Industrial Engineering

Luis G. Occeña, Chair
College of Engineering
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http://engineering.missouri.edu/imse

Industrial and manufacturing systems engineering is a blending of natural sciences, engineering science, mathematics, computers, social science and management. This fusion of diverse skills allows industrial engineers to design and implement socio-technical systems - complex combinations of people and technology brought together to solve problems. With its diversity, industrial engineering is used in a wide variety of areas in both manufacturing and service industries.

Industrial engineers in a manufacturing organization address many issues including designing workspaces, considering not only the capabilities of machines, but also the physiological and psychological capabilities of humans. They may design computer-integrated manufacturing systems with robots and computer systems to control production or manage inventory and quality of complex products, determining plant and warehouse locations. They may also develop sales forecasts, evaluate proposals to produce new products and build new or improved production facilities.

The same skills used as an industrial engineer to design manufacturing systems are also useful in designing better systems to care for patients in hospitals, to facilitate the judicial process, to provide faster and more accurate mail distribution and to improve airline routing and reservation methods. In effect, the industrial engineer may be involved in the design of a range of systems that provide beneficial services at a cost that society can afford.

The department offers the Bachelor of Science with a major in Industrial Engineering (BSIE), and 5 year Industrial Engineering BSIE/MS and BSIE/MBA programs. The department also offers students the opportunity to obtain Lean Six Sigma Green Belt certification.

Faculty

Professor C. M. Klein**, J. S. Noble**, B. Wu**
Associate Professor L. G. Occeña**
Assistant Professor J. H. Kim**, R. G. McGarvey**, S. Rajendran, K. Seo, S. Srinivas

* Graduate Faculty Member - membership is required to teach graduate-level courses, chair master's thesis committees, and serve on doctoral examination and dissertation committees.
** Doctoral Faculty Member - membership is required to chair doctoral examination or dissertation committees. Graduate faculty membership is a prerequisite for Doctoral faculty membership.

Undergraduate

• BSIE in Industrial Engineering (http://catalog.missouri.edu/undergraduategraduate/collegeofengineering/industrialengineering/bsie-industrial-engineering)

Advising Contact
James S. Noble, Director of Undergraduate Studies

Scholarship Information Contact

Luis G. Occeña

Industrial engineering undergraduates complete a curriculum similar to all engineering students during the first two years. The objective of this curriculum is to give the student a rigorous foundation in mathematics, natural sciences, basic engineering sciences, applied probability and computer science, as well as a complementary and meaningful exposure to the humanities and social sciences.

In addition to the foundational courses, students gain knowledge of optimization methodologies, static and dynamic modeling. They also learn evaluation techniques for the modeling and evaluation of integrated systems of people, technology and information in the areas of strategic planning, production systems, control systems, quality systems, information systems, product and process design.

These fundamental skills provide the foundation from which students learn to develop systematic and integrated solution approaches to large-scale enterprise problems. In order to be successful as they begin their careers (or graduate study) students learn to communicate effectively in both oral and written forms, and become proficient in working in diverse teams of individuals.

Lastly, the curriculum prepares the student to practice in an ethical and professional manner, to serve as well as benefit from the engineering profession, and to continue the learning of and the contribution to the advancement of industrial and manufacturing systems engineering concepts.

Industrial engineering design experiences are integrated throughout the curriculum, many times in a team-based environment. Industrial engineering design is the process of developing and improving integrated systems that include people, materials, information, equipment and energy.

Program Educational Objectives

The IE Program educational objectives have been developed to address the needs of our constituencies and to be consistent with the University of Missouri mission. Within 3-5 years of graduation from the industrial engineering program in the Industrial and Manufacturing Systems Engineering Department at the University of Missouri:

• Graduates will create value for their employers, demonstrating entrepreneurial initiative, and make contributions that benefit society.
• Graduates will expand their capabilities through professional development and advanced education.
• Graduates will provide leadership and be agents of change in their profession and/or communities.

The objectives are based on a few key concepts: value, entrepreneurial initiative, expanding capability, leadership, and being agents of change. “Value” creation is defined as what a graduate’s employer requires in order to achieve its stated objectives. The IMSE graduate adds value to the organization by taking entrepreneurial initiative that contributes to the greater good of society. Graduates face an environment where technology is advancing at an ever increasing pace, therefore, they will need to expand their knowledge and capabilities through professional development and advanced education. Due to their systems view of the enterprise, industrial engineers are often called upon to provide leadership within an enterprise and, as such, are required to manage the change that is inherent in today’s dynamic environment.

