



industrial & systems engineering

WAYNE STATE UNIVERSITY COLLEGE OF ENGINEERING

## Bachelor of Science in Industrial Engineering Student Handbook

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## From the Undergraduate Program Chair

On behalf of the Undergraduate Program Committee and the entire ISE faculty, I would like to welcome you to our program. I am dedicated to ensuring that you receive a high-quality, rewarding education in Industrial Engineering.



### Important Contact Information

Department Chair	Undergraduate Program Chair	Academic Advisor
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The purpose of this handbook is to provide industrial and systems engineering students at Wayne State University a quick and complete source of information and guidelines to curriculum requirements and academic policies. The most up-to-date version of this document will be placed on the department web site at <https://engineering.wayne.edu/industrial-systems>.

This Handbook is intended to be comprehensive and up to date but is subject to change without notice. Since the University Bulletin is published infrequently, this document supersedes the University Bulletin regarding ISE requirements and policies.

Consult the Academic Advisor or the Undergraduate Program Chair to determine your official status and current requirements.

## About the Profession & Program

Industrial Engineering is concerned with the design, improvement and installation of integrated systems of people, materials, information, equipment and energy. It draws upon specialized knowledge and skill in the mathematical, physical, and social sciences together with the principles and methods of engineering analysis and design, to specify, predict, and evaluate the results to be obtained from such systems.

*- Institute of Industrial & Systems Engineers.*

The industrial engineer is a broadly trained integration engineer, concerned with enabling complex systems to function effectively. Managing the inventory of a production facility, for example, involves issues of production and stocking policy, manufacturing equipment, human resources, customer demand, and supplier relationships. The industrial engineer must understand the interaction of the components of a system and coordinate the flow of materials and information to effectively manage the operation. The industrial engineer plays an important role in defining information needs and developing strategies for decision making based on incomplete knowledge. However, the skills of the industrial engineer have much greater application than to traditional production environments. In a growing service sector of the economy including health care delivery, public safety, air transportation, and banking, for example, issues of resource management, scheduling, quality of service, and systems design are important.

Traditionally, the industrial engineer was responsible for developing the process capability to realize the output of design engineering. Today, however, the boundary between design and industrial engineering is becoming blurred. Both groups work together in teams to assure the soundness of design and manufacturability of product. The industrial engineer must understand the design process, but the special expertise which is brought by the industrial engineer is the knowledge and understanding of the production process.

Today's production is computer-based and provides flexibility through computer control. The industrial engineer is responsible for designing and implementing the cells and production lines which become the basic units of manufacture. Increasingly, such production units are becoming parts of an integrated factory system and are not simply islands of automation. The industrial engineer must understand the multi-layered control architecture of the integrated factory, and the computer-based technologies which enable it.

The Department maintains laboratories in systems simulation, computer-aided manufacturing, human systems, and concurrent engineering design.

#### Program Educational Objectives *(Effective since Fall 2024)*

Building on skills developed in the academic program, and extended by experience and personal self-improvement, the graduates of our program have the ability to:

1. Effectively leverage technical knowledge, expertise in decision making, system design, thinking, and analysis.
2. Take on leadership roles, actively engage in multidisciplinary teams, and participate in professional organizations.
3. Grow professionally through lifelong learning while staying attuned to the latest trends in industrial engineering.
4. Contribute to the local and global communities, enriching the social and economic environment of society.

### Student Learning Outcomes

Upon completion of the Industrial Engineering Program, our graduates will exhibit skills necessary of all engineering professionals, including an ability to:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. an ability to communicate effectively with a range of audiences.
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

### Consistency of Program Objectives with University Mission Statement

The [Wayne State University mission statement](#) recognizes a dual character of the university and its programs. WSU "creates and advances knowledge, prepares a diverse student body to thrive, and positively impacts local and global communities". The Industrial Engineering Program defined by the objectives stated above, aims to prepare graduates for careers applying skills and knowledge to benefit the manufacturing and service industries in southeast Michigan.

### Accreditation

The ISE Program at Wayne State University is accredited by the Engineering Accreditation Commission of ABET Inc., 111 Market Place, Suite 1050, Baltimore, MD 21202-4012 - telephone: (410) 347-7700, <http://www.abet.org>. Wayne State University is accredited by the North Central Association Commission on Accreditation and School Improvement (NCA CASI).

## Faculty

Name	Room No (MEB)	Phone No (313)	E-mail (@wayne.edu)	Research Interests
Ratna Babu Chinnam (Department Chair)	2161	577-4846	<a href="mailto:r_chinnam@wayne.edu">r_chinnam</a>	Intelligent Engineering Systems, Supply Chain Mgmt, Production and Operations Mgmt.
Susan Aslanturk		577-6782	<a href="mailto:gl9815@wayne.edu">gl9815</a>	Data Mining, Descriptive & Predictive Modeling with Applications in Healthcare
Kenneth Chelst	2069	577-3857	<a href="mailto:kchelst@wayne.edu">kchelst</a>	Decision and Risk Analysis, Engineering Management, Urban Services, Operations Research
Evrin Dalkiran	2149	577-5372	<a href="mailto:ev5796@wayne.edu">ev5796</a>	Decision Analysis and Risk Management in Healthcare, Math Programming, Optimization
Darin Ellis	2145	577-3296	<a href="mailto:rdellis@wayne.edu">rdellis</a>	Human Factors Engineering, Human Computer Interaction
Yanchao Liu	2169	577-3301	<a href="mailto:yanchaoliu@wayne.edu">yanchaoliu</a>	Data Science and Analytics, Applied Engineering Statistics, Operations Research
Kyoung-Yun Kim	2067	577-4396	<a href="mailto:kykim@wayne.edu">kykim</a>	Globalization of business and industry
Sara Masoud	2057	577-4655	<a href="mailto:hb9225@wayne.edu">hb9225</a>	Data Analytics, Dynamic data driven systems, Machine Learning, Simulation, Smart Manufacturing
Olugbenga Mejabi	2157	577-3134	<a href="mailto:mejabi@wayne.edu">mejabi</a>	Flexible Manufacturing, Simulation, Factory Control.
Leslie Monplaisir	2163	577-1645	<a href="mailto:ad5365@wayne.edu">ad5365</a>	Group Decision Support Systems, Integrated Product Development & Computer-Integrated Manufacturing.
Alper Murat	2051	577-3872	<a href="mailto:alper@wayne.edu">alper</a>	Logistics & Distribution Planning, Supplier Selection and Contracting, Applied Operations Research
Jeremy Rickli	2173	577-1752	<a href="mailto:jrickli@wayne.edu">jrickli</a>	Sustainable Manufacturing, Remanufacturing, Fault Detection and Diagnosis in Manufacturing
Saravanan Venkatachalam	2155	577-1821	<a href="mailto:saravanan.v@wayne.edu">saravanan.v</a>	Operations Research, Supply Chain Management, Pricing & Revenue Management
Kai Yang	2151	577-3858	<a href="mailto:kyang@wayne.edu">kyang</a>	Robust Engineering, Quality Engineering Operations Research
Qingyu Yang	2167	577-9665	<a href="mailto:qyang@wayne.edu">qyang</a>	Systems Informatics, Complex System Modeling and Analysis
Melike Yildirim	2015		<a href="mailto:melike.y@wayne.edu">melike.y</a>	Medical Decision-Making, Prevention, Early Detection & Treatment of Chronic and Infectious Diseases
Murat Yildirim	2049	577-3858	<a href="mailto:murat@wayne.edu">murat</a>	Operations Research, Data Analytics, Energy and Mobility

