real industrial engineering problems with appropriate data managing and modeling strategies. Fundamental industrial database management strategies, data preprocessing, visualization and modeling techniques; industrial database management and analysis techniques using leading programming software (MySQL and R).

Requisites: (I SY E 210, ECE 331, MATH/STAT 309, STAT 311, or 324) or member of Engineering Guest Students

Repeatable for Credit: No

Last Taught: Spring 2024

Learning Outcomes: 1. Demonstrate knowledge of fundamental industrial database management strategies
Audience: Undergraduate

2. Apply data preprocessing, visualization, and modeling techniques
Audience: Undergraduate

3. Apply industrial database management techniques using structured query language (SQL)
Audience: Undergraduate

4. Use leading programming software to perform data regression analysis
Audience: Undergraduate

5. Create and solve a real-life industrial data analytics problem, and present results effectively to audience
Audience: Undergraduate

I SY E 313 — ENGINEERING ECONOMIC ANALYSIS
3 credits.

Financial accounting principles and cost systems, interpretation and use of accounting reports and supplemental information for engineering economic analyses, consideration of cost-volume-profit analyses, use of discounted cash flow techniques, flexible budgeting, transfer pricing, and capital budgeting.

Requisites: (MATH 217, 221, or concurrent enrollment), graduate/professional standing, or member of Engineering Guest Students

Repeatable for Credit: No

Last Taught: Spring 2024

Learning Outcomes: 1. Apply discounted cash-flow analysis to evaluate proposed capital investments
Audience: Undergraduate

2. Recognize, formulate, and analyze cash-flow models
Audience: Undergraduate

3. Explain model results to managers and other non-specialist decision makers
Audience: Undergraduate
I SY E 315 – PRODUCTION PLANNING AND CONTROL
3 credits.
Techniques and applications of control concepts in the design of inventory, production, quality, and project-planning systems; use of the computer as a component in such systems.

Requisites: (I SY E 210, E C E 331, MATH/STAT 309, STAT 311, 324, 371, MATH/STAT 431, 531, or concurrent enrollment), graduate/professional standing, or member of Engineering Guest Students

Repeatable for Credit: No
Last Taught: Spring 2024

Learning Outcomes:
1. Describe and apply fundamental principles and methodologies relevant to planning, design, operation, and control of production planning and control systems
   Audience: Undergraduate

2. Describe and explain how organizational strategy drives operations management approaches and supply chain decisions
   Audience: Undergraduate

3. Develop a portfolio of analytical tools and skills related to production planning and control and operations management
   Audience: Undergraduate

4. Recognize situations in production system environments that suggest the use of appropriate quantitative methods to assist in decision-making
   Audience: Undergraduate

5. Apply skills and tools to reduce waste and to increase productivity and quality in manufacturing and service organizations
   Audience: Undergraduate

I SY E 320 – SIMULATION AND PROBABILISTIC MODELING
3 credits.

Requisites: (MATH/STAT 309, STAT 311, MATH/STAT 431, 531 or concurrent enrollment) and (I SY E 210, E C E 331, STAT/MATH 310, STAT 312, 324, 371, or concurrent enrollment) and (MATH 320, 340, or concurrent enrollment), or member of Engineering Guest Students

Repeatable for Credit: No
Last Taught: Spring 2024

Learning Outcomes:
1. Apply knowledge of math, science, and engineering principles to model real stochastic systems
   Audience: Undergraduate

2. Identify, formulate, and solve problems using appropriate data analytic and simulation approaches
   Audience: Undergraduate

3. Understand and apply probabilistic modeling techniques such as Markov Chains and queueing theory to study stochastic systems
   Audience: Undergraduate

4. Apply statistical methods to analyze stochastic behaviors of the systems
   Audience: Undergraduate

5. Apply simulation software to model the process and evaluate performance measures of the systems
   Audience: Undergraduate
I SYE 321 — SIMULATION MODELING LABORATORY  
1 credit.

Computer exercises involving generation and analysis of random variables, spreadsheet models of queuing systems, use of simulation software packages. Project.  
**Requisites:** Concurrent enrollment in I SYE 320  
**Repeatable for Credit:** No  
**Last Taught:** Spring 2024  
**Learning Outcomes:** 1. Apply knowledge of math, science, and engineering principles to model real stochastic systems  
Audience: Undergraduate  
2. Identify, formulate, and solve problems using appropriate data analytic and simulation approaches  
Audience: Undergraduate  
3. Understand and apply probabilistic modeling techniques such as Markov Chains and queuing theory to study stochastic systems  
Audience: Undergraduate  
4. Apply statistical methods to analyze stochastic behaviors of the systems  
Audience: Undergraduate  
5. Apply simulation software to model the process and evaluate performance measures of the systems  
Audience: Undergraduate  

I SYE 323 — OPERATIONS RESEARCH-DETERMINISTIC MODELING  
3 credits.

Basic techniques for modeling and optimizing deterministic systems with emphasis on linear programming. Computer solution of optimization problems. Applications to production, logistics, and service systems.  
**Requisites:** MATH 222 and (MATH 340, 341 or 375), or member of Engineering Guest Students  
**Repeatable for Credit:** No  
**Last Taught:** Spring 2024  
**Learning Outcomes:** 1. Write an algebraic formulation of an optimization model that captures the main decision elements of practical problems  
Audience: Undergraduate  
2. Use an algebraic modeling language to solve an optimization model  
Audience: Undergraduate  
3. Model logical constraints using binary decision variables  
Audience: Undergraduate  
4. Understand the basic ideas behind algorithms for solving linear programming and discrete optimization problems  
Audience: Undergraduate  

I SYE 348 — INTRODUCTION TO HUMAN FACTORS ENGINEERING LABORATORY  
1 credit.

Hands on experience applying concepts discussed in I SYE/PSYCH 349. Complete a small three-part design project. Learn how to measure light, sound, anthropometric, and psychophysiological data, and then apply these measurements to product and workplace design challenges.  
**Requisites:** Declared in Industrial Engineering and concurrent enrollment in I SYE/PSYCH 349, or member of Engineering Guest Students  
**Repeatable for Credit:** No  
**Last Taught:** Spring 2024  
**Learning Outcomes:** 1. Recognize the strengths and limits of human perceptual, cognitive and physical abilities and their implications for system design  
Audience: Undergraduate  
2. Describe human factors tools, techniques and methods commonly used to design and improve system performance  
Audience: Undergraduate  
3. Evaluate and recommend work and task designs based on human factors and ergonomic principle  
Audience: Undergraduate  
4. Define the ethical application of human factors in designing products and processes  
Audience: Undergraduate
**I SY E/PSYCH 349 — INTRODUCTION TO HUMAN FACTORS**  
3 credits.

Conveys the importance of considering human capabilities and limits in system design and operation. This includes understanding human characteristics from the cognitive, physical, and psychosocial perspectives. Implications of these characteristics are explored through understanding the needs of people, designing to support these needs, and evaluating systems to ensure they serve the intended purpose. Case studies are used to identify the human role in accidents and to identify design improvements. Application domains include consumer product design, human–computer interaction, workplace safety, and complex systems such as healthcare delivery.

**Requisites:** (I SY E 210, E C E 331, MATH/STAT 309, 431, STAT 311, 324, 371, MATH 531, PSYCH 210, or C&E SOC/SOC 360, or concurrent registration), graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req  
Level - Intermediate  
L&S Credit - Counts as Liberal Arts and Science credit in L&S

**Repeatable for Credit:** No  
**Last Taught:** Spring 2024  

**Learning Outcomes:**  
1. Recognize the strengths and limits of human perceptual, cognitive and physical abilities and their implications for system design  
   Audience: Undergraduate  
2. Describe human factors tools, techniques and methods commonly used to design and improve system performance  
   Audience: Undergraduate  
3. Evaluate and recommend work and task designs based on human factors and ergonomic principles  
   Audience: Undergraduate  
4. Define the ethical application of human factors in designing products and processes  
   Audience: Undergraduate

**I SY E 350 — INDUSTRIAL ENGINEERING DESIGN I**  
3 credits.

Introduction to the tools needed for advanced design courses through experiential learning and hands-on opportunities to conduct experiments, take relevant measurements, analyze real-world data, design systems, and to make and test prototypes of designs.

**Requisites:** Declared in Industrial Engineering, (COMP SCI 200, 220, 300, 301, 302, or placement into COMP SCI 300), (I SY E 210, MATH/STAT 309, 431, MATH 531, STAT 311 or 324) and I SY E 315

**Repeatable for Credit:** No  
**Last Taught:** Spring 2024  

**Learning Outcomes:**  
1. Apply basic industrial engineering design methods  
   Audience: Undergraduate  
2. Use appropriate industrial and systems engineering design tools for establishing solutions to open-ended problems  
   Audience: Undergraduate  
3. Select the appropriate methods to utilize in order to collect real-world data  
   Audience: Undergraduate  
4. Observe and collect data relevant to an industrial engineering problem  
   Audience: Undergraduate

**I SY E 389 — HONORS IN RESEARCH**  
1-3 credits.

Undergraduate honors research projects supervised by faculty members.

