INDUSTRIAL ENGINEERING, B.S.

The first bachelor of science in industrial engineering at the University of Wisconsin–Madison was awarded in 1972. Since that time the demand for industrial engineers has grown dramatically for one chief reason: the need for organizations to raise their level of productivity through thoughtful, systematic applications.

Becoming an industrial engineer (IE) places one in an exciting field of engineering that focuses on productivity improvement worldwide. It is a field that deals as much with human aspects of work as with today's sophisticated tools of work.

What sets industrial engineering apart from other engineering disciplines is its broader scope. An IE deals with people as well as things. The industrial engineer applies problem-solving techniques in almost every kind of industry, business, or institution. There are IEs in banks, hospitals, government at all levels, transportation, construction, processing, social services, electronics, facilities design, manufacturing, and warehousing.

An IE looks at the "big picture" of what makes society perform best —the right combination of human resources, natural resources, and human-made structures and equipment. An IE bridges the gap between management and operations, dealing with and motivating people as well as determining what tools should be used and how they should be used. Industrial engineering is concerned with performance measures and standards, research of new products and product applications, ways to improve use of scarce resources, and many other problem-solving adventures.

Because industrial engineering serves a broad cross-section of business, industry and institutions, the IE's work environment varies from office to plant to field. Choices can be made even after the IE begins his or her career. Few other vocations offer a graduating student such a wide selection of places to work or kind of work to perform. Need for industrial engineers makes this profession particularly attractive from the financial standpoint. Beginning salaries rank in the top group of high-paying engineering disciplines, and fast advancement is not unusual.

In the industrial and systems engineering department at UW–Madison, the course curriculum is set up to provide a diversified background and at the same time allow choices according to individual interests. Specialized coursework might be categorized in four main areas:

- Engineering Analytics and Operations Research
- Healthcare Systems Engineering
- Human Factors and Ergonomics
- Manufacturing and Supply Chain Management

Although there is no sub major within IE, it is possible to achieve a degree of specialization through choice of a focus area. Courses focusing on teams and design projects prepare students to succeed in the workplace.

INDUSTRIAL ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES

During the first several years following graduation from the program, a graduate from UW-Madison with a B.S. in industrial engineering would be expected to:

1. Demonstrate competence in the professional practice of industrial engineering.
2. Demonstrate industrial engineering skills needed as a foundation for leadership in a career and the profession.
3. Act with professional and ethical responsibility, fostering an inclusive work environment, and appreciate the impact of proposed solutions to a global and/or societal context.

HOW TO GET IN

ADMISSION TO THE COLLEGE AS A FRESHMAN

Students applying to UW–Madison (https://www.admissions.wisc.edu/apply/) need to indicate an engineering major (https://engineering.wisc.edu/degrees-programs/undergraduate/) as their first choice in order to be considered for direct admission to the College of Engineering. Direct admission to a major means students will start in the program of their choice in the College of Engineering and will need to meet progression requirements (https://engineering.wisc.edu/student-services/undergraduate-student-advising/progression/) at the end of the first year to guarantee advancement in that program.

CROSS-CAMPUS TRANSFER TO ENGINEERING

UW–Madison students in other schools and colleges on campus must meet minimum admission requirements (https://engineering.wisc.edu/admissions/undergraduate/cross-campus-students/) for admission consideration to engineering degree granting classifications. Cross-campus admission is competitive and selective, and the grade point average expectations may increase as demand trends change. The student's overall academic record at UW–Madison is also considered. Students apply to their intended engineering program by submitting the online application by stated deadlines for spring and fall. The College of Engineering offers an online information tutorial and drop-in advising (https://engineering.wisc.edu/admissions/undergraduate/cross-campus-students/) for students to learn about the cross-campus transfer process.

OFF-CAMPUS TRANSFER TO ENGINEERING

With careful planning, students at other accredited institutions can transfer coursework that will apply toward engineering degree requirements at UW–Madison. Off-campus transfer applicants are considered for direct admission to the College of Engineering by applying to the Office of Admissions with an engineering major listed as their first choice. Those who are admitted to their intended engineering program must meet progression requirements (https://engineering.wisc.edu/admissions/undergraduate/transfer-from-off-campus/) at the point of transfer or within their first two semesters at UW–Madison to guarantee advancement in that program. A minimum of 30 credits in residence in the College of Engineering is required after transferring, and all students must meet all requirements for their major in the college. Transfer admission to the College of Engineering is competitive and selective, and students who have exceeded the 80 credit limit at the time of application are not eligible to apply.