## Admission Requirements

All students eligible for admission to the University are also eligible for admission to the College of Engineering. As a result of Wayne State University's urban mission, one of the governing principles of the university's admissions process is to be a university of opportunity to students from the southeastern Michigan region. Therefore, the university has a rolling admissions policy so that qualified students may be admitted through the beginning of the semester in which they wish to enroll. In addition, minimum admission standards have been set by the university at a level to provide students with the best opportunity to pursue a university-level education.

In order to provide appropriate academic advising, it has been determined by the faculty and administration of the College of Engineering that students interested in engineering should be admitted directly to the College. Courses within the pre-engineering program include courses taught in the College of Engineering as well as other preparatory courses taught outside the college. While recognizing the importance of working within the admissions framework established by the university, the Engineering faculty have also noted that many students who are both eligible for admission and interested in engineering may not be prepared to begin the engineering pre-professional program. As a result, a multi-tiered admissions structure has been established for the College.

## Pre-Professional Admission

In order to be admitted to the pre-professional engineering program, students must meet one of the following criteria:

- Freshmen:
  - 3.0 minimum cumulative high school GPA in science and math courses.
  - Minimum Math ACT score of 21 (SAT Math score of 530).
  - Placement into MAT 1800 (pre-calculus), CHM 1125 (General Chemistry for Engineers), and ENG 1020 (Introductory College Writing)<sup>1</sup> or above.
- Transfer students:
  - 3.0 minimum cumulative college GPA.
  - Placement into MAT 1800 (pre-calculus), CHM 1125 (General Chemistry for Engineers), and ENG 1020 (Introductory College Writing) or above based on transfer credit or placement examinations.
  - Completion of at least 12 credits at the college-level.

Pre-professional students must complete the following sequence of courses, either at Wayne State or through accepted transfer credit, with a minimum grade point average of 2.5 with no grade lower than a C- in order to advance to the professional program of their choice:

- Math: MAT 2010, 2020, 2030 (Calculus 1 through 3)

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<sup>1</sup> Students who meet all other requirements for admission to the pre-professional program but who have placed into no more than one lower level course in English (ENG 1010) or chemistry (CHM 1040) will be provided with a waiver to start in the pre-professional program.

- Chemistry: CHM 1125/1130 (General Chemistry for Engineers with lab)
- Physics: PHY 2175, 2185 (University Physics for Engineers 1, 2)
- English: ENG 1020 (Introductory College Writing)
- Basic Engineering: BE 1200 (Design in Engineering), 1300/1310 (Material Science for Engineering Applications with lab)

**EOS Program:** Students who are admissible to the University but who do not meet the minimum standards for the Engineering pre-professional program are admitted to the EOS Program. These students must complete a one-year program of math (algebra and pre-calculus), science (chemistry and physics), English, and pre-engineering courses with a minimum grade point average of 3.0 in order to progress into the pre-professional program of their choice. Students who do not meet these requirements after the completion of the one-year program are counseled to select a program other than engineering in order to meet their professional goals.

#### Professional Program Admission:

A small number of freshmen and a significant number of transfer students are admitted directly to the professional engineering program of their choice. Requirements for direct admission include:

- Freshmen:
  - 3.5 minimum cumulative high school GPA, overall and in science and math courses
  - Minimum Math ACT score of 26 (SAT Math of 650)
  - Placement into MAT 2010 (Calculus 1), CHM 1225 (General Chemistry for Engineers), and ENG 1020 (Introductory College Writing) or above
- Transfer students:
  - 3.0 cumulative college GPA, overall and in science and math courses
  - Completion of equivalent of MAT 2010, 2020, 2030 (Calculus 1 to 3); CHM 1125/1130 (General Chemistry for Engineers with lab); PHY 2175, 2185 (University Physics for Engineers 1, 2); and ENG 1020 (Introductory College Writing) with no grade lower than a C

Students who progress through the pre-professional program (see below) must earn a minimum of a 2.5 cumulative grade point average in the pre-professional courses with no grade lower than a C- in order to advance to the professional program of their choice. Students directly admitted to the professional program must maintain their grade point average above the 2.5 level or they will be moved back down to the pre-professional program and will be required to meet the general requirements for advancement to professional status.



## Degree Requirements

Candidates for the BS degree must complete a minimum of 122 credits in course work, including satisfaction of the University General Education Requirements (see <https://bulletins.wayne.edu/undergraduate/general-information/general-education/>), as outlined in the following curriculum. All course work must be completed in accordance with the academic procedures of the University and the College governing undergraduate scholarship and degrees; see the following sections in the Undergraduate Bulletin: Degree Requirements, Academic Regulations, Division of Engineering: B. S. Program.