**Requisites:** Declared in Industrial Engineering Honors in Research  
**Course Designation:** Honors - Honors Only Courses (H)  
**Repeatable for Credit:** Yes, unlimited number of completions  
**Last Taught:** Spring 2013

**Learning Outcomes:**  
1. Conduct and report on independent industrial engineering research  
   Audience: Undergraduate  
2. Independently develop industrial engineering research questions  
   Audience: Undergraduate  
3. Appropriately utilize online and library resources  
   Audience: Undergraduate
I SY E 412 — FUNDAMENTALS OF INDUSTRIAL DATA ANALYTICS
3 credits.
Provides an understanding of the fundamentals of using data analytics to make data-driven decisions. Emphasizes applying techniques to industrial engineering problems. Focuses on formulating and solving real industrial problems with the appropriate modeling strategies and analytics principles for better decision making.

Requisites: (I SY E 210, E C E 331, STAT 311, 324, MATH/STAT 309, 431, or MATH 531), graduate/professional standing, or member of Engineering Guest Students

Repeatable for Credit: No

Last Taught: Spring 2024

Learning Outcomes:
1. Apply fundamental knowledge of industrial data analytics concepts, problems, and techniques
   Audience: Undergraduate
2. Integrate data analytics techniques with industrial and systems engineering domain knowledge to appropriately formulate problem statements and facilitate decision making
   Audience: Undergraduate
3. Implement software programming skills to perform data analysis
   Audience: Undergraduate
4. Apply industrial data analytics methods and tools to solve real-world industrial engineering problems
   Audience: Undergraduate

I SY E 415 — INTRODUCTION TO MANUFACTURING SYSTEMS, DESIGN AND ANALYSIS
3 credits.
Introduction to the technologies, processes and systems of modern discrete part manufacturing. Emphasis on development of an understanding of the behavior of integrated systems.

Requisites: I SY E 315 or member of Engineering Guest Students

Repeatable for Credit: No

Last Taught: Spring 2024

Learning Outcomes:
1. Distinguish advantages and disadvantages for a range of manufacturing processes
   Audience: Undergraduate
2. Select an appropriate manufacturing process when given information such as part design, material, and production quantity
   Audience: Undergraduate
3. Use terminology that relates to manufacturing systems design and analysis
   Audience: Undergraduate
4. Examine manufacturing system performance by applying analytical techniques such as line balancing, manufacturing system benchmarking, inventory models, and queuing formulas
   Audience: Undergraduate
5. Utilize computer-aided design and manufacturing software to display part geometry and create toolpaths for a CNC program
   Audience: Undergraduate

I SY E 417 — HEALTH SYSTEMS ENGINEERING
3 credits.
Introduction to the application of industrial engineering methods to the analysis and improvement of health care delivery. Exploration of common problems of decision making and control in health care. Examination of social, regulatory and economic factors unique to health care.

Requisites: I SY E 320 and 349, graduate/professional standing, or member of Engineering Guest Students, or declared in Clinical and Community Outcomes Capstone Certificate

Repeatable for Credit: No

Last Taught: Spring 2024
I SY E/COMP SCI/MATH 425 – INTRODUCTION TO COMBINATORIAL OPTIMIZATION
3 credits.

Focuses on optimization problems over discrete structures, such as shortest paths, spanning trees, flows, matchings, and the traveling salesman problem. We will investigate structural properties of these problems, and we will study both exact methods for their solution, and approximation algorithms.

Requisites: (MATH 320, 340, 341, or 375) or graduate/professional standing or member of the Pre-Masters Mathematics (Visiting International) Program

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No
Last Taught: Fall 2023

Learning Outcomes:
1. Identify and use the structural properties of combinatorial optimization problems
   Audience: Undergraduate
2. Apply algorithms for the solution -exact or approximate- of a combinatorial optimization problem
   Audience: Undergraduate
3. Explain why the algorithms studied are correct and understand their running time
   Audience: Undergraduate

I SY E 450 – INDUSTRIAL ENGINEERING DESIGN II
3 credits.

Team-based project experience to address a real-world design challenge posed by an external organization. Collaboration with the project client to design a new system or process, or redesign an existing one, by integrating and applying appropriate Industrial and Systems Engineering knowledge, methodologies and tools for problem definition and analysis; idea generation; solution development, evaluation and justification; and implementation planning and impact assessment.

Requisites: Senior standing only, I SY E 313, 320, 323, 350, and PSYCH/ I SY E 349
Repeatable for Credit: No
Last Taught: Spring 2024

Learning Outcomes:
1. Employ design thinking, and engage the client in the creative process for problem space exploration and idea generation
   Audience: Undergraduate
2. Utilize a structured modeling, analysis and decision making framework to design a new system or process, or redesign an existing one
   Audience: Undergraduate
3. Choose, synthesize and effectively utilize appropriate ISyE methods, concepts, engineering standards, and modeling and analysis tools in all facets of the project lifecycle
   Audience: Undergraduate
4. Adjust and be flexible with design strategy and adapt it suitably to address unanticipated issues during project execution
   Audience: Undergraduate
5. Hone skills in teamwork, oral and written communication, and project management
   Audience: Undergraduate
I SY E 468 – INTRODUCTION TO INDUSTRIAL ENGINEERING RESEARCH
1 credit.

An introduction to the practice of conducting research in industrial engineering, literature reviews, identifying gaps in existing work, writing a research proposal.

Requisites: Consent of instructor
Course Designation: Honors - Honors Only Courses (H)
Repeatable for Credit: No
Last Taught: Spring 2023
Learning Outcomes: 1. Conduct a literature review
Audience: Undergraduate
2. Identify gaps in existing research
Audience: Undergraduate
3. Describe characteristics of a good research question
Audience: Undergraduate
4. Write a proposal to address an open research question
Audience: Undergraduate
5. Describe some current active research areas in industrial engineering
Audience: Undergraduate

I SY E 476 – INDUSTRIAL ENGINEERING PROJECTS
3 credits.

Complete design of an industrial engineering system in a real world setting, e.g., manufacturing, hospital, communications, food processing, distribution, transportation, etc.

Requisites: I SY E 320, 349, and INTEREGR 397 (formerly E P D 397)
Repeatable for Credit: No
Last Taught: Spring 2015

I SY E 478 – RESEARCH AND BEYOND IN INDUSTRIAL ENGINEERING
1 credit.

An introduction of skills required for successful research in graduate school. Preparing for graduate thesis writing, applying for graduate school, presenting research in a variety of ways. How to foster mental health and work-life balance.

Requisites: I SY E 468
Course Designation: Honors - Honors Only Courses (H)
Repeatable for Credit: No
Last Taught: Fall 2023
Learning Outcomes: 1. Prepare materials for graduate program applications, such as a personal statement
Audience: Undergraduate
2. List key elements of research ethics and common pitfalls in different types of research
Audience: Undergraduate
3. Make a poster summarizing completed and/or in-progress work
Audience: Undergraduate
4. Give a technical presentation summarizing completed and/or in-progress work
Audience: Undergraduate
5. Critique technical research presentations
Audience: Undergraduate
6. List strategies for maintaining healthy work-life balance in graduate school
Audience: Undergraduate

I SY E 489 – HONORS IN RESEARCH
1-3 credits.

Undergraduate honors research projects supervised by faculty members.

Requisites: Declared in Industrial Engineering Honors in Research
Course Designation: Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2023
Learning Outcomes: 1. Conduct and report on independent industrial engineering research
Audience: Undergraduate
2. Independently develop industrial engineering research questions
Audience: Undergraduate
3. Appropriately utilize online and library resources
Audience: Undergraduate
**I SY E/M E 510 – FACILITIES PLANNING**  
3 credits.

Introduction to plant location theory and analysis of models of plant location; models for determining plant size and time phasing; line balancing models; techniques for investigating conveyor and other material handling problems; and models of plant layout.  
**Requisites:** I SY E 315, (I SY E 323 or E C E/COMP SCI/I SY E 524) and I SY E/PSYCH 349, or graduate/professional standing, or member of Engineering Guest Students  
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement  
**Repeatable for Credit:** No  
**Last Taught:** Fall 2023  
**Learning Outcomes:** 1. Identify, formulate, and solve facilities layout problems by applying principles of engineering and mathematics  
Audience: Both Grad & Undergrad  
2. Apply engineering design to produce facilities design solutions that meet specified needs with consideration of productivity, safety, and economic factors  
Audience: Both Grad & Undergrad  
3. Utilize computer software to study and illustrate the operation of a manufacturing system  
Audience: Both Grad & Undergrad  
4. Collaborate with a team to develop solutions to engineering problems and communicate findings effectively  
Audience: Both Grad & Undergrad  
5. Demonstrate ability to lead a facilities planning project integrating quantitative techniques and management tools  
Audience: Graduate

**I SY E/M E 512 – INSPECTION, QUALITY CONTROL AND RELIABILITY**  
3 credits.

Inspection data for quality control; sampling plans for acceptance inspection; charts for process control. Introduction to reliability models and acceptance testing.  
**Requisites:** (STAT/MATH 309, STAT 311, 224, 324, or STAT/MATH 431), graduate/professional standing, or member of Engineering Guest Students  
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement  
**Repeatable for Credit:** No  
**Last Taught:** Spring 2024  
**Learning Outcomes:** 1. Apply statistical process control analysis for measuring and controlling quality  
Audience: Undergraduate  
2. Recognize, formulate, and analyze univariate continuous and discrete control charts  
Audience: Undergraduate  
3. Use Minitab to perform basic statistical process control analysis  
Audience: Undergraduate  
4. Communicate the results of the statistical process control analysis to management and other non-specialist users of engineering analyses  
Audience: Undergraduate  
5. Recognize, formulate, and analyze advanced continuous control charts  
Audience: Graduate  
6. Perform process capability and measurement system capability analysis  
Audience: Graduate
I SY E 515 – ENGINEERING MANAGEMENT OF CONTINUOUS PROCESS IMPROVEMENT
3 credits.