Student Outcomes
Student outcomes (SO) are defined as the abilities the department’s BSIE graduates will have upon graduation that will enable them to achieve the program’s educational objectives. The student objectives reflect the assimilation of what has been taught in the curriculum upon completion of the undergraduate education.

All MU BSIE graduates should have:

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

In summary, graduates of the Department of Industrial and Manufacturing Systems Engineering (IMSE) will possess a strong foundation upon which they can grow professionally, and continue to build a focused set of fundamental and engineering knowledge and skills that are integrated and applicable to real-world problems in any enterprise setting.

Accreditation

The University of Missouri program in industrial engineering is accredited by the Engineering Accreditation Commission (EAC) of ABET.

IMSE Honors Program

The IMSE Honors Program follows the regulations and philosophy of the College of Engineering Honors Program, and as such is intended to encourage, facilitate and reward independent study by high-ability undergraduate students.

The heart of the program is an undergraduate honors project, undertaken and completed by the time of graduation while enrolling in 3 to 6 credits of IMSE 4995 Undergraduate Research Industrial Engineering - Honors. The academic credit for the honors project (3-6 credits in IMSE 4995 replaces an equivalent number of credits of IMSE or Technical electives. The project is conducted under the direction of an IMSE professor (honors advisor) who is selected by the student, with agreement by the professor. The project culminates in an honors thesis, which is read and approved by the honors advisor and then approved by the chair of the IMSE honors committee. A finished copy of the honors thesis, signed by the honors advisor and second reader, is required for satisfactory completion of the project.

Academic Qualifications for the Honors Program

In the case of a transfer student, transferred credit plus MU credit must average 3.0/4.0. A student is typically eligible for the honors program at the junior year of their undergraduate program.

The successful honors scholar is given a degree of flexibility in the program of study. Additionally, honors scholars may reduce the credits required for degree completion to the University minimum (i.e., 120 credits) by substituting graduate course credits through dual enrollment (undergraduate/graduate at MU) during the last two semesters of the undergraduate program.

Honors students must maintain and graduate with a 3.0 overall GPA.

Lean Six Sigma Green Belt Certification

IMSE students have the opportunity to obtain a Lean Six Sigma Green Belt certification either during their degree program or after. Certification requires students to obtain a GPA average of 2.5 or better in IMSE 4110, IMSE 4310, and IMSE 4610, then they must successfully complete IMSE 4385 - Lean Six Sigma Green Belt Project (a 1 credit hour course where DMAIC is used to improve a process within an organization).

Graduate

- MS in Industrial Engineering (http://catalog.missouri.edu/undergraduategraduate/collegeofengineering/industrialengineering/ms-industrial-engineering)
- PhD in Industrial Engineering (http://catalog.missouri.edu/undergraduategraduate/collegeofengineering/industrialengineering/phd-industrial-engineering)

Industrial & Manufacturing Systems Engineering Graduate Programs
College of Engineering
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Interim Director of Graduate Studies: Luis G. Occeña

About IMSE

The graduate program in industrial engineering provides a scholarly environment in which highly qualified, creative students may obtain the knowledge and develop the skills necessary to solve complex industrial, governmental and societal system design problems. These systems are required to operate within increasingly complex constraints, thus requiring the use of sophisticated and creative designs. The industrial engineer responsible for such designs must be capable of applying a broad spectrum of scientific tools if the most effective systems are to be obtained.

Our master of science program is designed to provide a basic understanding of these tools and experience in the application of these tools in the design process. The doctor of philosophy program is designed to provide the specialized knowledge and skills necessary to develop new tools or methods for solving complex systems design problems. Information on engineering licensure is detailed under Professional Engineering Registration.

General Admission Guidelines

Acceptance for advisement in the department’s graduate programs is available to students with an ABET accredited undergraduate engineering degree. Engineering graduates who have not taken linear
programming, linear algebra, statistical quality control or engineering economic analysis must complete 12 hours of additional course work before graduation.

Students with baccalaureate degrees in mathematics, physics, chemistry or computer science may be accepted if they have completed 13 hours of calculus, three hours of differential equations and six hours of calculus-based probability and statistics. Several factors are considered in evaluating an applicant’s capability, such as overall GPA, grade trends and major area grades. In addition, each applicant is required to take the general test of the GRE and international students must take the TOEFL and TWE, or IELTS.