The BS in Industrial Engineering program is built on a solid foundation of core IE courses. Students choose IE Technical Electives to gain depth in areas such as production management or quality engineering. In addition, a Directed Elective—approved by the IE undergraduate advisor and selected from an approved list—must support the student's plan of work. Students are strongly encouraged to meet with the advisor to plan their professional program, including core, Technical, and Directed Electives.

The Engineering Design Project sequence (IE 4800/4880) is a year-long capstone taken in the final academic year (within 40 credits of graduation). In the Fall, students enroll in IE 4800 (2 credits), form teams, and plan their project, typically in collaboration with industrial partners. In Winter, they take IE 4880 (2 credits) and apply their IE knowledge to the project. Students should consult an advisor before enrolling.

To take IE 4800, students must have passed IE 3120, IE 4250, and IE 4850, and have completed or be concurrently enrolled in at least two of the following: IE 4420, IE 4330, IE 4560. In special cases, with instructor approval, students may enroll in IE 4800 if they have completed at least 6 of the 8 IE core courses and will finish the remaining core courses with IE 4880 the following semester.

The IE program is rigorous. Students taking a full load (16 credits) should expect to spend over 40 hours per week on coursework. With consistent progress, the degree can be completed in 4 academic years. Transfer and non-traditional students should plan for a minimum of 2 years in the professional program (2.5 years if starting in Winter).

The curriculum summary table below outlines degree requirements, including general education courses listed by subject. Requirements are current as of this handbook's publication, but students should confirm details with an academic advisor.

Degree Requirements	
Description	Credits
Wayne Experience (WE)	1
Cultural Inquiry-CI (PHIL 1120)	3
Social Inquiry-SI (ECON 2010 or 2020) <sup>2</sup>	4
Any Diversity, Equity, & Inclusion (DEI)	3
Any Global Learning (GL)	3
Any Civic Literacy (CL)	3
ENG 1020 Introductory College Writing (BC)	3
ENG 3050 Technical Communication I: Reports (IC)	3
ENG 3060 Technical Communication II: Presentations (OC)	3
CHM 1125 General Chemistry I for Engineers (NSI)	3
CHM 1130 General Chemistry I Laboratory (NSI)	1
MAT 2010 Calculus I	4
MAT 2020 Calculus II	4
MAT 2030 Calculus III	4
MAT 2150 Differential Equations and Matrix Algebra	4
PHY 2175 University Physics for Engineers I (NSI)	4
PHY 2185 University Physics for Engineers II (NSI)	4
BE 1200 Basic Engineering I - Design in Engineering (CL)	3
BE 1300 Basic Engineering II - Material Science for Engineering Applications	3
BE 1310 Basic Engineering II – Material Science for Engineering Applications Lab	1
BE 2100 Basic Engineering III - Probability and Statistics in Engineering	3
BE 1600 Introduction to Programming and Computation: Python	3
Engineering Breadth #1 (See Advisor for current list of acceptable courses)	3
Engineering Breadth #2 (See Advisor for current list of acceptable courses)	3
IE 3120 Work Design	3
IE 4250 Data Science and Analysis	3
IE 4420 System Simulation	3
IE 4850 Engineering Economy	3
IE 4560 Operations Research	3
IE 4260 Principles of Quality Control	3
IE 4310 Production Control (WI)	3
IE 4330 Facilities Design	3
IE 4800 Engineering Design I: Project Management	2
IE 4880 Engineering Design II	2
IE Technical Electives (See Advisor for current list of acceptable courses)	18
Directed Elective (See Advisor for current list of acceptable courses)	3
<b>TOTAL MINIMUM CREDITS REQUIRED</b>	<b>122</b>

<sup>2</sup> Student may transfer a different course that fulfills Social Inquiry (SI) requirement.

## Curriculum

Freshman Year	
<u>First Semester</u> BE 1200 Basic Engg. I: Design in Engineering: Cr. 3 CHM 1125 (NSI) General Chemistry I for Engineers: Cr. 3 CHM 1130 (NSI) General Chemistry I Laboratory: Cr. 1 ENG 1020 (BC) Introductory College Writing: Cr. 3 MAT 2010 (QE) Calculus I: Cr. 4 Wayne Experience (WE) <sup>3</sup> : Cr. 1 <b>Total Credits: 15</b>	<u>Second Semester</u> BE 1300 Basic Engg. II: Materials Science for Engineering Applications: Cr. 3 BE 1310 Materials Science for Engineering Lab: Cr. 1 MAT 2020 Calculus II: Cr. 4 PHY 2175 (NSI) University Physics for Engineers I: Cr. 4 PHI 1120 (CI) Professional Ethics: Cr.3 <b>Total Credits: 15</b>
Sophomore Year	
<u>First Semester</u> BE 2100 Basic Engg. III: Probability and Statistics in Engineering: Cr. 3 MAT 2030 Calculus III: Cr. 4 PHY 2185 University Physics for Engineers II: Cr. 4 Engineering Breadth Elective <sup>4</sup> : Cr. 3 <b>Total Credits: 14</b>	<u>Second Semester</u> BE 1600 Introduction to Programming and Computation: Python Cr. 3 MAT 2150 Differential Equations & Matrix Algebra: Cr. 4 ECO 2010/2020 (SI) Principles of Microeconomics /Macroeconomics: Cr. 4 (DEI) Diversity, Equity and Inclusion: Cr. 3 IE Technical Elective: Cr. 3 <b>Total Credits: 17</b>
Junior Year	
<u>First Semester</u> ENG 3050 (IC) Tech. Communication I Reports: Cr. 3 IE 3120 Work Design: Cr. 3 IE 4850 Engineering Economy: Cr. 3 IE Technical Elective: Cr. 3 IE Technical Elective: Cr. 3 (GL) Global Learning: Cr. 3 <b>Total Credits: 18</b>	<u>Second Semester</u> ENG 3060 Technical Comm. II: Presentations: Cr. 3 IE 4250 Data Science and Analysis: Cr. 3 IE 4420 System Simulation: Cr. 3 Engineering Breadth Elective <sup>5</sup> : Cr. 3 (CIV) Civic Literacy: Cr. 3 <b>Total Credits: 15</b>
Senior Year	
<u>First Semester</u> IE4260 Principles Quality Control: Cr. 3 IE4560 Operations Research: Cr. 3 IE4800 Engineering Design I: Project Mngt: Cr. 2 IE Technical Elective: Cr. 3 Directed Elective <sup>6</sup> : Cr. 3 <b>Total Credits: 14</b>	<u>Second Semester</u> IE4310 Production Control (WI): Cr. 3 IE4330 Facilities Design: Cr. 3 IE4880 Engineering Design II: Cr. 2 IE Technical Elective: Cr. 3 IE Technical Elective: Cr. 3 <b>Total Credits: 14</b>