Addresses the role of the industrial engineer as a "manager" of continuous improvement in design and production processes. Provides modern tools and techniques for planning and managing team projects, integrating the concepts of total quality, data based decision making, and resource management.

**Requisites:** Senior standing and INTEREGR 397 (formerly E P D 397) or concurrent enrollment, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2022

**Learning Outcomes:**
1. Describe and explain the nature of and tools for change management and continual process improvement
   Audience: Both Grad & Undergrad
2. Experience the role of the industrial and systems engineer as a "manager" of continual process improvement
   Audience: Both Grad & Undergrad
3. Work effectively on a team-based experiential project focused on process design, analysis, and resource management and integrating the concepts of continual improvement, customer focus, and teamwork
   Audience: Both Grad & Undergrad
4. Implement technical skills and processes, often with a non-technical workforce
   Audience: Both Grad & Undergrad
5. Apply problem solving and management/planning tools for effectively defining problems, feasible alternative solutions, and measurable goals in a "real world" environment
   Audience: Both Grad & Undergrad
6. Identify the impact of organizational and cultural influences on the planning and implementation of change
   Audience: Both Grad & Undergrad
7. Demonstrate ability to lead an industry-based team project integrating contemporary change management frameworks and considering organizational culture
   Audience: Graduate

I SY E 516 – INTRODUCTION TO DECISION ANALYSIS
3 credits.

Overview of modeling techniques and methods used in decision analysis, including multiattribute utility models, decision trees, and Bayesian models. Psychological components of decision making are discussed. Elicitation techniques for model building are emphasized. Practical applications through real world model building are described and conducted.

**Requisites:** (STAT/MATH 309, STAT 311, or STAT/MATH 431), graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2022

**Learning Outcomes:**
1. Recognize the types of problems that decision analysis can and cannot solve
   Audience: Both Grad & Undergrad
2. Structure decision problems by identifying the relevant values, objectives, attributes, decisions, uncertainties, consequences, and trade-offs
   Audience: Both Grad & Undergrad
3. Represent aspects of a decision problem graphically or mathematically
   Audience: Both Grad & Undergrad
4. Determine the optimal decision, using mathematical techniques as appropriate
   Audience: Both Grad & Undergrad
5. Identify which parameters have the most impact on the result
   Audience: Both Grad & Undergrad
6. Explain the results of a decision analysis to managers and other non-specialists
   Audience: Both Grad & Undergrad
7. Articulate mathematical foundations of decision problems
   Audience: Graduate
I SY E 517 — DECISION MAKING IN HEALTH CARE
3 credits.

Introduction to the use of decision sciences in health-care. Conceptual understanding of medical decision making and its tools including decision trees, sensitivity analysis, Markov (decision) processes, and Monte Carlo simulations with examples from the current medical literature.

Requisites: (STAT/MATH 309, STAT 311, or STAT/MATH 431) and (I SY E 323 or E C E/COMP SCI/I SY E 524), or graduate/professional standing, or member of Engineering Guest Students

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2023

Learning Outcomes: 1. Explain how decision sciences are used in the health-care industry
   Audience: Both Grad & Undergrad

2. Describe concepts related to medical decision making and cost-effectiveness analysis
   Audience: Both Grad & Undergrad

3. Apply technical skills in decision analysis including the creation and evaluation of decision trees, the use of sensitivity analysis, and the use of Markov processes and Monte Carlo simulation
   Audience: Both Grad & Undergrad

4. Incorporate specific patient preferences into medical decision models through the use of utility analysis
   Audience: Both Grad & Undergrad

5. Identify and apply an advanced decision analytical modeling framework to solve medical decision making problems
   Audience: Graduate

I SY E/COMP SCI/DS 518 — WEARABLE TECHNOLOGY
3 credits.

Gives students hands-on experience in building wearable computing platforms. Designed for students who have a background in textiles and apparel design, computer science, engineering or media arts. By the completion of the course students will have fundamental knowledge of electronic circuitry, programming, and "maker skills".

Requisites: Sophomore standing

Course Designation: Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2022

I SY E 520 — QUALITY ASSURANCE SYSTEMS
3 credits.

Introduces engineers to applications of total quality concepts and tools to develop, implement, and maintain an effective quality assurance system in a manufacturing or service organization. Emphasis is on documentation development, team-based improvement strategies, and international quality standards.

Requisites: Junior standing and I SY E 315, or graduate/professional standing, or member of Engineering Guest Students

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2023

Learning Outcomes: 1. Describe and apply the basic elements of quality and environmental management systems, including the requirements and certification process of international standards such as ISO 9001 and ISO 14001 and industry-specific applications of these standards
   Audience: Both Grad & Undergrad

2. Apply concepts and tools in the development, implementation, and maintenance of effective quality and environmental management systems in manufacturing and service organizations, including various approaches for management system documentation structure
   Audience: Both Grad & Undergrad

3. Describe and explain strategic and competitive considerations in management system implementation and maintenance, including risk-based thinking and continual improvement
   Audience: Both Grad & Undergrad

4. Develop and apply auditing techniques and skills
   Audience: Both Grad & Undergrad

5. Demonstrate ability to synthesize and apply requirements for quality and environmental management considering organizational strategy, culture and constraints
   Audience: Graduate
I SY E 521 – MACHINE LEARNING IN ACTION FOR INDUSTRIAL ENGINEERS
3 credits.

Principles, algorithms, and industrial engineering applications of machine learning. Predictive analytics, with a focus on combining data and models to improve decision-making. Methods include: statistics, linear regression, logistic regression, regularization, over-fitting, clustering, classification and regression trees, boosting, bagging, deep learning, and neural networks. Applications areas include: healthcare, transportation, and the public sector.

Requisites: (COMP SCI 200, 220, or placement into COMP SCI 300), (I SY E 323 or I SY E/COMP SCI/E C E 524), and (I SY E 210, STAT 311, 324, STAT/MATH 309, or 431), graduate/professional standing, or member of Engineering Guest Students

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2023

Learning Outcomes:
1. Identify problems amenable to machine learning and the techniques required to solve those problems (regression vs. classification, regularization, bagging vs. boosting, etc.)
   Audience: Both Grad & Undergrad

2. Apply appropriate analytical models to solve problems and improve decision-making using Python
   Audience: Both Grad & Undergrad

3. Effectively communicate findings through both oral and written formats
   Audience: Both Grad & Undergrad

4. Demonstrate an understanding of how industrial engineering techniques (e.g., optimization) are used to train machine learning models
   Audience: Graduate

I SY E/COMP SCI/E C E 524 – INTRODUCTION TO OPTIMIZATION
3 credits.

Introduction to mathematical optimization from a modeling and solution perspective. Formulation of applications as discrete and continuous optimization problems and equilibrium models. Survey and appropriate usage of basic algorithms, data and software tools, including modeling languages and subroutine libraries.

Requisites: (COMP SCI 200, 220, 300, 301, 302, 310, or placement into COMP SCI 300) and (MATH 320, 340, 341, or 375) or graduate/professional standing

Course Designation: Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2024

Learning Outcomes:
1. Engage in topics about "optimization in practice".
   Audience: Undergraduate

2. Use and analyze the results of state of the art optimization software.
   Audience: Undergraduate

3. Use the GAMS modeling system and Jupyter notebooks (in conjunction with elementary Python) or Julia and JUMP.
   Audience: Undergraduate

4. Design good models for realistic applications in engineering and the sciences.
   Audience: Undergraduate

5. Develop a "commercial strength" application of optimization technology.
   Audience: Undergraduate
**I SY E/COMP SCI/MATH/STAT 525 – LINEAR OPTIMIZATION**

3 credits.

Introduces optimization problems whose constraints are expressed by linear inequalities. Develops geometric and algebraic insights into the structure of the problem, with an emphasis on formal proofs. Presents the theory behind the simplex method, the main algorithm used to solve linear optimization problems. Explores duality theory and theorems of the alternatives.

**Requisites:** MATH 320, 340, 341, 375, or 443 or graduate/professional standing or member of the Pre-Masters Mathematics (Visiting International) Program

**Course Designation:** Breadth - Natural Science

**Level:** Advanced

**L&S Credit:** Counts as Liberal Arts and Science credit in L&S

**Grad 50%:** Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

**Learning Outcomes:**

1. Use linear programming to formulate real-world decision problems.
   
   Audience: Both Grad & Undergrad

2. Apply algorithms to solve linear programming problems and demonstrate their correctness.
   
   Audience: Both Grad & Undergrad

3. Combine different proving techniques explored in class in an original way to show new results.
   
   Audience: Graduate

**I SY E/COMP SCI 526 – ADVANCED LINEAR PROGRAMMING**

3 credits.