Facilities and Resources
Laboratory facilities in several major application areas, both within the department and in the college, support the academic program. Neighboring industries, city, county and state government agencies, local hospitals and nearby large metropolitan centers provide a reservoir of research and design opportunities.

Computing and Reference Materials
The department has access to the University of Missouri System computing network and maintains its own computing facilities for student use. Besides Ellis Library facilities, an excellent collection of mathematical, statistical and engineering books and reference materials are housed in the engineering library and the industrial and manufacturing systems engineering departmental library.

Funding
Fellowships, scholarships and teaching and research assistantships are available to qualified graduate students. These forms of financial assistance are supported by funds made available through state, federal and industrial graduate support programs and through research grants from various industrial and governmental agencies

**IMSE 1000: Introduction to Industrial Engineering**
Introduction to industrial engineering profession, the Industrial and Manufacturing Systems Engineering department, and the core topics of industrial engineering. Introduction to problem solving, ethics and industrial engineering design and analysis techniques.

**Credit Hours:** 1

**Prerequisites:**

**IMSE 1010: Experimental Course**
For freshman-level students. Content and credit to be listed in the Schedule of Courses.

**Credit Hours:** 1-99

**IMSE 1087: Undergraduate Seminar**
Seminars are held monthly to provide a forum for departmental communication of upcoming opportunities (jobs, speakers, deadlines, etc.). Speakers from industry to provide educational context, and student interaction. Required every semester of enrollment for graduation. Graded on S/U basis only.

**Credit Hours:** 0

**IMSE 2030: Fundamentals of Systems Design and Analysis**
Develop an understanding of a systems approach to the design and operation of modern industrial organizations: systems structure and function, system specification, structured problem solving and system design methodology.

**Credit Hours:** 3

**IMSE 2110: Probability and Statistics for Engineers**
Introduction to data analysis, probability concepts, random variables, parameter estimation and hypothesis testing.

**Credit Hours:** 3

**Prerequisites:** MATH 1500. Restricted to Engineering Students who are non-IMSE majors

**IMSE 2210: Linear Algebra for Engineers**
Study of quantitative methods necessary for analysis, modeling and design of optimal industrial systems.

**Credit Hours:** 3

**Prerequisites:** MATH 1700

**IMSE 2410: Introduction to Information Technologies**
A survey of current technologies and their use. Different technologies will be reviewed. Examples: web search strategies, common application tools, searching and sorting on the WWW, upcoming trends and directions in information technologies. This is a web-based self-study course with instructor's guidance.

**Credit Hour:** 1

**IMSE 2710: Engineering Economic Analysis**
Fundamentals of engineering economic decision making. Includes time value of money, breakeven analysis, capital budgeting, replacement, after-tax analysis, inflation, risk, sensitivity analysis and multi-attribute analysis.

**Credit Hours:** 3

**Prerequisites:** sophomore standing

**IMSE 2810: Performance Measurement and Ergonomics**

**Credit Hours:** 3

**Prerequisites:** IMSE 2110

**IMSE 3001: Topics in Industrial and Manufacturing Systems Engineering**
Current and new technical developments in industrial engineering. May be repeated to 6 hours.

**Credit Hour:** 0-4

**Prerequisites:** instructor's consent

**IMSE 3030: Manufacturing and Supply Systems**
Provide a structured approach for the design and optimization of a system throughout its lifecycle: techniques following the logical sequence of strategic analysis, system design, implementation, and monitoring.