General Note: This information is provided to give students guidance for general planning purposes. Course schedules and degree requirements are subject to change; therefore, students are

<sup>3</sup> The Wayne Experience (WE) requirement has been suspended for the 2023-24 academic year.

<sup>4</sup> See Academic Advisor for current list of Engineering Breadth options

<sup>5</sup> See Academic Advisor for current list of Engineering Breadth options

<sup>6</sup> See Academic Advisor for the acceptability of directed elective courses. The directed elective must be approved by the program director or undergraduate advisor. A list of courses appropriate for the directed elective is available from the Department.

STRONGLY encouraged to develop a plan and regularly consult with the program's Academic Advisor or the UG Program Chair.

## IE Core Course Descriptions

The Bachelor of Science programs offered by the College of Engineering are built upon a strong core of common courses generally completed in the freshman and sophomore years under the *Pre-Professional Engineering* status. They satisfy the University General Education Requirements and provide the foundation for more targeted study at the department level. These courses and other University obligations can be found on the *Degree Requirements* section.

In the junior year, you'll transfer to the *Professional Industrial Engineering* program and focus on courses that support their major. Professors in the ISE Department have developed classes and sequences that provide in-depth understanding of the principles of industrial and systems engineering. Listed below are brief descriptions of courses offered for students declaring a major in Industrial Engineering. In addition to these undergraduate courses, students are allowed to select IE technical electives from the 5000 and 6000-level courses listed in the Graduate Bulletin (Note: all prerequisites apply).

### IE 3120 – Work Design Cr. 3

**Prerequisite:** BE 2100. Role of the human as an element of the work environment. Traditional issues of work standards, productivity analysis, and occupational safety are introduced. Examination of functional and organizational role of the worker; impact of emerging computer-based technologies on work design and implementation strategies are discussed.

### IE 4250 – Data Science and Analysis Cr. 3

**Prerequisite:** BE 2100. Advanced concepts for the analysis of variability in engineering problems, multivariate distributions, hypothesis testing, non-parametric statistics, point and interval estimation, fitting straight lines, goodness of fit tests, contingency tables, and an introduction to the analysis of variance.

### IE 4260 – Principles of Quality Control Cr. 3

**Prerequisite:** BE 2100. Statistical quality control including process capability, control charts, and acceptance sampling procedures. Procedures for measurement of dimensional tolerance are introduced. Computer-based data collection and analysis.

### IE 4310 – Production Control (W) Cr. 3

**Prerequisite:** ENG 3050. Enrolled in professional engineering program. The design of production planning and control systems. Materials management, forecasting, planning, scheduling of production systems, the planning and scheduling for large scale projects and introduction to the design of computerized materials management systems. Applications of operations research models to production control problem.

# Flow Chart for BS in IE Required Courses

## Legend

### General Education Requirements (16 cr.)

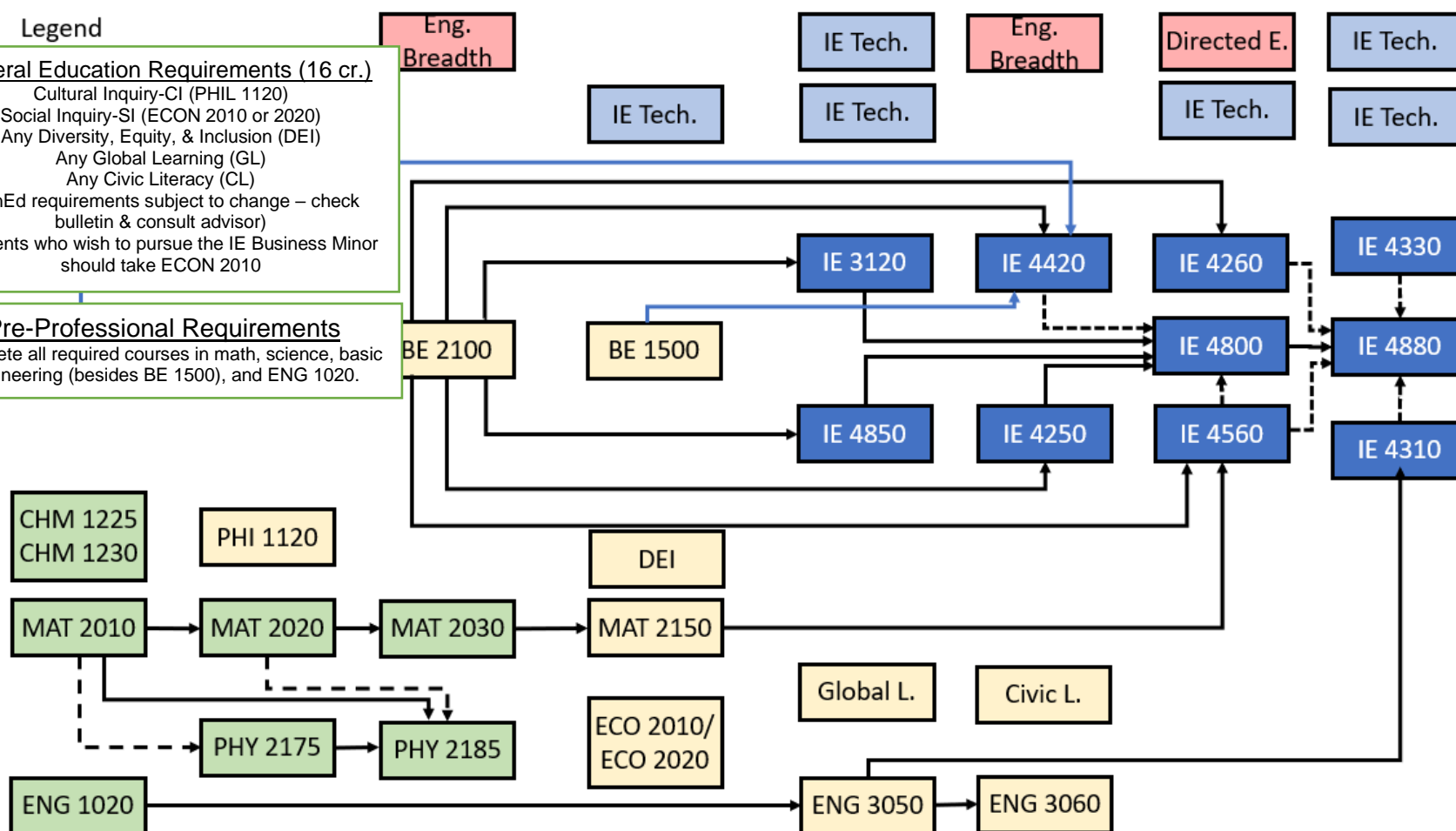
Cultural Inquiry-CI (PHIL 1120)  
Social Inquiry-SI (ECON 2010 or 2020)  
Any Diversity, Equity, & Inclusion (DEI)  
Any Global Learning (GL)  
Any Civic Literacy (CL)