**Requisites:** STAT/COMP SCI/I SY E/MATH 525 and (COMP SCI 200, 220, 300, 301, 302, 310, or placement into COMP SCI 300) or graduate/professional standing

**Course Designation:** Level - Advanced

**L&S Credit:** Counts as Liberal Arts and Science credit in L&S

**Repeatable for Credit:** No

**Last Taught:** Spring 2020

**Learning Outcomes:**

1. Use the theory of linear programming to prove general duality results
   
   Audience: Undergraduate

2. Apply the concept of complementarity
   
   Audience: Undergraduate

3. Analyze and develop algorithms for solving optimization and equilibrium problems
   
   Audience: Undergraduate

4. Apply decomposition methods and other advanced algorithms for the solution of optimization and equilibrium problems
   
   Audience: Undergraduate

5. Understand economic concepts and how they relate to optimization and equilibria
   
   Audience: Undergraduate

6. Extend theory of linear programming into the framework of conic programming
   
   Audience: Undergraduate
ISYE/PSYCH 549 – HUMAN FACTORS ENGINEERING
3 credits.
Analysis and design of man-machine systems using human performance models and data. Emphasis on systems involving communication and control. Projects using digital and analog computer simulation techniques for system design.
**Requisites:** ISYE/PSYCH 349, graduate/professional standing, or member of Engineering Guest Students
**Course Designation:** Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Fall 2023
**Learning Outcomes:**
1. Explain the topics involved in cognitive human factors and design implications of these concepts
   Audience: Both Grad & Undergrad
2. Describe the interactions between human operators and system components including the environment, technology, and organizations
   Audience: Both Grad & Undergrad
3. Discuss different human factors perspectives regarding human error and limitations of human performance, especially as these relate to memory, decision-making, action selection, and workload and stress
   Audience: Both Grad & Undergrad
4. Identify barriers and limitations to memory and how these must be accounted for in design of systems and displays
   Audience: Both Grad & Undergrad
5. Articulate the role of simulation and modeling in system design involving human operators
   Audience: Both Grad & Undergrad
6. Use cognitive engineering analysis methods to complete a detailed analysis of a real incident or accident including outlining each layer and component of system failure and proposing possible redesign solutions
   Audience: Graduate

ISYE 552 – HUMAN FACTORS ENGINEERING DESIGN AND EVALUATION
3 credits.
**Requisites:** ISYE/PSYCH 349 and INTEREGR 397 (formerly E P D 397) or concurrent enrollment or graduate/professional standing, or member of Engineering Guest Students
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement
**Repeatable for Credit:** No
**Last Taught:** Spring 2020
**Learning Outcomes:**
1. Apply observation and interview skills to understand customer needs and system interactions
   Audience: Both Grad & Undergrad
2. Translate observation and interview data into models of customer requirements and system constraints
   Audience: Both Grad & Undergrad
3. Communicate model content to the customer and to marketing, engineering, management, and other members of the design team
   Audience: Both Grad & Undergrad
4. Translate work models into aesthetically appealing and functional design concepts and prototypes
   Audience: Both Grad & Undergrad
5. Evaluate and iterate prototype designs into a system that satisfies customer requirements
   Audience: Both Grad & Undergrad
6. Design a user study to resolve a design issue, such as the choice of opt-in or opt-out default
   Audience: Graduate
I SY E 555 – HUMAN PERFORMANCE AND ACCIDENT CAUSATION
3 credits.

A systems view of accident causation, with emphasis on the human performance limitations important in industrial and other accidents. Models of causation, data collection systems, economic evaluation, and safety programs. Small group projects.

**Requisites:** I SY E/PSYCH 349, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2023

**Learning Outcomes:**
1. Explain the rules and regulations governing accident investigations in different industries including transportation and healthcare
   Audience: Both Grad & Undergrad

2. Describe the standard process for conducting an accident investigation
   Audience: Both Grad & Undergrad

3. Describe basic accident investigation tools, methods and techniques
   Audience: Both Grad & Undergrad

4. Discuss different human factors perspectives regarding the underlying causes of errors and accidents
   Audience: Both Grad & Undergrad

5. Identify different approaches for redesigning systems to improve safety
   Audience: Both Grad & Undergrad

6. Utilize accident investigation methods and tools to analyze a major accident to determine causes and corrective actions
   Audience: Graduate

I SY E 557 – HUMAN FACTORS ENGINEERING FOR HEALTHCARE SYSTEMS
3 credits.

Introduction to the application of Human Factors Engineering theory and methods to the analysis and improvement of healthcare delivery systems.

**Requisites:** PSYCH/I SY E 349, or graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2023

**Learning Outcomes:**
1. Explain Human Factors Engineering theories and methods as they pertain to the evaluation and design of healthcare sociotechnical systems
   Audience: Both Grad & Undergrad

2. Select and critically evaluate the utility of key Human Factors Engineering concepts and tools for assessing and modeling healthcare delivery challenges in sociotechnical systems
   Audience: Both Grad & Undergrad

3. Identify the impact of changes to the healthcare sociotechnical system at the individual and organizational level
   Audience: Both Grad & Undergrad

4. Apply a Human Factors Engineering-based sociotechnical system approach to evaluate and design interaction between users and information technologies
   Audience: Both Grad & Undergrad

5. Demonstrate the use of Human Factors Engineering techniques in solving healthcare delivery problems within the organizational, social, and physical contexts in information system design
   Audience: Both Grad & Undergrad

6. Demonstrate ability to independently evaluate Human Factors Engineering research in healthcare
   Audience: Graduate

I SY E/COMP SCI/M E 558 – INTRODUCTION TO COMPUTATIONAL GEOMETRY
3 credits.

Introduction to fundamental geometric computations and algorithms, and their use for solving engineering and scientific problems. Computer representations of simple geometric objects and paradigms for algorithm design. Applications from areas of engineering analysis, design and manufacturing, biology, statistics, and other sciences.

**Requisites:** (COMP SCI 367 or 400) and MATH 234 or graduate/professional standing

**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2018
**I SY E/MED PHYS 559 – PATIENT SAFETY AND ERROR REDUCTION IN HEALTHCARE**

2 credits.

Techniques for evaluating and reducing risks in medical procedures, including probabilistic risk assessment methods, failure mode and effects analysis, human factors analysis, and quality management. Discussions of patient safety standards, recommendations from agencies, and continual quality improvement.

**Requisites:** Consent of instructor

**Course Designation:** Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

Last Taught: Spring 2019

**Learning Outcomes:**
1. Demonstrate knowledge of quality tools used to improve patient safety and quality in healthcare through reading, discussion, individual assignments, and exams
   Audience: Both Grad & Undergrad

2. Identify patient safety standards and agency recommendations
   Audience: Both Grad & Undergrad

3. Apply techniques to evaluate and reduce risks in medical procedures through group participation in class
   Audience: Both Grad & Undergrad

4. Investigate safety events and concepts and restate their relevance to healthcare in reading assignments
   Audience: Graduate

---

**I SY E 562 – HUMAN FACTORS OF DATA SCIENCE AND MACHINE LEARNING**

3 credits.

An examination of the “human side” of data science. Issues of bias, fairness, trust, and understandability. Unique characteristics of behavioral data, such as representative sampling, human adaptation, and grouped data. Practical skills in behavioral data analytics with a focus on important conceptual, design, and ethical issues specific to behavioral data.

Survey of machine learning techniques including supervised learning, unsupervised learning, reinforcement learning, deep learning, and text analysis. Methods are contextualized through engineering case studies.

**Requisites:** (I SY E 210, E C E 331, MATH/STAT 310, STAT 312, or 340), graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

Last Taught: Spring 2024

**Learning Outcomes:**
1. Consider human values and behavior in developing and using machine learning models
   Audience: Both Grad & Undergrad

2. Apply a human-centered design process to data and algorithm-intensive products
   Audience: Both Grad & Undergrad

3. Describe the basic elements of machine learning and their limits
   Audience: Both Grad & Undergrad

4. Analyze a case study of machine learning deployed by a company and discuss strengths and limits of the deployment using the concepts of the course.
   Audience: Graduate
I SY E/B M E 564 – OCCUPATIONAL ERGONOMICS AND BIOMECHANICS
3 credits.

Introduces engineers how to design manufacturing and industrial operations in which people play a significant role, so that human capabilities are maximized, physical stress is minimized, and workload is optimized. Examples and topics emphasize industrial applications.