**Credit Hours:** 3

**Prerequisites:** IMSE 2030
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Credit Hours</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMSE 3110</td>
<td>Probability Models for Engineers</td>
<td>Introduction to probability concept and theory, random variables, discrete and continuous probability distributions, joint probability distributions.</td>
<td>3</td>
<td>MATH 1500. Restricted to IMSE students only</td>
</tr>
<tr>
<td>IMSE 3810</td>
<td>Ergonomics and Workstation Design</td>
<td>Ergonomics and human factors theories applied to the design of man-machine systems. Discussion of ergonomic methods for measurement, assessment, and evaluation, with major topics including workstation design, environmental stresses, and workplace safety. Includes lab.</td>
<td>3</td>
<td>Restricted to IMSE students or by Departmental consent. Grade of C- or better in IMSE 2210 and IMSE 3110</td>
</tr>
<tr>
<td>IMSE 4001</td>
<td>Topics in Industrial and Manufacturing Systems Engineering</td>
<td>Current and new technical developments in industrial engineering.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>IMSE 4085</td>
<td>Problems in Industrial Engineering</td>
<td>Supervised investigation in industrial engineering presented in form of an engineering report.</td>
<td>1-4</td>
<td></td>
</tr>
<tr>
<td>IMSE 4110</td>
<td>Engineering Statistics</td>
<td>Understanding and application of statistical analysis techniques. Emphasis on hypothesis testing, regression analysis, analysis of variance (ANOVA) and design of experiments (DOE).</td>
<td>3</td>
<td>Restricted to IMSE students or by Departmental consent. Grade of C- or better in IMSE 3110</td>
</tr>
<tr>
<td>IMSE 4210</td>
<td>Linear Optimization</td>
<td>(cross-leveled with IMSE 7210). Theory and application of linear optimization.</td>
<td>3</td>
<td>Restricted to IMSE students. Grade of C- or better in IMSE 2210</td>
</tr>
<tr>
<td>IMSE 4220</td>
<td>Optimization Modeling and Computational Methods</td>
<td>(cross-leveled with IMSE 7220). Modeling and solution techniques for mathematical optimization, including linear, nonlinear, integer, and stochastic programming. Emphasis on formulation of models for most-efficient use of solution algorithms. Graded on A-F basis only.</td>
<td>3</td>
<td></td>
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<tr>
<td>IMSE 4230</td>
<td>Operations Research Models</td>
<td>Formulates probabilistic models and determines optimal control policies for queuing and inventory systems. Introduces Markov chains and dynamic programming.</td>
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<td>IMSE 3110, IMSE 4210</td>
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<td>IMSE 4280</td>
<td>Systems Simulation</td>
<td>Discrete-event stochastic systems modeling and experimentation using simulation software. Statistical design and analysis including distribution fitting and alternative comparison methodologies.</td>
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<tr>
<td>IMSE 4310</td>
<td>Integrated Production Systems Design</td>
<td>Design and operation of production systems, including lean six sigma concepts, just-in-time/kanban, facility layout and material flow issues.</td>
<td>3</td>
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</tr>
<tr>
<td>IMSE 4330</td>
<td>Material Flow and Logistics System Design</td>
<td>Modeling and analysis of structural and operational issues associated with material-flow system design including facility location, warehouse/inventory systems, and distribution/transportation systems.</td>
<td>3</td>
<td>IMSE 4210 and IMSE 4280</td>
</tr>
<tr>
<td>IMSE 4350</td>
<td>Production and Operations Analysis</td>
<td>Quantitative methods for forecasting, scheduling, and production control in manufacturing and service systems. Use of Enterprise Resource Planning (ERP) systems.</td>
<td>3</td>
<td>Restricted to IMSE students or by Departmental consent. IMSE 4210 and IMSE 4230</td>
</tr>
<tr>
<td>IMSE 4360</td>
<td>Supply Chain Engineering</td>
<td>(cross-leveled with IMSE 7360). Modeling and analysis of supply chain network design and management issues including integration of production, inventory control, supplier selection, risk management and logistics network design. Graded on A-F basis only.</td>
<td>3</td>
<td>IMSE 4210 and IMSE 4230</td>
</tr>
<tr>
<td>IMSE 4380</td>
<td>Six Sigma Methodology</td>
<td>(cross-leveled with IMSE 7380). An overview of the Six Sigma DMAIC methodology for analyzing and improving processes. Requires completing a Six Sigma Green Belt project. Graded on A-F basis only.</td>
<td>3</td>
<td>IMSE 4350</td>
</tr>
</tbody>
</table>
Prerequisites: Grade of C or better in IMSE 2110 or IMSE 4110 or STAT 4710

IMSE 4385: Lean Six Sigma Green Belt Project
Application of the Lean Six Sigma methodology in an industry-based project. Prerequisites: IMSE 4310
Credit Hours: 1

IMSE 4410: Management Information Systems Design
MIS concepts and management issues, HTML for web pages and eShop (front-office operations), back-office operations using relational databases, introduction to SQL.
Credit Hours: 3
Prerequisites: Restricted to IMSE students. INFOTC 1040 or CMP_SC 1050 and junior standing required

IMSE 4420: Web-Based Information Systems
Data models, design of databases using E-R, UML (Access/Oracle), web databases, web servers and interfaces (Visual Basic, JavaScript), E-commerce infrastructure (PDM, STEP, XML), data mining for management information and services.
Credit Hours: 3
Prerequisites: IMSE 4410 and instructor’s consent