(GenEd requirements subject to change – check bulletin & consult advisor)

\* Students who wish to pursue the IE Business Minor should take ECON 2010

### Pre-Professional Requirements

Complete all required courses in math, science, basic engineering (besides BE 1500), and ENG 1020.



## Industrial Engineering Requirements

There are 10 core courses (28 cr.) plus 18 credits of IE technical electives required. All IE courses require students to be registered in the IE Professional Program. Exceptions to this requirement may be granted with a petition to the UG program coordinator.

The course sequence is for illustrative purposes only depicting a typical path through the program. Check the Undergraduate Bulletin for current prerequisites.

To enroll in IE 4800 student must have taken and passed IE 3120, IE 4250, IE 4850, and should have taken and passed or be taking at least two of the IE 4420, IE 4330, IE 4560 in the same semester of IE 4800. Under special cases, students are allowed to register for IE 4800 provided that they have completed at least 6 of the eight IE core courses and are on track to complete all 8 IE core courses together with the IE 4880 in the following semester.

See the advisor for a plan of work that will best suit your needs.

IE 4330 – Facilities Design Cr. 3

**Prerequisite:** Enrolled in professional engineering program. Design of manufacturing, warehouse, and material handling facilities. Use of analytic and computer-aided methods in the facilities design process.

IE 4420 – Systems Simulation Cr. 3

**Prerequisite:** BE 1200, BE 1500, BE 2100. Enrolled in professional engineering program. Systems modeling and discrete event simulation. Methodology applied to analysis and design of a broad range of systems including both production and service systems. Computer assignments and a term project are required.

IE 4560 – Operations Research Cr. 3

**Prerequisite:** BE 2100 and MAT 2150. Enrolled in professional engineering program. An introduction to the philosophy of operations research. Formulation of linear programming models and their solutions. Duality and sensitivity analysis. The transportation model. Introduction to probabilistic modeling and application of queuing models.

IE 4800 - Engineering Design Project I Cr. 2

**Prerequisite:** IE 3120, IE 4250, IE 4850, and should have taken and passed or be taking at least two of the following: IE 4420, IE 4330, IE 4560 in the same semester as IE 4800. Admission to the IE Professional Program. Preparation for capstone course – Covers project selection, team building, and methodological preparation required for Engineering Design Project II.

IE 4850 – Engineering Economy Cr. 3

**Prerequisite:** BE 2100; Enrolled in professional engineering program. Economic analysis of engineering projects. Selection of appropriate interest rates and methods of analysis, depreciation, tax considerations and use of accounting data in the comparison of investment alternatives.

IE 4880 - Engineering Design Project II Cr. 2

**Prerequisite:** Prerequisites 4800 and pre- or co-requires IE 4260, 4310, 4330, 4420, and 4560; Admission to the IE Professional Program. An intensive design experience defined and executed by the student; Requires synthesis and application of skills and knowledge gained in the program.

AGRADE students should take IE 6210 in lieu of IE 4250 and IE 6560 in lieu of IE 4560.

IE 6210 Applied Engineering Statistics Cr. 3

**Prerequisite:** BE 2100. Analysis of variability in engineering decision making; data analysis, probabilistic models, hypothesis testing, regression and analysis of variance. No credit after IE 4250.

IE 6560 Deterministic Optimization Cr. 3

**Prerequisite:** BE 2100 and MAT 2150. Introduction to philosophy of operations research. Formulation of linear program models and their solutions. Duality and sensitivity analysis. The transportation models. Introduction to probabilistic modeling and applications of queuing models. Network models decision theory.

## Technical Electives

Any course in with the IE designation from the 0000-6999, and DSA and DSB designation, that is not otherwise required (see exceptions below) is a candidate for IE technical elective credit. Some courses at the master's level, including IE 6210, IE 6430, IE 6442 and IE 6560 may not be taken for undergraduate credit because their content overlaps with undergraduate required courses. Additionally, some 6000-level courses require graduate standing and are thus may not eligible for undergraduate technical elective credit.

The following is a partial list of technical electives. In addition to these courses, other courses in the college of engineering may be eligible for IE technical elective credit if their content is highly relevant to IE research and practice.

IE 3450 – Manufacturing Processes I Cr. 3

**Prerequisite:** BE 1300, BE 1310, BE 1500, ME 2420. A study of the field of manufacturing processes from a mechanical engineering design standpoint. Topics include processing of metals, polymers, and ceramics, and computer-aided manufacturing.