Requisites: PSYCH/I SY E 349 or B M E 315, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

Learning Outcomes: 1. Evaluate jobs, equipment, tools, products, and environments, in which people play a significant role, for health and safety hazards and the risk of injuries and illnesses
Audience: Both Grad & Undergrad
2. Devise how to reduce or eliminate physical stresses and the risk of injuries and illnesses in jobs, equipment, tools, products, and environments
Audience: Both Grad & Undergrad
3. Design jobs, workspaces and products for a diverse work population, to accommodate the variability of human dimensions strength, endurance, and physical capacity to do work
Audience: Both Grad & Undergrad
4. Design jobs equipment, tools, products, and environments so that human capabilities are maximized, physical stress is minimized, and workload is optimized
Audience: Both Grad & Undergrad
5. Identify fundamental physiological principles and biomechanical theories that are germane to the evaluation, design and reduction or elimination of stresses and strain in jobs, equipment, tools, products, and environments
Audience: Graduate

I SY E/E C E 570 – ETHICS OF DATA FOR ENGINEERS
3 credits.

Introduction to ethical issues in data engineering and principled solutions. Algorithmic fairness (individual fairness, group fairness, counterfactual fairness), differential privacy and its applications, and robustness.

Requisites: I SY E 521, 562, M E/COMP SCI/E C E 532, 539, or graduate/professional standing
Repeatable for Credit: No
Last Taught: Spring 2024

Learning Outcomes: 1. Describe the importance of ethical data science/engineering
Audience: Undergraduate
2. Identify challenges of trustworthy data use in engineering such as fairness, privacy, and robustness
Audience: Undergraduate
3. Apply the definitions of trustworthy data engineering to real-world datasets
Audience: Undergraduate
4. Analyze the data analysis pipelines and evaluate the trustworthiness of their outcomes
Audience: Undergraduate
5. Create proper data analysis pipelines with ethical considerations
Audience: Undergraduate

I SY E/N E 574 – METHODS FOR PROBABILISTIC RISK ANALYSIS OF NUCLEAR POWER PLANTS
3 credits.

Methods for risk and reliability analysis of engineered systems, particularly as applied in the nuclear power industry. Fault trees and event trees, Bayesian data analysis, probabilistic risk management. Some familiarity with nuclear plant safety systems is helpful, but not required.

Requisites: (STAT/MATH 309, STAT 311, 224, 324, or STAT/MATH 431), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2023

Learning Outcomes: 1. Correctly apply methods of fault tree, event-tree, data, and uncertainty analysis to evaluate potential risks of engineering systems
Audience: Both Grad & Undergrad
2. Recognize, formulate, and analyze risks of engineered systems
Audience: Both Grad & Undergrad
3. Explain the results of risk analysis to managers and other non-specialist decision-makers
Audience: Graduate
I SY E 575 – INTRODUCTION TO QUALITY ENGINEERING
3 credits.

Introduction to statistically based quality improvement methods useful in industrial settings; observational methods and design of experiments; experimentation to discover influential factors and to analyze sources of variation; robust products.

Requisites: (I SY E 210, MATH/STAT 310, STAT 312 or concurrent enrollment), graduate/professional standing, or member of Engineering Guest Students

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Summer 2023

Learning Outcomes: 1. Design experiments for various phases of engineering work, including new product design and development, process development, manufacturing process improvement, and health systems design and improvement

Audience: Both Grad & Undergrad

2. Analyze the results of experiments conducted at different phases of engineering work

Audience: Both Grad & Undergrad

3. Apply data analysis skills in statistical methodologies, graphical displays, and visual and inferential interpretations

Audience: Both Grad & Undergrad

4. Work effectively in an experiential project focused on applying appropriate statistical tools and techniques

Audience: Both Grad & Undergrad

5. Explain the eight phases of Six Sigma and apply these steps to a wide range of actual situations

Audience: Both Grad & Undergrad

6. Demonstrate ability to synthesize applications of statistical methodologies via analysis of current literature and case studies

Audience: Graduate

I SY E 602 – SPECIAL TOPICS IN HUMAN FACTORS
3 credits.

Various special topics in human factors engineering. Course topic may vary from semester to semester. Different versions of this course may be offered in same semester.

Requisites: None

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Fall 2022

Learning Outcomes: 1. Identify and describe key theories, concepts, and methods in human factors engineering

Audience: Both Grad & Undergrad

2. Apply key theories, concepts, and methods in human factors engineering, using appropriate tools, processes, and/or software

Audience: Both Grad & Undergrad

3. Apply, analyze, or evaluate advanced theories, concepts, or methods in human factors engineering

Audience: Graduate

I SY E 603 – SPECIAL TOPICS IN ENGINEERING ANALYTICS AND OPERATIONS RESEARCH
1-3 credits.

Various special topics in engineering analytics and operations research, such as machine learning, data management and analysis, optimization, etc.

Requisites: None

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2024

Learning Outcomes: 1. Identify and describe key theories, concepts, and methods in engineering analytics and operations research

Audience: Both Grad & Undergrad

2. Apply key theories, concepts, and methods in engineering analytics and operations research, using appropriate tools, processes, and/or software

Audience: Both Grad & Undergrad

3. Apply, analyze, or evaluate advanced theories, concepts, or methods in engineering analytics and operations research

Audience: Graduate
**ISYE 604 – SPECIAL TOPICS IN MANUFACTURING AND SUPPLY CHAIN MANAGEMENT**
1-3 credits.

Various special topics in manufacturing systems and supply chain management, such as digital manufacturing technologies, Internet of Things (IoT), supply chain, etc.

**Requisites:** None

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** Yes, unlimited number of completions

**Last Taught:** Spring 2024

**Learning Outcomes:**
1. Identify and describe key theories, concepts, and methods in manufacturing and supply chain management
Audience: Both Grad & Undergrad

2. Apply key theories, concepts, and methods in manufacturing and supply chain management, using appropriate tools, processes, and/or software
Audience: Both Grad & Undergrad

3. Apply, analyze, or evaluate advanced theories, concepts, or methods in manufacturing and supply chain management
Audience: Graduate

**ISYE 605 – COMPUTER INTEGRATED MANUFACTURING**
3 credits.

An introduction to computer-integrated design and manufacturing with a focus on manufacturing process planning. Emphasis on concurrent engineering principles, manufacturing process engineering, computer-aided process planning, NC programming, and CAM integration. Course provides experience with CAM software and NC machines.

**Requisites:** ISYE 315, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

**Learning Outcomes:**
1. Identify and formulate manufacturing process and system level problems by applying principles of engineering and mathematics
Audience: Both Grad & Undergrad

2. Design the geometry of a mechanical component and develop computer code needed to fabricate the component
Audience: Both Grad & Undergrad

3. Apply principles of engineering and mathematics to solve process- and system-level problems such as setting process parameters and evaluating the system performance
Audience: Both Grad & Undergrad

4. Demonstrate ability to combine different modeling and analysis methods explored in the class for manufacturing processes and systems to achieve strategies for performance improvement
Audience: Graduate

**ISYE 606 – SPECIAL TOPICS IN HEALTHCARE SYSTEMS ENGINEERING**
1-3 credits.

Various special topics in healthcare systems engineering, such as human factors in healthcare settings, operations research applied to healthcare, etc.

**Requisites:** None

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** Yes, unlimited number of completions

**Learning Outcomes:**
1. Identify and describe key theories, concepts, and methods in healthcare systems engineering
Audience: Both Grad & Undergrad

2. Apply key theories, concepts, and methods in healthcare systems engineering, using appropriate tools, processes, and/or software
Audience: Both Grad & Undergrad

3. Apply, analyze, or evaluate advanced theories, concepts, or methods in healthcare systems engineering
Audience: Graduate
I SY E/PHARMACY 608 – SAFETY AND QUALITY IN THE MEDICATION USE SYSTEM
3 credits.

Addresses the problems of medication errors and quality in health care, problem resolutions, methods of assessment, and intervention implementation and quality management.

Requisites: Declared in Doctor of Pharmacy program with third year standing

Repeatable for Credit: No
Last Taught: Fall 2023

Learning Outcomes: 1. Recognize types, sources, and contributors to error within the medication use system.
Audience: Undergraduate

2. Explain the influence of work systems and human factors on the development of safe processes for improving safety within the medication use system.
Audience: Undergraduate

3. Apply tools for identifying, analyzing, and anticipating errors within the medication use system (e.g., error reporting systems, root cause analysis, failure modes and effects analysis) and use these to develop safer processes.
Audience: Undergraduate

4. Describe characteristics of healthcare settings that contribute to improved quality and how pharmacists can influence the characteristics.
Audience: Undergraduate

5. Explain how quality indicators are developed, measured, and monitored in the US healthcare system.
Audience: Undergraduate

6. Describe and apply economic evaluation and pharmacoeconomic principles to evaluate pharmacy programs and drug products.
Audience: Undergraduate

I SY E 612 – INFORMATION SENSING AND ANALYSIS FOR MANUFACTURING PROCESSES
3 credits.

Focuses on the sensing and multivariate data modeling and analysis techniques for monitoring, diagnosis, and quality improvement of manufacturing processes. The techniques introduced can find wide applications in health care, financial engineering, service industry applications, human factors, etc.

Requisites: I SY E/M E 512, graduate/professional standing, or member of Engineering Guest Students

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No
Last Taught: Spring 2024

Learning Outcomes: 1. Perform data analysis and propose quality improvement plans
Audience: Both Grad & Undergrad

2. Develop, implement, and interpret advanced control charts for monitoring continuous and discrete quality characteristics and multivariate systems
Audience: Both Grad & Undergrad

3. Implement appropriate data reduction and data processing methods in statistical process control
Audience: Both Grad & Undergrad

4. Apply methods and tools to a real problem-solving experience via a course project
Audience: Graduate
**I SY E 615 – PRODUCTION SYSTEMS CONTROL**
3 credits.