The College of Engineering has dual degree programs with select four-year UW System campuses. Eligible dual degree applicants are not subject to the 80 credit limit.

Off-campus transfer students are encouraged to discuss their interests, academic background, and admission options with the Transfer

Coordinator in the College of Engineering: ugtransfer@engr.wisc.edu or 608-262-2473.

SECOND BACHELOR'S DEGREE

The College of Engineering does not accept second undergraduate degree applications. Second degree student (https://engineering.wisc.edu/admissions/undergraduate/adult-students-second-degree-students/)s (https://engineering.wisc.edu/student-services/undergraduate-student-advising/) might explore the Biological Systems Engineering program at UW–Madison, an undergraduate engineering degree elsewhere, or a graduate program in the College of Engineering.

REQUIREMENTS

UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatestudytext) section of the *Guide*.

General Education

- Breadth—Humanities/Literature/Arts: 6 credits
- Breadth—Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits
- Breadth—Social Studies: 3 credits
- Communication Part A & Part B *
- Ethnic Studies *
- Quantitative Reasoning Part A & Part B *

* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

SUMMARY OF REQUIREMENTS

The following curriculum applies to students admitted to the Industrial Engineering, BS, degree program beginning in Fall 2020 or later. Required courses and electives satisfying the Mathematics and Basic Science, Computer Sciences, IE Focus Area, and General Education Communication requirements are indicated. For Liberal Studies Electives refer to the College of Engineering Liberal Studies Guidelines.

Code	Title	Credits
Mathematics and Basic Science		30-31
Probability and Statistics		6
Computer Sciences		7-8
Required I SY E Courses		28
I SY E Focus Area Technical Electives		18
Professional Electives, Communication Skills, and Liberal Studies		27
Free Electives		4
Total Credits		**120-122**

MATHEMATICS AND BASIC SCIENCE

Code	Title	Credits
MATH 221	Calculus and Analytic Geometry 1	5
MATH 222	Calculus and Analytic Geometry 2	4
MATH 234	Calculus--Functions of Several Variables	4
MATH 340	Elementary Matrix and Linear Algebra	3
Select one of the following: [1]		5-6
PHYSICS 201	General Physics	
PHYSICS 207	General Physics	
E M A 201 & E M A 202	Statics and Dynamics	
E M A 201 & M E 240	Statics and Dynamics	
Choose 9 credits from the following list: [1]		**9**
Basic Science		
ANAT&PHY 335	Physiology	
BIOLOGY/ BOTANY/ ZOOLOGY 151	Introductory Biology	
or ZOOLOGY 153	Introductory Biology	
BIOLOGY/ BOTANY/ ZOOLOGY 152	Introductory Biology	
CHEM 103	General Chemistry I [2]	
or CHEM 109	Advanced General Chemistry	
or CHEM 115	Chemical Principles I	
CHEM 104	General Chemistry II	
CHEM 116	Chemical Principles II	
CHEM 311	Chemistry Across the Periodic Table	
CHEM 327	Fundamentals of Analytical Science	
or CHEM 329	Fundamentals of Analytical Science	
CHEM 341	Elementary Organic Chemistry	
CHEM 342	Elementary Organic Chemistry Laboratory	
CHEM 343	Organic Chemistry I	
CHEM 344	Introductory Organic Chemistry Laboratory	
CHEM 345	Organic Chemistry II	
CHEM 346	Intermediate Organic Chemistry Laboratory	
MICROBIO 101	General Microbiology	
MICROBIO 102	General Microbiology Laboratory	
PHYSICS 202	General Physics	
or PHYSICS 208	General Physics	
or PHYSICS 248	A Modern Introduction to Physics	
PHYSICS 205	Modern Physics for Engineers	
or PHYSICS 241	Introduction to Modern Physics	
or PHYSICS 249	A Modern Introduction to Physics	
Mathematics		

MATH/ COMP SCI 240	Introduction to Discrete Mathematics	
MATH 319	Techniques in Ordinary Differential Equations	
MATH 421	The Theory of Single Variable Calculus	
MATH 441	Introduction to Modern Algebra	
MATH 443	Applied Linear Algebra	
MATH/ COMP SCI/ STAT 475	Introduction to Combinatorics	
MATH 521	Analysis I	
MATH 522	Analysis II	
Total Credits		**30-31**

[1]

If E M A 201 and E M A 202 or M E 240 are used to fulfill the PHYSICS requirement, 5 additional credits of math or basic science will be required

[2]

Credit will not be given for both CHEM 103 and CHEM 109 to fulfill Mathematics and Basic Science requirements.