IE 4355 Product Engineering Cr. 3

**Prerequisite:** BE 2100. Enrolled in professional engineering program. Current principles and processes of product engineering. Use of integrated product engineering processes and methods.

IE 4710 Labor Relations in Manufacturing Cr. 3

**Prerequisite:** Admission to the IE Professional Program. Knowledge and skills in administering labor agreements. Technical elective for Operations Management Leadership Program (OMLP) students.

IE 4990 – Directed Study Cr. 1-4 (max 2 credits per project)

**Prerequisite:** senior standing; consent of chairperson; outline of proposed study approved by instructor and chairperson prior to election of course. Supervised study and instruction in a field selected by the student.

IE 4991 – Undergraduate Internship Cr. 1-3 (max 2 credits per internship)

**Prerequisite:** junior or senior standing; consent of chairperson; outline of proposed internship approved by chairperson.

IE 5490 Creative Problem Solving in Design and Manufacturing Cr. 3

**Prerequisite:** None. Concepts of laws of natural development of engineering systems. Algorithm for inventive (creative) problem-solving (AIPS-85). Creative use of physical and geometrical effects in design of mechanical and manufacturing systems. Concepts of strength, stiffness, vibratory effects, reliability in mechanical design.

IE 5995 – Special Topics in Industrial Engineering Cr. 3

**Prerequisite:** Consent of instructor. Covers current topics in industrial engineering research and practice.

IE 6000 – Digital Automation. Cr. 3

**Prerequisite:** None. Fundamentals of digital control and logic; integration and automation solution technologies (barcode systems, vision systems, etc.); data acquisition. (W)

IE 6010 IoT and Edge AI Programming Cr. 3

**Prerequisite:** Approval from the instructor. Learn sensor programming on an embedded device; use Wi-Fi, Bluetooth and MQTT to implement data streaming, remote control, and multi-device networking; explore the IoT data processing life cycle which includes capturing, cloud storage, and data analysis; develop and deploy machine learning models for use in mobile and edge computing environments.

IE 6040 Simulation in Robotics Using ROS Cr. 3

**Prerequisite:** None. Robotic systems are increasingly used for various tasks and applications. ROS, the Robot Operating System, is an open-source framework used to direct the robots to perform tasks. ROS provides a software infrastructure for people who are interested in building and using robots.

IE 6125 Human Factors Engineering Cr. 3

**Prerequisite:** BE 2100. Current methods and topics in engineering research on human capabilities and limitations as a system component. Advanced analysis, modeling and design of human-centered systems.

IE 6220 Value Engineering Cr. 3

**Prerequisite:** None. Resource management; systematic approach to solving problems and making decisions; forcing latent capabilities to be applied to challenging assumptions; application of unbiased logic techniques to produce superior results.

IE 6240 – Quality Management Systems. Cr.3

**Prerequisite:** None. Design of quality management systems. Topics include: QFD, quality planning, business operating systems, TQM, standards, and auditing. Quality management tools such as PDCA and root case analysis. (W)



IE 6255 Quality Engineering Cr. 3

**Prerequisite:** IE 4250 or IE 6210, and approval from the instructor. This course covers several important methods in supporting engineering design activities. These methods include quality function deployment, axiomatic design, Theory of Inventive Problem Solving (TRIZ), Taguchi method (robust design) and tolerance design.

IE 6270 – Engineering Experimental Design. Cr. 3

**Prerequisite:** IE 4250 or IE 6210. The design of engineering experiments for manufacturing process analysis, human factors experimentation, societal systems analysis and life testing; basic experimental design models, blocking, factorial experiments, nested designs, covariance analysis, response surface analysis, estimation of effects. (F)

IE 6275 - Reliability Estimation Cr. 3

**Prerequisite:** IE 4250 or IE 6210. The course is designed for graduate students specializing in quality engineering. These individuals play a significant role in designing and developing new products and manufacturing systems and processes. Topics include: reliability measures, failure distributions, reliability block diagrams, reliability estimation using exponential and Weibull distributions, sequential life testing, test planning, and Bayesian reliability. (F)

IE 6310 – Lean Operations and Manufacturing. Cr. 3

**Prerequisite:** IE 4250 or IE 6210. Fundamental theories and concepts in lean manufacturing, six-sigma, mistake proofing, problem solving, process management. Students develop competency in identifying causes and sources of waste in manufacturing, industrial, and business operations. (F)

IE 6315 Production and Service Systems Cr. 3

**Prerequisite:** IE 4250 or IE 6210, and approval from the instructor. Fundamental theories and concepts in the design and operation of production systems for manufacturing and service organizations. Topics may include Inventory Management, Production Planning (MRP, JIT, ERP), Factory Physics, Production Control, Introduction to Supply Chain Management.

IE 6325 Supply Chain Management Cr. 3

**Prerequisite:** Approval from the instructor. Supply chain management and logistics is unique and, to some degree, represents a paradox because it is concerned with one of the oldest and also the most newly discovered activities of business. Supply chain system activities - communication, inventory management, warehousing, transportation, facility location, and production - have been performed since the start of commercial activity.

IE 6405 – Integrated Product Development. (AET 5600) (EVE 5600) Cr. 3

**Prerequisite:** Approval from the instructor. Product development process: product architectures, concurrent engineering. Integration of marketing, design, and manufacturing functions for product development. How such processes are designed to account for

various manufacturing and other business constraints to ensure that customer needs are met.

**IE 6420 Computer Aided Manufacturing and Lab Cr. 3**

**Prerequisite:** None. CAM and process planning. Principles of manufacturing planning and control. Design and integration of ASRS, AGVS, robotic systems in manufacturing.

**IE 6422 Flexible Manufacturing Systems Cr. 3**

**Prerequisite:** Approval from the instructor. Flexible manufacturing systems are a highly automated group technology machine cell, consisting of a group of processing stations, interconnected by an automated material handling and storage system, and controlled by an integrated computer system. The analysis and design of flexible manufacturing systems will be covered.