An intermediate to advanced course stressing the application of recent operations research techniques to production planning, scheduling and inventory control.

**Requisites:** I SY E 315, 320, and 323 and (STAT/MATH 310, STAT 312 or STAT/MATH 431), graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

**Learning Outcomes:**
1. Apply knowledge of math, science, and engineering principles to solve manufacturing, service, business, or societal operations problems
   Audience: Both Grad & Undergrad

2. Identify, formulate, and solve manufacturing and service operations problems using appropriate data and analytics approaches
   Audience: Both Grad & Undergrad

3. Identify opportunities and apply engineering solutions for system productivity and quality improvement
   Audience: Both Grad & Undergrad

4. Apply the techniques, skills, and tools for engineering practice, such as modeling, design, simulation, and management
   Audience: Both Grad & Undergrad

5. Apply advanced skills and tools for analysis, control and optimization of manufacturing and service systems operations
   Audience: Graduate

**I SY E/B M I 617 – HEALTH INFORMATION SYSTEMS**
3 credits.

Provides grounding in core concepts of health information systems. Major applications include clinical information systems, language and standards, decision support, image technology and digital libraries. Evaluation of IE tools and perspectives designed to improve the quality, efficiency and effectiveness of health information.

**Requisites:** I SY E 417, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2016

**I SY E 618 – QUALITY ENGINEERING AND QUALITY MANAGEMENT**
3 credits.

Strategic quality planning, change management, problem identification and solving, process improvement, and performance evaluation. Business and decision-making skills related to quality systems and process improvement.

**Requisites:** Graduate/professional standing

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2023

**Learning Outcomes:**
1. Work effectively on a team-based experiential project focused on process design, analysis, and resource management and integrating the concepts of continual improvement, customer focus, and teamwork
   Audience: Graduate

2. Apply problem solving and management/planning tools for effectively defining problems, feasible alternative solutions, and measurable goals in a real-world environment
   Audience: Graduate

3. Demonstrate ability to lead an industry-based team project integrating contemporary change management frameworks and considering organizational culture
   Audience: Graduate

4. Apply the basics of Factorial Design of Experiments (DOE) as a statistical tool for continuous process improvement
   Audience: Graduate
** I SY E 620 – SIMULATION MODELING AND ANALYSIS  
3 credits.

Introduction to simulation modeling and analysis techniques with application to production, logistics, service, and other systems. Emphasis on model building, application of basic statistical data analysis, and the use of simulation for design, evaluation, and improvement of such systems. Introduction to available software. Case studies.  
**Requisites:** (COMP SCI 200, 220, 300, 301, 302, or placement into COMP SCI 300) and (STAT 224, 312, 324, or STAT/MATH 310), graduate/professional standing, or member of Engineering Guest Students  
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement  
**Repeatable for Credit:** No  
**Last Taught:** Spring 2023  
**Learning Outcomes:** 1. Identify the major capabilities and limitations of discrete-event simulation for modeling types of systems that industrial engineers commonly encounter  
Audience: Both Grad & Undergrad  
2. Model and run discrete-event simulation in practical situations  
Audience: Both Grad & Undergrad  
3. Identify the main assumptions underlying simulation models, and what can happen when these assumptions do not hold  
Audience: Both Grad & Undergrad  
4. Apply the results of the modeling process to management and other non-specialist users of engineering analyses  
Audience: Both Grad & Undergrad  
5. Apply experimental design or data analytics for systems comparison and output analysis of the simulation models  
Audience: Both Grad & Undergrad  
6. Apply simulation input/output techniques to model complicated stochastic systems such as manufacturing production systems and health care systems  
Audience: Graduate

** I SY E 624 – STOCHASTIC MODELING TECHNIQUES  
3 credits.

Techniques for modeling systems in which uncertainty is an essential factor. Emphasizes why, how and when techniques can or cannot be applied, rather than their mathematical derivation. Case studies and/or examples from such areas as logistics, production, and service industries.  
**Requisites:** (STAT/MATH 309, 311, or STAT/MATH 431) and (MATH 320, 340, 341, or 375), graduate/professional standing, or member of Engineering Guest Students  
**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement  
**Repeatable for Credit:** No  
**Last Taught:** Spring 2024  
**Learning Outcomes:** 1. Identify and interpret basic concepts of probability, including random variables, and conditional probability, expectation, and variance  
Audience: Both Grad & Undergrad  
2. Analyze probability models such as the Markov chains, the exponential distribution, Poisson processes, and queuing models  
Audience: Both Grad & Undergrad  
3. Identify, formulate, and develop solution techniques for problems that can be modeled by stochastic models in various domains (engineering, computer science, supply chains, healthcare systems, operations research)  
Audience: Both Grad & Undergrad  
4. Recognize how and when to apply each type of probability model  
Audience: Both Grad & Undergrad  
5. Formulate mathematical formulations and apply proof techniques  
Audience: Graduate
I SY E 625 – LOGISTICS SYSTEMS DESIGN

3 credits.

Practical methods for the planning, design and evaluation of complex logistics and distribution systems. Modeling techniques and solution approaches that reduce cumbersome details of logistics systems into models with a manageable number of parameters and decision variables. It shows how the solutions to these models are interpreted into optimal rules that guide the operation, design or planning process. Practical methods for the planning, design and evaluation of complex logistics and distribution systems. Modeling techniques and solution approaches that reduce cumbersome details of logistics systems into models with a manageable number of parameters and decision variables. It shows how the solutions to these models are interpreted into optimal rules that guide the operation, design or planning process. Builds on knowledge of introductory programming such as Python, Matlab, or R.

Requisites: (I SY E 323 or E C E/COMP SCI/I SY E 524) and (I SY E 210, E C E 331, MATH/STAT 310, STAT 312, 324, or 340), graduate/professional standing, or member of Engineering Guest Students

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Learning Outcomes: 1. Identify decision problems for typical logistics systems
Audience: Both Grad & Undergrad

2. Establish optimization models for typical logistics systems
Audience: Both Grad & Undergrad

3. Use multiple methods to solve logistics system models
Audience: Both Grad & Undergrad

4. Explain the insights of solutions and apply them in realistic situations
Audience: Graduate

I SY E/MATH/OTM/STAT 632 – INTRODUCTION TO STOCHASTIC PROCESSES

3 credits.

Topics include discrete-time Markov chains, Poisson point processes, continuous-time Markov chains, and renewal processes. Applications to queueing, branching, and other models in science, engineering and business.

Requisites: (STAT/MATH 431, 309, STAT 311 or MATH 531) and (MATH 320, 340, 341, 375, 421 or 531) or graduate/professional standing or member of the Pre-Masters Mathematics (Visiting International) Program

Course Designation: Breadth - Natural Science

Level – Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

Learning Outcomes: 1. Recall and state the formal definitions of the mathematical objects and their properties for stochastic processes (e.g., discrete space Markov chains, Poisson processes, renewal processes, branching processes, etc.).
Audience: Both Grad & Undergrad

2. Use such definitions to argue that a mathematical object does or does not have the condition of being a particular type or having a particular property (e.g., irreducibility, aperiodicity, recurrence, transience, the Markov property, etc.).
Audience: Both Grad & Undergrad

3. Recall and state the standard theorems of stochastic processes. (e.g., laws of large numbers for Markov chains, existence of limiting/stationary distributions, law of large numbers for renewal processes, etc.) and recall the arguments for these theorems and the underlying logic of their proofs.
Audience: Both Grad & Undergrad

4. Construct mathematical arguments related to the above definitions, properties, and theorems, including the construction of examples and counterexamples.
Audience: Both Grad & Undergrad

5. Convey arguments in oral and written forms using English and appropriate mathematical terminology, notation and grammar.
Audience: Both Grad & Undergrad

Audience: Both Grad & Undergrad

7. Identify applications of course content in current areas of research.
Audience: Graduate
I SY E/COMP SCI 635 – TOOLS AND ENVIRONMENTS FOR OPTIMIZATION
3 credits.

Formulation and modeling of applications from computer sciences, operations research, business, science and engineering involving optimization and equilibrium models. Survey and appropriate usage of software tools for solving such problems, including modeling language use, automatic differentiation, subroutine libraries and web-based optimization tools and environments.

**Requisites:** (MATH 320, 340, 341, or 375) and (COMP SCI 200, 300, 301, 302, placement into COMP SCI 300, or LIS/COMP SCI 102 (COMP SCI 202 prior to Fall 2023)); grad/professional standing; declared in the Capstone Certificate in Computer Sciences for Professionals

**Course Designation:** Breadth - Physical Sci. Counts toward the Natural Sci req

**Level - Intermediate**

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2015

I SY E/M E 641 – DESIGN AND ANALYSIS OF MANUFACTURING SYSTEMS
3 credits.

Covers a broad range of techniques and tools relevant to the design, analysis, development, implementation, operation and control of modern manufacturing systems. Case studies assignments using industry data will be used to elaborate the practical applications of the theoretical concepts.