IMSE 4550: Computer Aided Design and Manufacturing
(cross-leveled with IMSE 7550). Product realization process from design, process planning, to manufacturing. Includes CE, DFS/DFM, CAD, CAPP, CNC, and survey of manufacturing methods.
Credit Hours: 4
Prerequisites: Restricted to IMSE students; Junior Standing

IMSE 4560: Introduction to Rapid Prototyping
(cross-leveled with IMSE 4560). Course covers all five MU systems: FDM, SLS, SLA, Polyjet, 3DP. Students will learn fundamental rapid prototyping and related concepts, and design and produce models from each system. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: Sophomore standing or higher

IMSE 4570: Computer Integrated Manufacturing Control
Implementation of computer integrated manufacturing (CIM) and automation at the shop floor level. Covers essential components of machine sensing and actuation (including programmable robots), information representation and processing, data communication and networking.
Credit Hours: 3
Prerequisites: Junior Standing

IMSE 4580: Industrial Energy Efficiency and Management
(cross-leveled with IMSE 7580). Introduction to the fundamentals of industrial energy efficiency and management. Covers the essential concepts, best practices, management systems and current standards to achieve and improve energy efficiency in industrial settings, and utilizes hands-on experiences involving real assessment and analysis of industrial site visits and projects.
Credit Hours: 3
Prerequisites: IMSE 2030 or instructor’s consent

IMSE 4610: Engineering Quality Control
Analysis of quality in manufacturing including control charts, sampling plans, process capability, experimental design; introduction to system reliability. Overview of Six Sigma and DMAIC methodology.
Credit Hours: 3
Prerequisites: Restricted to IMSE students or by Departmental consent.
IMSE 4110

IMSE 4750: Entrepreneurial Innovation Management: Enterprise Conception
(same as MANGMT 4750). Develop a new business and technology plan including marketing, finance, engineering, manufacturing, and production concepts in this joint College of Engineering and College of Business course.
Credit Hours: 3
Prerequisites: sophomore standing

IMSE 4755H: Entrepreneurial Innovation Management: Enterprise Conception-Honors
(same as MANGMT 4750). Develop a new business and technology plan including marketing, finance, engineering, manufacturing, and production concepts in this joint College of Engineering and College of Business course.
Credit Hours: 3
Prerequisites: sophomore standing. Honors eligibility required

IMSE 4760: Entrepreneurial Innovation Management: Enterprise Design
(same as MANGMT 4760). Expand on IMSE 4750 business/technology plan into an operations plan; advertising facilities layout, selling and distribution channels, product designs, accounting procedures, manufacturing processes, and prototypes.
Credit Hours: 3
Prerequisites: IMSE 4750

IMSE 4765H: Entrepreneurial Innovation Management: Enterprise Design-Honors
(same as MANGMT 4765H). Expand on IMSE 4755H business/technology plan into an operations plan; advertising facilities layout, selling and distribution channels, product designs, accounting procedures, manufacturing processes, and prototypes.
Credit Hours: 3
Prerequisites: IMSE 4755H. Honors eligibility required

IMSE 4770: Entrepreneurial Innovation Management: Enterprise Operations
(same as MANGMT 4770). Perform the day-to-day operations for an enterprise by managing all business processes including finance, manufacturing, sales and delivery. Prerequisites: Junior Standing
Credit Hours: 3
IMSE 4775H: Entrepreneurial Innovation Management: Enterprise Operations-Honors
Perform the day-to-day operations for an enterprise by managing all business processes including finance, manufacturing, sales and delivery.
Credit Hours: 3
Prerequisites: Junior Standing. Honors eligibility required

IMSE 4810: Cognitive Ergonomics
(cross-leveled with IMSE 7810). This course will cover the study of empirical research in Cognitive ergonomics and Human-Computer Interaction (HCI). Students will learn cognitive information processing, mental workload, human reliability, and empirical methods in HCI research. Graded on A-F basis only.
Credit Hours: 3
Recommended: Junior or senior level undergraduate students

IMSE 4910: Industrial Engineering Internship
An industry-based learning experience that provides opportunities to apply industrial engineering skills, concepts and theories in a practical context. Requires submission of an internship plan for prior approval and a final oral presentation / written report at the completion of the internship. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: instructor and departmental consent
Recommended: junior standing

IMSE 4920: Industrial Engineering COOP
An industry-based learning experience that provides opportunities to apply industrial engineering skills, concepts and theories in a practical context. Requires submission of a COOP plan for prior approval and a final oral presentation / written report at the completion of the COOP. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: instructor and departmental consent
Recommended: junior standing