PROBABILITY AND STATISTICS

Code	Title	Credits
STAT 311	Introduction to Theory and Methods of Mathematical Statistics I	3
or STAT/ MATH 309	Introduction to Probability and Mathematical Statistics I	
I SY E 210	Introduction to Industrial Statistics	3
or STAT/ MATH 310	Introduction to Probability and Mathematical Statistics II	
or STAT 312	Introduction to Theory and Methods of Mathematical Statistics II	
Total Credits		**6**

COMPUTER SCIENCES

Code	Title	Credits
COMP SCI 220	Data Science Programming I	4
Select one of the following:		3-4
COMP SCI 200	Programming I	
COMP SCI 300	Programming II	
COMP SCI 320	Data Science Programming II	
COMP SCI 400	Programming III	
COMP SCI 412	Introduction to Numerical Methods	
Total Credits		**7-8**

REQUIRED I SY E COURSES

Code	Title	Credits
I SY E 191	The Practice of Industrial Engineering	2
I SY E 312	Data Management and Analysis for Industrial Engineers	3
I SY E 313	Engineering Economic Analysis	3
I SY E 315	Production Planning and Control	3
I SY E 320	Simulation and Probabilistic Modeling	3
I SY E 321	Simulation Modeling Laboratory	1
I SY E 323	Operations Research-Deterministic Modeling	3
I SY E 348	Introduction to Human Factors Engineering Laboratory	1
I SY E/PSYCH 349	Introduction to Human Factors	3
I SY E 350	Industrial Engineering Design I	3
I SY E 450	Industrial Engineering Design II	3
Total Credits		**28**

I SY E FOCUS AREA TECHNICAL ELECTIVES

Choose 1 of the following 6 focus areas.

Engineering Analytics and Operations Research

Code	Title	Credits
Choose at least 3:		9
I SY E 412	Fundamentals of Industrial Data Analytics	
I SY E/COMP SCI/ MATH 425	Introduction to Combinatorial Optimization	
I SY E 460		
I SY E 516	Introduction to Decision Analysis	
I SY E 521	Machine Learning in Action for Industrial Engineers	
I SY E/COMP SCI/ E C E 524	Introduction to Optimization	
I SY E/COMP SCI/ MATH/STAT 525	Linear Optimization	
I SY E/ COMP SCI 526	Advanced Linear Programming	
I SY E/COMP SCI/ M E 558	Introduction to Computational Geometry	
I SY E/N E 574	Methods for Probabilistic Risk Analysis of Nuclear Power Plants	
I SY E 603	Special Topics in Engineering Analytics and Operations Research	
I SY E 620	Simulation Modeling and Analysis	
I SY E 624	Stochastic Modeling Techniques	
I SY E/MATH/ OTM/STAT 632	Introduction to Stochastic Processes	
One elective I SY E course other than those listed in the Engineering Analytics and Operations Research area		3
Additional elective I SY E courses in any area		6
Total Credits		**18**

Healthcare Systems Engineering

Code	Title	Credits
Choose at least 3:		9
I SY E 417	Health Systems Engineering	
I SY E 517	Decision Making in Health Care	
I SY E 557	Human Factors Engineering for Healthcare Systems	
I SY E 555	Human Performance and Accident Causation	

I SY E/ MED PHYS 559	Patient Safety and Error Reduction in Healthcare	
I SY E 606	Special Topics in Healthcare Systems Engineering	
I SY E/ PHARMACY 608	Safety and Quality in the Medication Use System	
I SY E/B M I 617	Health Information Systems	
One elective I SY E course other than those listed in the Healthcare Systems Engineering area		3
Additional elective I SY E courses in any area		6
Total Credits		**18**