**Requisites:** I SY E 315, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

**Learning Outcomes:**
1. Identify suitable analysis techniques to investigate processes related to manufacturing, planning, engineering or office operations within a manufacturing firm
   Audience: Both Grad & Undergrad

2. Perform analysis to describe, predict and analyze behavior of a manufacturing system to meet desired managerial and economic objectives for a real-world or realistic manufacturing systems improvement project/case study
   Audience: Both Grad & Undergrad

3. Develop recommendations that will improve manufacturing system performance (e.g. reduce flow time, increase throughput)
   Audience: Both Grad & Undergrad

4. Collaborate effectively in teams to develop solutions to engineering problems and communicate findings effectively
   Audience: Both Grad & Undergrad

5. Reflect on personal strengths and weaknesses with respect to team leadership and project management
   Audience: Graduate

I SY E/M E 643 – PERFORMANCE ANALYSIS OF MANUFACTURING SYSTEMS
3 credits.

Examines the state of the art in the use of stochastic network theory to develop performance models of modern manufacturing systems.

**Requisites:** (I SY E 624 or STAT/I SY E/MATH/OTM 632) and (COMP SCI 200, 220, 300, 301, 302, 400, or placement into COMP SCI 300), graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2021

**Learning Outcomes:**
1. Model a variety of manufacturing problems as stochastic models using Markov Chain and Process theory
   Audience: Both Grad & Undergrad

2. Identify the basic assumptions underlying stochastic models and understand what can happen when these assumptions do not hold
   Audience: Both Grad & Undergrad

3. Apply queueing theory to model manufacturing systems
   Audience: Both Grad & Undergrad

4. Apply the line balancing method for assembly systems design
   Audience: Both Grad & Undergrad

5. Perform cost analysis for manufacturing systems
   Audience: Both Grad & Undergrad

6. Apply the analytical approaches of performance analysis for manufacturing systems to real industry cases
   Audience: Both Grad & Undergrad

7. Apply advanced Markov process method to solve complicated performance evaluation problems encountered in manufacturing production systems
   Audience: Graduate
I SY E 645 – ENGINEERING MODELS FOR SUPPLY CHAINS
3 credits.

Provides an overview of engineering fundamentals behind supply chains. Topics covered will include modeling and design of multi-stage production distribution systems, multi-echelon inventory models, theory of supply chain contracts, value of flexibility and information sharing in supply chains.

**Requisites:** I SY E 323 and I SY E 415, or graduate/professional standing, or member of Engineering Guest Students

**Repeatable for Credit:** No

**Last Taught:** Fall 2023

**Learning Outcomes:**
1. Apply multiple forecasting methods for customer demand
   Audience: Undergraduate

2. Identify and apply multiple inventory management models
   Audience: Undergraduate

3. Identify the limitation of models and tune them for realistic cases
   Audience: Undergraduate

4. Create and present reports for realistic inventory management policy
   Audience: Undergraduate

5. Demonstrate ability to lead a team project to optimize realistic supply chain decisions with analytical tools and numerical simulation
   Audience: Undergraduate

I SY E 649 – INTERACTIVE DATA ANALYTICS
3 credits.

A cognitive engineering approach to human-computer interaction and data visualization in particular. Includes a four-part description of effective visualization: design intent, data and application domain, representation and interface features, and human limits and capabilities. The philosophical perspective, scientific basis, and practical tools for effective data visualization and visual analytics. Data processing and how to create static graphs as well as web-based interactive visualizations using the statistical language R.

**Requisites:** I SY E/PSYCH 349 and (I SY E 210, E C E 331, MATH/STAT 310, STAT 312, 324, or 340), graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2023

**Learning Outcomes:**
1. Approach visualization as a design process, using the critical response process and paper prototypes
   Audience: Both Grad & Undergrad

2. Design visualizations for different audiences and different purposes
   Audience: Both Grad & Undergrad

3. Use the concepts of abstraction and aggregation to translate raw data into meaningful information
   Audience: Both Grad & Undergrad

4. Use the flexibility of the grammar of graphics to craft graphs for effective communication
   Audience: Both Grad & Undergrad

5. Develop replicable data analyses and visualizations with R and RShiny
   Audience: Both Grad & Undergrad

6. Create specialized data analytic visualizations such as time series decompositions and ROC curves
   Audience: Graduate
**I SY E/PSYCH 653 – ORGANIZATION AND JOB DESIGN**

3 credits.

Design of productive organizations and people’s roles within them. Issues including boundary location, organizational decision levels, autonomous work groups, implementation and diffusion. Roles of the union. Case studies.

**Requisites:** I SY E/PSYCH 349, graduate/professional standing, or member of Engineering Guest Students

**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Fall 2021

**Learning Outcomes:**

1. Apply the work system model
   
   Audience: Both Grad & Undergrad

2. Apply a variety of models and theories of job and organization design to answer questions such as, “What makes for a good job?” and “What makes for a bad job?”
   
   Audience: Both Grad & Undergrad

3. Apply interview and survey methods for analyzing jobs
   
   Audience: Both Grad & Undergrad

4. Identify approaches to implement job redesign
   
   Audience: Both Grad & Undergrad

5. Identify societal trends related to job design
   
   Audience: Both Grad & Undergrad

6. Identify similarities and differences between various models and theories of job and organization design
   
   Audience: Graduate

---

**I SY E/B ME 662 – DESIGN AND HUMAN DISABILITY AND AGING**

3 credits.

Design of products for persons with physical, sensory or cognitive impairments is covered as well as the design of standard mass market products. Interdisciplinary teams explore specific disabilities, then design a standard mass market product in competition with each other.

**Requisites:** Junior standing or member of Engineering Guest Students

**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement

**Repeatable for Credit:** No

**Last Taught:** Spring 2024

**Learning Outcomes:**

1. Explain the access and usability issues that users with physical, sensory, or cognitive impairments due to age or permanent or temporary disability might experience when interacting with everyday products and environmental designs
   
   Audience: Both Grad & Undergrad

2. Apply human factors principles of universal design to describe redesign solutions for common products and environmental designs to improve accessibility for all users
   
   Audience: Both Grad & Undergrad

3. Identify barriers to access for users based on specific disabilities
   
   Audience: Both Grad & Undergrad

4. Articulate common misconceptions and biases related to users with disabilities and use various data sources to discuss the reality of designing for users with disabilities or impairments
   
   Audience: Both Grad & Undergrad

5. Identify usability issues for mass-market products and environmental designs using universal design and basic access principles
   
   Audience: Both Grad & Undergrad

6. Propose methods for improving accessibility and usability using universal design and basic access principles
   
   Audience: Both Grad & Undergrad

7. Articulate how social, institutional, and organizational structures and insufficiently designed systems and environments disadvantage various user groups, with special focus on aging and disabled users
   
   Audience: Graduate
I SY E 699 – ADVANCED INDEPENDENT STUDY
1-5 credits.
Under faculty supervision.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024
Learning Outcomes: 1. Conduct and report on graduate-level industrial engineering research
Audience: Graduate
2. Independently develop industrial engineering research questions
Audience: Graduate
3. Appropriately utilize online and library resources
Audience: Graduate

I SY E 702 – GRADUATE COOPERATIVE EDUCATION PROGRAM
1-2 credits.
Work experience that combines classroom theory with practical knowledge of operations to provide students with a background on which to develop and enhance a professional career. The work experience is tailored for MS students from within the U.S. as well as eligible international students.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024
Learning Outcomes: 1. Identify and respond appropriately to real-life engineering ethics cases relevant to co-op work
Audience: Graduate
2. Synthesize and apply appropriate technical education to real world technical work
Audience: Graduate
3. Communicate effectively in writing and speaking with a range of audiences in the workplace, including those without disciplinary expertise
Audience: Graduate
4. Develop professional and transferable habits like time management skills, collaborative problem-solving skills, and research skills for learning new information
Audience: Graduate

I SY E/POP HLTH 703 – QUALITY OF HEALTH CARE: EVALUATION AND ASSURANCE
1-3 credits.
Implementation, oversight, and management of quality-oriented activities in health care settings. Overview of current and historical activities, approaches, and issues confronting health care related to quality assessment, assurance, and improvement.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2018
Learning Outcomes: 1. Understand and communicate the conceptualization and measurement of quality of healthcare and patient safety.
Audience: Graduate
2. Illustrate basic concepts and methods in quality improvement as applied to current issues in healthcare.
Audience: Graduate
3. Demonstrate an understanding of the diverse perspectives that can be used to address quality and safety issues in different healthcare organizations.
Audience: Graduate

I SY E/C&E SOC/N E/SOC 708 – SOCIETAL RISK MANAGEMENT OF TECHNOLOGICAL HAZARDS
3 credits.
Issues involved in decision-making regarding technological risks and risk management in areas such as nuclear power, hazardous waste disposal, and pollution control. Risk perception and cognitive biases; risk analysis and decision analysis; political issues in risk management; regulatory mechanisms; and risk communication. Selected case studies.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2020
I SY E/COMP SCI 719 – STOCHASTIC PROGRAMMING
3 credits.