IMSE 4970: Capstone Design I
Overview of professional engineering issues such as ethics, team dynamics, communication, and project management. Includes team-based industrial assessments to develop skills in problem/opportunity identification. Graded on A-F basis only.
Credit Hour: 1
Prerequisites: Restricted to IMSE students; Senior Standing, IMSE 2030; IMSE 2710

IMSE 4970W: Capstone Design I - Writing Intensive
Overview of professional engineering issues such as ethics, team dynamics, communication, and project management. Includes team-based industrial assessments to develop skills in problem/opportunity identification. Graded on A-F basis only.
Credit Hour: 1
Prerequisites: Restricted to IMSE students; Senior Standing, IMSE 2030; IMSE 2710

IMSE 4980: Capstone Design II
Industry-based team design experience structured to integrate material presented throughout the Industrial and Manufacturing Systems Engineering curriculum. Must immediately follow IMSE 4970.
Credit Hours: 3
Prerequisites: Restricted to IMSE student; IMSE 3810, IMSE 4310, and IMSE 4970

IMSE 4980W: Capstone Design II - Writing Intensive
Industry-based team design experience structured to integrate material presented throughout the Industrial and Manufacturing Systems Engineering curriculum. Must immediately follow IMSE 4970.
Credit Hours: 3
Prerequisites: Restricted to IMSE student; IMSE 3810, IMSE 4310, and IMSE 4970

IMSE 4990: Undergraduate Research in Industrial Engineering
Independent investigation or project in industrial engineering. May be repeated to 6 hours.
Credit Hour: 0-6

IMSE 4995: Undergraduate Research Industrial Engineering - Honors
Independent investigation or project in industrial engineering. May be repeated to 6 hours. Enrollment limited to receiving departmental honors
Credit Hour: 0-6
Prerequisites: Restricted to IMSE students only

IMSE 7001: Topics in Industrial and Manufacturing Systems Engineering
Current and new technical developments in industrial engineering.
Credit Hours: 3

IMSE 7110: Engineering Statistics
Understanding and application of statistical analysis of techniques. Emphasis on hypothesis testing, regression analysis, analysis of variance (ANOVA) and design of experiments (DOE).
Credit Hours: 3
Prerequisites: grade of C- or better in IMSE 3110

IMSE 7210: Linear Optimization
(cross-leveled with IMSE 4210). Theory and application of linear optimization.
Credit Hours: 3
Prerequisites: IMSE 2210

IMSE 7220: Optimization Modeling and Computational Methods
(cross-leveled with IMSE 4220). Modeling and solution techniques for mathematical optimization, including linear, nonlinear, integer, and stochastic programming. Emphasis on formulation of models for most-efficient use of solution algorithms. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: IMSE 3110, IMSE 4210
IMSE 7230: Operations Research Models
Formulates probabilistic models and determines optimal control policies for queuing and inventory systems. Introduces Markov chains and dynamic programming.
Credit Hours: 3
Prerequisites: grade of C- or better in IMSE 2110 and IMSE 3110

IMSE 7280: Systems Simulation
Discrete-event stochastic systems modeling and experimentation using simulation software. Statistical design and analysis including distribution fitting and alternative comparison methodologies. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: grade of C- or better in IMSE 4110, INFOTC 1040 or CMP_SC 1050

IMSE 7310: Integrated Production Systems Design
Design and operation of production systems, including lean production concepts, just-in-time / kanban, facility layout and material flow issues.
Credit Hours: 3
Prerequisites: IMSE 4210, IMSE 4280

IMSE 7330: Material Flow and Logistics System Design
Modeling and analysis of structural and operational issues associated with material-flow system design including facility location, warehouse/ inventory systems, and distribution/transportation systems.
Credit Hours: 3
Prerequisites: IMSE 4210, IMSE 4280

IMSE 7350: Production and Operations Analysis
Quantitative methods for forecasting, scheduling, and production control in manufacturing and service systems. Use of Enterprise Resource Planning (ERP) systems.
Credit Hours: 3
Prerequisites: IMSE 4210 and IMSE 4230

IMSE 7360: Supply Chain Engineering
(cross-leveled with IMSE 4360). Modeling and analysis of supply chain network design and management issues including integration of production, inventory control, supplier selection, risk management and logistics network design. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: IMSE 4350

IMSE 7380: Six Sigma Methodology
(cross-leveled with IMSE 4380). An overview of the Six Sigma DMAIC methodology for analyzing and improving processes. Requires completing a Six Sigma Green Belt project. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: Grade of C or better in IMSE 2110 or IMSE 4110 or STAT 4710