Human Factors and Ergonomics

Code	Title	Credits
Choose at least 3:		9
I SY E/COMP SCI/ DS 518	Wearable Technology	
I SY E/ PSYCH 549	Human Factors Engineering	
I SY E 552	Human Factors Engineering Design and Evaluation	
I SY E 555	Human Performance and Accident Causation	
I SY E 557	Human Factors Engineering for Healthcare Systems	
I SY E 562	Human Factors of Data Science and Machine Learning	
I SY E/B M E 564	Occupational Ergonomics and Biomechanics	
I SY E 602	Special Topics in Human Factors	
I SY E/ PSYCH 653	Organization and Job Design	
I SY E 649	Interactive Data Analytics	
I SY E/B M E 662	Design and Human Disability and Aging	
One elective I SY E course other than those listed in the Human Factors and Ergonomics area		3
Additional elective I SY E courses in any area		6
Total Credits		**18**

Manufacturing and Supply Chain Management

Code	Title	Credits
Choose at least 3:		9
I SY E 415	Introduction to Manufacturing Systems, Design and Analysis	
I SY E/M E 510	Facilities Planning	
I SY E/M E 512	Inspection, Quality Control and Reliability	
I SY E 515	Engineering Management of Continuous Process Improvement	
I SY E 520	Quality Assurance Systems	
I SY E 575	Introduction to Quality Engineering	
I SY E 604	Special Topics in Manufacturing and Supply Chain Management	
I SY E 605	Computer Integrated Manufacturing	
I SY E 612	Information Sensing and Analysis for Manufacturing Processes	
I SY E 615	Production Systems Control	
I SY E/M E 641	Design and Analysis of Manufacturing Systems	
I SY E/M E 643	Performance Analysis of Manufacturing Systems	
I SY E 645	Engineering Models for Supply Chains	
One elective I SY E course other than those listed in the Manufacturing and Supply Chain Management area		3
Additional elective I SY E courses in any area		6
Total Credits		**18**

Distributed Focus Area

Code	Title	Credits
Total credits in Distributed Focus Area:		**18**
Choose 6 courses in at least 3 of the 4 areas listed above (Engineering Analytics and Operations Research, Healthcare Systems Engineering, Human Factors and Ergonomics, and Manufacturing and Supply Chain Management)		

Honors in Research Focus Area

Code	Title	Credits
Total credits in Honors in Research Focus Area:		**20**
I SY E 468	Introduction to Industrial Engineering Research	1
I SY E 478	Research and Beyond in Industrial Engineering	1
I SY E 489	Honors in Research	3
Choose 5 courses in at least 2 of the 4 areas listed above (Engineering Analytics and Operations Research, Healthcare Systems Engineering, Human Factors and Ergonomics, and Manufacturing and Supply Chain Management)		

PROFESSIONAL ELECTIVES, COMMUNICATION SKILLS, AND LIBERAL STUDIES

Code	Title	Credits
Professional Electives [1]		**6**
Choose 6 credits from:		
College of Engineering courses numbered 200 or higher		
Biological, natural, social, or physical sciences; humanities; or literature at the Intermediate or Advanced level		
At most 5 credits of I SY E 699 and/or I SY E 1 (independent study courses from other engineering subject areas can also be used)		
School of Business courses numbered 200 or higher (as well as ACCT I S 100)		
Communication Skills		**6**
ENGL 100	Introduction to College Composition	3
or COM ARTS 100	Introduction to Speech Composition	
or LSC 100	Science and Storytelling	

or ESL 118	Academic Writing II	
INTEREGR 397	Engineering Communication	3
Liberal Studies		**15**
Liberal Studies Electives (according to CoE requirements) (http://guide.wisc.edu/undergraduate/engineering/#requirementstext)		11
ECON 101	Principles of Microeconomics	4
Total Credits		**27**

[1]

Professional electives may not include STAT 301 Introduction to Statistical Methods or transfer/test math elective credits for calculus.

FREE ELECTIVES

Code	Title	Credits
4 credits of Free Electives		4
Total Credits		**4**

MINIMUM REQUIRED CREDITS: 120

UNIVERSITY DEGREE REQUIREMENTS

Total Degree	To receive a bachelor's degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements.
Residency	Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. "In residence" means on the UW–Madison campus with an undergraduate degree classification. “In residence” credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.
Quality of Work	Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation.