Stochastic programming is concerned with decision making in the presence of uncertainty, where the eventual outcome depends on a future random event. Topics include modeling uncertainty in optimization problems, risk measures, stochastic programming algorithms, approximation and sampling methods, and applications. Students are strongly encouraged to have knowledge of linear programming (e.g., MATH/COMP SCI/I SY E/STAT 525) and probability and statistics (e.g., MATH/STAT 431). Knowledge of integer optimization (MATH/COMP SCI/I SY E 728) is helpful, but not required.

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeateable for Credit: No
Last Taught: Fall 2023

Learning Outcomes: 1. Learn the terms, basic capabilities, and limitations of stochastic programming models
   Audience: Graduate

   2. Formulate stochastic programming models
   Audience: Graduate

   3. Implement the algorithms used to solve stochastic programming problems
   Audience: Graduate

   4. Learn principles of decomposition algorithms for solving large-scale optimization problems
   Audience: Graduate

I SY E/INFO SYS 722 – COMPUTER-BASED DATA MANAGEMENT
3 credits.

Use, control and administration of centralized and distributed data bases. Topics include the definition, design, creation, revision, interrogation, update, security and integrity of data bases.

Requisites: Graduate/professional standing and INFO SYS 371
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeateable for Credit: No
Last Taught: Fall 2020

I SY E/COMP SCI 723 – DYNAMIC PROGRAMMING AND ASSOCIATED TOPICS
3 credits.

General and special techniques of dynamic programming developed by means of examples. Shortest-path algorithms. Deterministic equipment replacement models. Resource allocation problem. Traveling-salesman problem. Knapsack problem. Analysis of inventory systems. General stochastic formulations. Markovian decision processes. Students are strongly encouraged to have knowledge of mathematical optimization (e.g., COMP SCI/I SY E/MATH/STAT 525, I SY E 623, COMP SCI/I SY E/MATH/STAT 726), knowledge of analysis (e.g., MATH/STAT 431 or 521) and programming ability (e.g., COMP SCI 200 or 301)

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeateable for Credit: No
Last Taught: Fall 2023

Learning Outcomes: 1. Identify basic components, such as the state space, of a dynamic program
   Audience: Graduate

   2. Formulate and solve dynamic programs under different performance criteria such as finite horizon discounted reward/cost criteria
   Audience: Graduate

   3. Apply dynamic programming tools and concepts in `traditional' industrial engineering applications such as supply chain, manufacturing, and healthcare
   Audience: Graduate

I SY E/COMP SCI/MATH/STAT 726 – NONLINEAR OPTIMIZATION I
3 credits.

Theory and algorithms for nonlinear optimization, focusing on unconstrained optimization. Line-search and trust-region methods; quasi-Newton methods; conjugate-gradient and limited-memory methods for large-scale problems; derivative-free optimization; algorithms for least-squares problems and nonlinear equations; gradient projection algorithms for bound-constrained problems; and simple penalty methods for nonlinearly constrained optimization. Students are strongly encouraged to have knowledge of linear algebra and familiarity with basic mathematical analysis.

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeateable for Credit: No
Last Taught: Spring 2024
ISYE/COMP SCI 727 – CONVEX ANALYSIS
3 credits.
Convex sets in finite-dimensional spaces: relative interiors, separation, set operations. Convex functions: conjugacy, subdifferentials and directional derivations, functional operations, Fenchel–Rockafellar duality. Applications to operations research and related areas. Students taking this course are strongly encouraged to have had a course in basic analysis (e.g., MATH 521) and a course in linear algebra (e.g., MATH 340).

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2020

ISYE/COMP SCI/MATH 728 – INTEGER OPTIMIZATION
3 credits.
Introduces optimization problems over integers, and surveys the theory behind the algorithms used in state-of-the-art methods for solving such problems. Special attention is given to the polyhedral formulations of these problems, and to their algebraic and geometric properties. Applicability of Integer Optimization is highlighted with applications in combinatorial optimization. Key topics include: formulations, relaxations, polyhedral theory, cutting planes, decomposition, enumeration. Students are strongly encouraged to have knowledge of Linear Programming (e.g., MATH/COMP SCI/ISYE/MATH 525), including algorithms, duality and polyhedral theory.

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024
Learning Outcomes: 1. Describe and explain the basics of polyhedral theory, which consists in the study of systems of linear inequalities both from an algebraic and a geometric point of view
Audience: Graduate
2. Define perfect formulations and identify what properties are desirable in an integer programming formulation of a problem
Audience: Graduate
3. Explain how valid inequalities can be used as cutting planes to strengthen integer programming formulations
Audience: Graduate

ISYE/COMP SCI/MATH 730 – NONLINEAR OPTIMIZATION II
3 credits.

Requisites: STAT/COMP SCI/ISYE/MATH 726
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

ISYE/MHR 729 – BEHAVIORAL ANALYSIS OF MANAGEMENT DECISION MAKING
3 credits.
Examination of behavioral science literature dealing with the processes by which individuals, small groups and organizations make decisions. Understanding decision-making behavior in order to improve managerial performance; modeling decision-making processes for systems design and theory building purposes. Knowledge of statistics strongly encouraged such as STAT 301.

Requisites: Graduate/professional standing or declared in graduate Business Exchange program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2022

ISYE 790 – MASTER’S RESEARCH AND THESIS
1-9 credits.
Directed Master’s-level research projects as arranged with instructor.

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024
Learning Outcomes: 1. Demonstrate an ability to formulate, analyze, and independently solve advanced industrial engineering problems
Audience: Graduate
2. Communicate research results in writing and/or technical presentations
Audience: Graduate
**ISYE 823 – SPECIAL TOPICS IN OPERATIONS RESEARCH**
1-3 credits.

Subjects vary.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2021

Learning Outcomes:
1. Apply advanced operations research tools to solve a variety of industrial engineering problems
   Audience: Graduate

2. Analyze rigorously the methods used in operations research
   Audience: Graduate

**ISYE/PSYCH 854 – SPECIAL TOPICS IN ORGANIZATION DESIGN**
1-3 credits.

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2020

Learning Outcomes:
1. Apply advanced organizational design tools to solve a variety of industrial engineering problems
   Audience: Graduate

2. Analyze rigorously the methods used in organizational design
   Audience: Graduate

**ISYE/PSYCH 859 – SPECIAL TOPICS IN HUMAN FACTORS ENGINEERING**
1-3 credits.

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2023

**ISYE/POP HLTH 875 – COST EFFECTIVENESS ANALYSIS IN HEALTH AND HEALTHCARE**
3 credits.

Basic ideas and tools of cost effectiveness analysis as applied in evaluating medical technologies. Addresses special problems and methods in assessing diagnostic technologies, including ROC analysis, and in measuring health for technology assessment. Uses “classical” and current journal literature.

Requisites: SOC/POP HLTH 797 and POP HLTH/B M 1 552
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

Learning Outcomes:
1. Apply basic concepts of economic analysis to the assessment of medical technologies and healthcare interventions more broadly
   Audience: Graduate

2. Examine health outcomes on a range from objective measures of physical systems to subjective preference-based measures of health utility and describe the benefits and limitations of using quality-adjusted life years (QALYs) as a health outcome measure
   Audience: Graduate

3. Explain why we seek to obtain estimates of the “opportunity cost” of using health care resources, describe the process of “costing” in economic assessments of medical technologies and identify useful sources of information for obtaining cost information (and their limitations)
   Audience: Graduate

4. Describe how primary data from randomized controlled trials and observational studies can be designed to assess medical technologies and explain the advantages and disadvantages of different designs in terms of their internal and external validity and decision-relevance
   Audience: Graduate

5. Describe how evidence from secondary data can be integrated using meta-analysis and decision-analytic modeling methods to assess medical technologies and demonstrate basic ability to design and execute simple decision tree and Markov models for cost-effectiveness analysis
   Audience: Graduate

**ISYE 890 – PRE-DISSERTATOR’S RESEARCH**
1-9 credits.

Directed PhD-level research projects as arranged with faculty advisor.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

Learning Outcomes:
1. Demonstrate an ability to formulate, analyze, and independently solve advanced industrial engineering problems
   Audience: Graduate

2. Communicate research results in writing and/or technical presentations
   Audience: Graduate
I SY E 961 – GRADUATE SEMINAR IN INDUSTRIAL ENGINEERING
1-3 credits.

Topics vary.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024
Learning Outcomes: 1. Identify and describe modern challenges in industrial engineering
Audience: Graduate

I SY E 990 – RESEARCH AND THESIS
1-6 credits.

Directed PhD-level research projects as arranged with faculty advisor.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024
Learning Outcomes: 1. Demonstrate an ability to formulate, analyze, and independently solve advanced industrial engineering problems
Audience: Graduate
2. Communicate research results in writing and/or technical presentations
Audience: Graduate

I SY E 999 – ADVANCED INDEPENDENT STUDY
1-6 credits.

Under faculty supervision.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2022
Learning Outcomes: 1. Conduct and report on graduate-level industrial engineering research
Audience: Graduate
2. Independently develop industrial engineering research questions
Audience: Graduate
3. Appropriately utilize online and library resources
Audience: Graduate