IMSE 7385: Lean Six Sigma Green Belt Project
Application of the Lean Six Sigma methodology in an industry-based project.
Credit: 1
Prerequisites: IMSE 4310

IMSE 7410: Management Information Systems Design
MIS concepts and management issues, HTML for web pages and eShop (front office operation), back-office operations using relational databases, introduction for SQL. Graded on A-F basis only.
Credit Hours: 3
Prerequisites: INFOTC 1040 or CMP_SC 1050

IMSE 7420: Web-Based Information Systems
Data models, design of databases using E-R, UML (Access/Oracle), web databases, web servers and interfaces (Visual Basic, JavaScript), E-commerce infrastructure (PDM, STEP, XML), data mining for management information and services.
Credit Hours: 3
Prerequisites: IMSE 4410 and instructor's consent

IMSE 7550: Computer Aided Design and Manufacturing
(cross-leveled with IMSE 4550). Product realization process from design, process planning, to manufacturing. Includes CE, DFS/DFM, CAD, CAPP, CNC, and survey of manufacturing methods.
Credit Hours: 4

IMSE 7560: Introduction to Rapid Prototyping
(cross-leveled with IMSE 4560). Course covers all five MU systems: FDM, SLS, SLA, Polyjet, 3DP. Students will learn fundamental rapid prototyping and related concepts, and design and produce models from each system. Graded on A-F basis only.
Credit Hours: 3

IMSE 7570: Computer Integrated Manufacturing Control
Implementation of computer integrated manufacturing (CIM) and automation at the shop floor level. Covers essential components of machine sensing and actuation (including programmable robots), information representation and processing, data communication and networking.
Credit Hours: 3

IMSE 7580: Industrial Energy Efficiency and Management
(cross-leveled with IMSE 4580). Introduction to the fundamentals of industrial energy efficiency and management. Covers the essential concepts, best practices, management systems and current standards to achieve and improve energy efficiency in industrial settings, and utilizes hands-on experiences involving real assessment and analysis of industrial site visits and projects.
Credit Hours: 3
Prerequisites: IMSE 2030 or instructor's consent
IMSE 7610: Engineering Quality Control
Analysis of quality in manufacturing including control charts, sampling plans, process capability, experimental design; introduction to system reliability. Overview of Six Sigma and DMAIC methodology.
Credit Hours: 3
Prerequisites: IMSE 4110 or IMSE 7110

IMSE 7705: Entrepreneurial Innovation Management: Advanced Enterprise Conception
Develop a new business and technology plan (including marketing, finance, engineering, manufacturing, and production concepts) in this joint College of Engineering/College of Business course.
Credit Hours: 3

IMSE 7760: Entrepreneurial Innovation Management: Advanced Enterprise Design
Expand on IMSE 7750 business and technology plan into a business operation plan: advertising designs, facilities layout, selling and distribution channels, product designs, accounting procedures, manufacturing processes, and product prototypes.
Credit Hours: 3
Prerequisites: IMSE 7750

IMSE 7770: Entrepreneurial Innovation Management: Advanced Enterprise Operations
Perform the day-to-day operations for an enterprise by managing all business processes including finance, manufacturing, sales, and delivery.
Credit Hours: 3

IMSE 7810: Cognitive Ergonomics and Decision Making
(cross-leveled with IMSE 4810). This course will cover the study of empirical research in cognitive ergonomics and Human-Computer Interaction (HCI). Students will learn cognitive information processing, mental workload, human reliability, decision-making, and empirical methods in HCI research. Graded on A-F basis only.
Credit Hours: 3

IMSE 8001: Advanced Topics in Industrial & Manufacturing Systems Engineering
Current and new technical developments in industrial engineering.
Credit Hours: 3

IMSE 8030: Advanced Manufacturing and Supply Systems
The design, regulation, and optimization of manufacturing and supply systems through systems analysis.
Credit Hours: 3

IMSE 8070: Research Methods in Industrial & Manufacturing System Engineering
Development of research approach. Selection of topic area including techniques of literature search with special emphasis on problem definition. Topics pertinent to planning, organizing and carrying out industrial engineering research or design project.
Credit Hour: 1

IMSE 8085: Problems in Industrial and Manufacturing Systems Engineering
Supervised investigation in industrial engineering to be presented in the form of an engineering report.
Credit Hour: 1-99