LEARNING OUTCOMES

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. 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. Communicate effectively with a range of audiences
4. 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. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. Acquire and apply new knowledge as needed, using appropriate learning strategies
8. Recognize, describe, predict and analyze systems behavior
9. Understand physiological, cognitive, and sociotechnical aspects of humans as components in complex systems design
10. Apply the techniques, skills, and modern engineering tools necessary for engineering practice, such as quality engineering, optimization, simulation, and project management

FOUR-YEAR PLAN

SAMPLE FOUR-YEAR PLAN

First Year

Fall	Credits	Spring	Credits
MATH 221 or 275	5	I SY E 191	2
ECON 101	4	MATH 222 or 276	4
COMP SCI 220	4	PHYSICS 201	5
Communications A	3	Liberal Studies Elective	3
	16		**14**

Second Year

Fall	Credits	Spring	Credits
I SY E 313	3	I SY E 315	3
MATH 234	4	I SY E 348	1
Liberal Studies Elective	2	I SY E/PSYCH 349	3
Computer Sciences Elective	3-4	MATH 340	3
Math and Basic Science Elective	3	Math and Basic Science Elective	3
		I SY E 210	3
	15-16		**16**

Third Year

Fall	Credits	Spring	Credits
I SY E 312	3	I SY E 320	3
I SY E 323	3	I SY E 321	1
Professional Elective	3	I SY E 350	3
STAT 311	3	INTEREGR 397	3
Liberal Studies Elective	3	I SY E Focus Area Elective	3
		Free Elective	1
	15		**14**

Fourth Year

Fall	Credits	Spring	Credits
I SY E Focus Area Elective	3	I SY E 450	3
I SY E Focus Area Elective	3	I SY E Focus Area Elective	3
Professional Elective	3	I SY E Focus Area Elective	3
Free Elective	3	I SY E Focus Area Elective	3

Math and Basic Science Elective	3 Liberal Studies Elective	3
	15	**15**

Total Credits 120-121

ADVISING AND CAREERS

ADVISING

Each College of Engineering program has academic advisors dedicated to serving its students. Program advisors can help current College of Engineering students with questions about accessing courses, navigating degree requirements, resolving academic issues and more. Students can find their assigned advisor on the homepage of their student center.

ENGINEERING CAREER SERVICES

Engineering Career Services (ECS) assists students in identifying pre-professional work-based learning experiences such as co-ops and summer internships, considering and applying to graduate or professional school, and finding full-time professional employment during their graduation year.

ECS offers two major career fairs per year, assists with resume writing and interviewing skills, hosts workshops on the job search, and meets one-on-one with students to discuss offer negotiations.

Students are encouraged to utilize the ECS office early in their academic careers. For comprehensive information on ECS programs and workshops, see the ECS website or call 608-262-3471.

PEOPLE

PROFESSORS

Laura Albert (Chair)
Oguzhan Alagoz
John D. Lee
Jeffrey Linderoth
Kaibo Liu
James Luedtke
Ranjana Mehta
Robert Radwin
Raj Veeramani

Doug Wiegmann
Shiyu Zhou

ASSOCIATE PROFESSORS

Alberto Del Pia

ASSISTANT PROFESSORS

Justin J. Boutilier
Tony McDonald
Carla Michini
Yonatan Mintz
Hantang Qin
Xin Wang
Qiaomin Xie
Gabriel Zayas-Caban

TEACHING PROFESSORS

Amanda Smith

TEACHING FACULTY

Hannah Silber
Sinan Tas
Tina Xu
Charlene Yauch

LECTURERS

Terry Mann

UNDERGRADUATE ADVISORS

Michele Crandell
Missy Moreau

GRADUATE PROGRAM COORDINATOR

Pam Peterson

See also Industrial and Systems Engineering Faculty Directory (http://directory.engr.wisc.edu/ie/faculty/).

ACCREDITATION

ACCREDITATION

Accredited by the Engineering Accreditation Commission of ABET (https://www.abet.org), https://www.abet.org, under the commission's General Criteria and Program Criteria for Industrial and Similarly Named Engineering Programs.

Note: Undergraduate Program Educational Objectives and Student Outcomes are made publicly available at the Departmental website. (In this Guide, the program's Student Outcomes are designated by our campus as "Learning Outcomes.")