**IE 6425 Product Lifecycle Management and Sustainable Design Cr. 3**

**Prerequisite:** None. Introduction to modern principles, practices, and applications of PLM and sustainable design.

**IE 6435 Fundamentals of Sustainable Manufacturing Cr. 3**

**Prerequisite:** None. This course is designed to introduce the fundamental concepts of sustainable manufacturing. While the focus will be on sustainable manufacturing, topics will also include connections of sustainable design, environmental sciences, and the social sciences with sustainable manufacturing.

**IE 6470 – Stochastic System Modeling: Queuing and Simulation. Cr. 2**

**Prerequisite:** None. Description of queuing systems; analytical solutions; discrete events systems; modeling framework and object models; terminating and non-terminating systems; statistical analysis; case studies. (Y)

**IE 6490 Introduction to Systems Engineering in Design Cr. 3**

**Prerequisite:** None. Provides an introduction to the engineering and analysis of human-made systems with an emphasis on the process of bringing systems into being. Includes an introduction to systems sciences and engineering and will follow the engineering process from conceptual systems design through concept selection, concept validation, life-cycle acquisition, life-cycle costing, software development, system architecture, and risk management.

**IE 6510 – Information Systems for the Manufacturing Enterprise. Cr. 3**

**Prerequisite:** None. Methods for information flow modeling. Information needs of global manufacturer: design, testing, manufacture, and delivery. Partnership relation to suppliers via information. (W)

IE 6611 Fundamentals of Six Sigma Cr. 3

**Prerequisite:** None. This comprehensive course covers the fundamental aspects of Lean and Six Sigma, Lean operation principles and tools, and the Six Sigma process improvement, that is Define-Measure-Analyze-Improve-Control (DMAIC).

IE 6620 Lean Six Sigma Capstone Cr. 3

**Prerequisite:** IE 6611 and approval from the instructor. Covers extended aspects of Lean and Six Sigma, both the Six Sigma process improvement, that is, Define-Measure-Analyze-Improve-Control (DMAIC), and Lean operation principles and tools.

IE 6720 Engineering Risk and Decision Analysis Cr. 3

**Prerequisite:** None. Structure, modeling and analysis of technical management decisions with emphasis on multiple objectives and trade-offs, and significant uncertainty. Explores barriers to rational decision making. Instructor approval is needed.

IE 6830 Management of Technology Change Cr. 3

**Prerequisite:** Approval from the instructor. Focuses on technology change and use of systems approach to plan for, manage and implement the diffusion and dynamics of product, process and business model innovation.

IE 6840 (MGT 6840) – Project Management. Cr. 3

**Prerequisite:** Principles of successful project management including time and cost management, risk analysis, human resource management. Consideration of both operational and conceptual issues. Introduction to project management tools. (W)

IE 6850 – Manufacturing Strategies. Cr. 3

**Prerequisite:** None. The objective of this course is to introduce and discuss key components of manufacturing strategy and how these fits within an overall business strategy. Offered Intermittently.

DSA 6000 Data Science and Analytics Cr. 3

**Prerequisite:** Approval from the instructor. Basic data science and analytics concepts covered through case studies, success stories, and a semester project that cuts across all course modules.

DSA 6100 Statistical Learning for Data Science and Analytics Cr. 3

**Prerequisite:** Approval from the instructor. A fundamental course covering statistical learning techniques required for data science and analytics applications through methods, case studies, and a semester project that cuts across all course modules.

DSA 6200 Operations Research Cr. 3

**Prerequisite:** Approval from the instructor. Mathematical optimization models that come into play in data science and analytics applications covered through case studies and a

semester project. Heuristic solution approaches will also be addressed along with sensitivity analysis techniques.

#### DSA 6300 Decision Analysis and Simulation Cr. 3

**Prerequisite:** Approval from the instructor. Coherent approach to decision making, developing rules of thought to transform complex decisions into simpler decision situations covered through case studies, success stories, and a semester project that cuts across all course modules.

#### DSB 6000 Data Science Strategy & Leadership Cr. 3

**Prerequisite:** Approval from the instructor. Provides an understanding of how organizations can leverage data science and analytics to gain competitive advantage and how to use the data to align with a company's mission and goals.

#### DSB 6100 Marketing Analytics Cr. 3

**Prerequisite:** Approval from the instructor. Application and synthesis of marketing methods and modeling approaches to design, analyze, and optimize digital marketing campaigns and to understand customer segments, customer life cycles, and lifetime values.

#### DSB 6200 Manufacturing & Supply Chain Analytics Cr. 3

**Prerequisite:** Approval from the instructor. Discussion of the strategic and tactical issues surrounding the design and operation of supply chains through effective information collection, sharing, and collaboration, an understanding of applied analytical tools and methods that can be used to make better supply chain decisions and practical application of supply chain advanced planning and optimization solutions.

#### DSB 6300 Social and Collaboration Networks Cr. 3

**Prerequisite:** Approval from the instructor. Leveraging data science tools & technologies for network analysis with practical applications to support and provide a structure for fact-based decision making for individuals working to gain insight into complex organizational problems.

### Engineering Breadth Electives

IE students are required to take 8 credits and can elect from the following list of courses.

- ECE 3300 / ECE 3310 – Circuits + Lab (4 cr.)
- ECE 2620 – Introduction to Microcomputers (4 cr.)
- ME 2210 – Thermodynamics + Lab (3 cr.)
- ME 3300 – Fluid Mechanics (4 cr.)
- ME 3400 – Dynamics (3 cr.)
- BME 5010 – Engineering Physiology (4 cr.)
- CE 3250 – Applied Fluid Mechanics (4 cr.)
- CE 4600 – Transportation Engineering (4 cr.)
- ME/CE 2410 – Statics (3 cr.)
- PH 3300 – Epidemiology (3 cr.)

- DSE 6000 Computing Platforms for Data Science (3 cr.)
- DSE 6100 Data Modeling and Management (3 cr.)
- DSE 6200 Modern Databases (3 cr.)
- DSE 6300 Data Science Applications Development (3 cr.)

In addition to these courses, other courses which are focused on engineering fundamentals, such as might be present on the FE or EIT licensing exams, may be accepted. See your Academic Advisor for details.