IMSE 8087: Industrial Engineering Graduate Seminar
Selected topics in industrial engineering; oral presentations and engineering reports. Graded on S/U basis only.
Credit Hours: 0

IMSE 8110: Engineering Experimentation
Application of advanced statistical methods for the analysis of engineering design and experimental problems.
Credit Hours: 3
Prerequisites: IMSE 4110 or IMSE 7110

IMSE 8210: Operations Research-Discrete Models
Applications of discrete operations research methods, including linear programming, fuzzy sets, integer programming, and meta-heuristics.
Credit Hours: 3
Prerequisites: IMSE 4210 or IMSE 7210

IMSE 8220: Nonlinear Optimization
Introduces computational non-linear mathematical programming procedures their use in solving complex industrial systems design problems.
Credit Hours: 3
Prerequisites: IMSE 4210 or IMSE 7210

IMSE 8230: Operations Research-Stochastic Models
Theory and applications of stochastic processes; includes continuous time Markov chain, Markov decision process, queueing theory, and stochastic manufacturing systems.
Credit Hours: 3
Prerequisites: IMSE 4230 or IMSE 7230

IMSE 8280: Advanced Systems Simulation
Theory and practice of dynamic modeling and statistical experimentation.
Credit Hours: 3
Prerequisites: IMSE 4280

IMSE 8310: Advanced Integrated Production Systems
Advanced study of the design and operation of flow shop, job shop, and cell-based production systems, including scheduling, layout and material flow issues.
Credit Hours: 3
Prerequisites: IMSE 4310 or IMSE 7310

IMSE 8370: Supply Chain Modeling and Analysis
Theory and application of supply chain networks, integration of production and inventory control methods.
IMSE 8410: Advanced Management Information Systems Design
Develops requirements for management information, staffing, cost estimating, evaluation, and the design of management communication systems; includes case studies.
Credit Hours: 3
Prerequisites: IMSE 8210, IMSE 8230

IMSE 8550: Advanced CAD/CAM
Covers the state-of-the-art in CAD/CAM and explores the latest developments, residual problems, and new direction in CAD/CAM. Includes sculptured surface modeling, rapid prototyping and manufacturing, integrated process planning, shape analysis, machine intelligence.
Credit Hours: 3
Prerequisites: IMSE 4550 or IMSE 7550

IMSE 8610: Advanced Quality Systems
Advanced process control charts, empirical model-building, fractional factorial designs and Taguchi techniques as tools for process and product improvement, professional ethics in quality management; TQM and ISO 9000.
Credit Hours: 3
Prerequisites: IMSE 4610, IMSE 8110

IMSE 8730: Strategic Enterprise Management
Topics including enterprise strategies, process and content models, strategy implementation, value chain analysis, business processes, systems engineering approaches, business process reengineering, and dynamic systems modeling.
Credit Hours: 3

IMSE 8810: Human Factors
Human factors inputs, outputs and environment and their influence on design and evaluation of man and machine systems.
Credit Hours: 3

IMSE 8850: Health Care Systems Design and Analysis
Health care systems design principles and major problems, basic organization within health care system, alternative system design strategies, factors affecting design process success.
Credit Hours: 3

IMSE 8990: Research-Masters Thesis in Industrial Engineering
Independent investigation in field of industrial engineering to be presented as a thesis. Graded on S/U basis only.
Credit Hour: 1-99

IMSE 9210: Advanced Linear Optimization
Advanced study of linear programming, including optimization and its application including large-scale optimization, primal-dual methods, decomposition, interior point methods, convex analysis, and integer programming. Prerequisites: IMSE 4210 or IMSE 7210
Credit Hours: 3

IMSE 9230: Stochastic Service Systems
Development and application of stochastic models in the design of service systems in which either demands for service or services supplies, or both, have a probabilistic nature.
Credit Hours: 3
Prerequisites: STAT 4750, IMSE 8230

IMSE 9250: Dynamic Programming
Introduces theory and computational aspects of dynamic programming; its application to sequential decision problems.
Credit Hours: 3
Prerequisites: IMSE 4210 or IMSE 7210 and IMSE 4230 or IMSE 7230

IMSE 9260: Integer and Combinatorial Optimization
Theory, solution methodology, and application of integer and combinatorial optimization.
Credit Hours: 3
Prerequisites: IMSE 8210

IMSE 9990: Research-Doctoral Dissertation in Industrial Engineering
Independent investigation in field of industrial engineering to be presented as a dissertation. Graded on S/U basis only.
Credit Hour: 1-99