## Directed Electives

The following is a list of currently approved courses for Directed Elective credit. This list is not comprehensive. If you want to take a course for Directed Elective credit that is not on this list, please submit an Academic Petition form with the course and your rationale for its inclusion in your plan of work. Courses may not count for both Non-IE Engineering Breadth elective and Directed Elective credit.

- |   |   |
|---|---|
| • ACC 3010 Elementary Financial Accounting Theory   | • ECE 2620 Introduction to Microcomputers         |
| • ANT 3150 Anthropology of Business (IF FC covered by another course - can't double count as general education and directed elective) | • ECE 3330 Electrical Circuits II                 |
| • BME 5010 Engineering Physiology (ME 5100)   | • ISM 4630 Business Information Systems           |
| • BME 5570 Design of Human Rehabilitation Systems (ME 5170, ECE 5170)   | • ISM 5820 Systems Analysis and Design            |
| • CE 4600 Transportation Engineering  | • ISM 5860 Data Communications and Networks       |
| • CE 5810 Legal Aspects of Engineering Problems   | • LBS 4500 Applied Labor Studies                  |
| • CE 6010 Construction organization and management  | • ME 2200 Thermodynamics                          |
| • CE 6050 Construction estimating   | • ME 3400 Dynamics                                |
| • CHE 2800 Material and Energy Balances   | • ME 5440 Industrial Noise Control                |
| • CHE 3300 Thermodynamics   | • MGT 4520 Managing Organizational Behavior       |
| • CSC 1100 Problem Solving and Programming  | • MGT 2530 Management of Organizational Behavior  |
|   | • PSY 3500 Psychology and the Workplace           |
|   | • PSY 5540 Motivation in the World of Work        |
|   | • ECO 5100 Introductory Statistics & Econometrics |

Note: Many of these courses have program restrictions or complicated prerequisites. Being on this list does not imply that any given student will be able to take any course listed. It will be the student's responsibility to determine the applicability of this list to their circumstances

## Academic Policies

BSIE students complete their degrees in accordance with all applicable University and College academic regulations and policies. The following items are important areas where the ISE department places additional policies/regulations in place, over and above the applicable University and College policies/regulations. The following was current at the time of the last handbook update – see the College of Engineering Associate Dean for Academic Affairs for confirmation on these policies.

### Transfer credits accepted

Per University policy, a maximum of 64 credits will be accepted from a 2-year institution (i.e. community college). For students transferring from a bachelor's degree granting institution, the College requires 34 credits to be completed at WSU. Further, the ISE Department requires that IE 4800/4880 Engineering Design be taken at WSU – under no circumstances will transfer credit be accepted for our capstone course. In addition, at least 4 of the remaining 8 IE core courses must be taken at WSU. A minimum of 20 IE-designated credits earned at WSU will be required (including core and technical electives) to fulfill BSIE program requirements.

### Withdrawals and Repeating Courses.

The University has implemented a new grading system, effective Fall 2006. More information will be provided from the Registrar's Office on the policy changes and processes. Approvals for withdrawals do not require the approval of the Associate Dean for Academic Affairs. However, after the end of the 4th week of the semester, instructor approval is required. This will be requested through the University withdrawal system on Pipeline.

For the purpose of determining the allowed number of repeats for a student, ANY grade of WP, WF, or WN that appears on your transcript will count as an 'attempt' (refer to the *Pre-Professional Handbook* for the specific policies on allowed number of repeats). Due to the fact that Withdrawals will count as an attempt, students should consider carefully whether or not they will withdraw from the course after the fourth week.

Students who feel that extenuating circumstances (e.g. extended illness, family emergency, out-of-town work responsibilities) justify the withdrawal should submit a petition *in writing* to the Associate Dean for Academic Affairs before the end of the semester. Supporting documentation should be included with the petition. These petitions will only be considered if submitted before the end of the semester in which the course is taken. If the petition is approved, a notation will be made in your advising record not to count the course among the allowed repeats. If you have any questions about this policy, please contact your advisor.

### Academic Progress

BSIE students are expected to make academic progress in accordance with the policies of the College of Engineering. Consult the Associate Dean for Academic Affairs for a complete

description of policies regarding progress, calculation of College GPA, probation, and exclusion.

## The Institute of Industrial and Systems Engineers (IISE)

### Professional Involvement

BSIE students are strongly encouraged to become involved in professional societies while a student. Participation in professional societies gives our students an edge in everything from professional networking to maintaining current technical skills. BSIE students who join the Institute of Industrial and Systems Engineers (IISE) as a student member may be entitled to a 100% dues rebate from the Department -- see Gail Evans for details.

### IISE Student Chapter

Wayne State's BSIE program is home to a vibrant, active student chapter of the Institute of Industrial and Systems Engineers. Chapter operations are housed in Room 2042 of the Manufacturing Engineering building. The chapter office houses 2 PCs with access to the internet through WSU's network. Annual activities include the following: social gatherings, volunteering/attending local IISE workshops and symposia, public service (e.g. volunteering for Gleaner's Food bank). See the WSU IISE bulletin board (outside the chapter office) for a list of upcoming events.

Other benefits of membership include access to the IISE's online resource library, the IISE Online Career Center, IISE fellowships, and discounted conference registration fees.

### Detroit Professional Chapter

Students are also encouraged to participate with your local IISE student chapter in Detroit IISE Senior Chapter events and activities. The Detroit Chapter of IISE has monthly meetings, a website, and newsletter. Aside from learning current applications of ISE techniques in industry, you also get to meet individuals that have been in the field 5, 10, 15+ years. You'll make connections and contacts - but more importantly you learn first hand what it means to be a practicing ISE. The Detroit Chapter makes every effort to support ISE students. A scholarship is available to students - all you have to do is apply to your Faculty Advisor. Also, a Technical Paper contest is sponsored by the Detroit chapter - which puts you in line for Regional, National, and International awards. And the Detroit Chapter funds (in part) trips to Regional and National ISE conferences.

Find out more on the web at <http://www.iisedetroit.org/>