ELECTRICAL ENGINEERING, B.S.

As an electrical engineering major, you can learn to design, develop, analyze, research and create systems for a wide variety of fields, including power generation, communication, healthcare and instrumentation. You'll also learn about the devices and components that make up these systems —from the smallest transistors (of which there can be hundreds of billions on a single chip!) to antennas, lasers, electric engines and even fusion devices that could provide power for the world.

Electrical engineering majors learn the tools for analyzing and operating systems, including signal processing, control and machine learning. You can even focus on the mathematics, tools and practices associated with machine learning and data science in engineering with our new Machine Learning and Data Science named degree option. In the UW-Madison ECE department, our program will match your ambition.

ELECTRICAL ENGINEERING AND COMPUTER ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES

Our graduates should be engaged in activities such as:

1. Employment in industry, government, academia, or nonprofit using their degree knowledge or skills for professional functions such as teaching, research and development, quality control, technical marketing, intellectual property management, or sales. Graduates may eventually reach a leadership position supervising others.
2. Continuing education through self-study or short courses and workshops through their employer, local or online educational institutions, or attendance at professional events such as conferences.
3. Taking a principal role in starting a new business or product line.
4. Pursuing a postgraduate degree.

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 who were admitted to the electrical engineering degree program (classification changed to EE) in Fall 2017 or later.

Code	Title	Credits
Mathematics		16
Science		17-18
Electrical Engineering Core		33
Electrical Engineering Advanced Electives		24
Professional Electives		9
Communication Skills		6
Liberal Studies		15
Total Credits		**120-121**

MATHEMATICS [1]

Code	Title	Credits
MATH 221	Calculus and Analytic Geometry 1	5
or MATH 217	Calculus with Algebra and Trigonometry II	
or MATH 275	Topics in Calculus I	
MATH 222	Calculus and Analytic Geometry 2	4
or MATH 276	Topics in Calculus II	
MATH 234	Calculus--Functions of Several Variables [2]	4
Probability and Statistics Elective		3
STAT 311	Introduction to Theory and Methods of Mathematical Statistics I	
STAT/M E 424	Statistical Experimental Design	
MATH/STAT 431	Introduction to the Theory of Probability	
E C E 331	Introduction to Random Signal Analysis and Statistics	
Total Credits		**16**

1

In additional to the courses listed in the Mathematics Requirement at least one additional course must be completed for the advanced mathematics auxiliary condition. Choose: MATH 319 Techniques in Ordinary Differential Equations, MATH 320 Linear Algebra and Differential Equations, MATH 340 Elementary Matrix and Linear Algebra, MATH 341 Linear Algebra, E C E 334 State Space Systems Analysis, or E C E/ COMP SCI/M E 532 Matrix Methods in Machine Learning to satisfy the advanced math auxiliary condition. These credits count toward either professional electives or advanced elective credit depending on the course.

2

MATH 375 and MATH 376 taken in sequence will fulfill the requirement for MATH 234, professional elective credit, and advanced math auxiliary condition.

SCIENCE

Code	Title	Credits
COMP SCI 300	Programming II	3
PHYSICS 201	General Physics [1]	5
or PHYSICS 207	General Physics	
or PHYSICS 247	A Modern Introduction to Physics	
PHYSICS 202	General Physics	5
or PHYSICS 208	General Physics	
or PHYSICS 248	A Modern Introduction to Physics	
Select one of the following:		4-5
CHEM 109	Advanced General Chemistry	
CHEM 103	General Chemistry I	
CHEM 104	General Chemistry II	
Total Credits		**17-18**

1

Students may also fulfill this requirement by taking E M A 201 Statics and E M A 202 Dynamics or E M A 201 Statics and M E 240 Dynamics.

ELECTRICAL ENGINEERING CORE

Code	Title	Credits
E C E 203	Signals, Information, and Computation	3
E C E 210	Introductory Experience in Electrical Engineering	2
E C E 219	Analytical Methods for Electromagnetics Engineering	2
E C E 220	Electrodynamics I	3
E C E 230	Circuit Analysis	4
E C E/PHYSICS 235	Introduction to Solid State Electronics	3
E C E/ COMP SCI 252	Introduction to Computer Engineering	3
E C E 270	Circuits Laboratory I	1
E C E 271	Circuits Laboratory II	1
E C E 330	Signals and Systems	3
E C E 340	Electronic Circuits I	3
E C E/ COMP SCI 352	Digital System Fundamentals	3

E C E 370	Advanced Laboratory	2
Total Credits		**33**

ELECTRICAL ENGINEERING ADVANCED ELECTIVES

Students must take 22 credits in at least three of six areas and at least 2 credits in two laboratory courses.

- At least 9 credits must be in E C E courses numbered 400 and above.
- At least one course must be a capstone design course.
- At least one course must be MATH 319 Techniques in Ordinary Differential Equations, MATH 320 Linear Algebra and Differential Equations, MATH 340 Elementary Matrix and Linear Algebra, MATH 341 Linear Algebra, E C E 334 State Space Systems Analysis, or E C E/COMP SCI/M E 532 Matrix Methods in Machine Learning to satisfy the advanced math auxiliary condition. MATH 319 Techniques in Ordinary Differential Equations, MATH 320 Linear Algebra and Differential Equations, MATH 340 Elementary Matrix and Linear Algebra, and MATH 341 Linear Algebra count toward professional electives. E C E 334 State Space Systems Analysis and E C E/COMP SCI/M E 532 Matrix Methods in Machine Learning count as advanced electives.
- Students can count 1 credit of E C E 1 Cooperative Education Program toward advanced electives.
- Students can count up to 6 credits of E C E 399 Independent Study , E C E 489 Honors in Research or E C E 699 Advanced Independent Study towards advanced electives.
- Students can take E C E 379 Special Topics in Electrical and Computer Engineering and E C E 601 Special Topics in Electrical and Computer Engineering as advanced electives.
- Students can count up to 5 credits of COMP SCI courses numbered 500 and above (not including independent study)
- E C E courses numbered 300 and above that are not specified in an area can count toward the total number of advanced elective credits required.

Laboratory

Code	Title	Credits
Select at least one course from E C E 301 to E C E 317		
An additional laboratory course must be taken from the following list:		
E C E 303	Introduction to Real-Time Digital Signal Processing	
E C E 304	Electric Machines Laboratory	
E C E 305	Semiconductor Properties Laboratory	
E C E 306	Linear Active Circuits Laboratory	
E C E 308	Nonlinear Electronic Circuits Laboratory	
E C E 313	Optoelectronics Lab	
E C E 315	Introductory Microprocessor Laboratory	
E C E 317	Sensors Laboratory	
E C E 432	Digital Signal Processing Laboratory	
E C E 453	Embedded Microprocessor System Design	
E C E/B M E 462	Medical Instrumentation [1]	
E C E 504	Electric Machine & Drive System Laboratory	
E C E 512	Power Electronics Laboratory	
E C E 545	Advanced Microwave Measurements for Communications	
E C E 549	Integrated Circuit Fabrication Laboratory	
E C E 554	Digital Engineering Laboratory	
E C E/M E 577	Automatic Controls Laboratory	

1

Designated as a capstone course. Students can also take E C E 491 Senior Design Project for capstone credit.

Fields & Waves

Code	Title	Credits
E C E 320	Electrodynamics II	3
E C E 420	Electromagnetic Wave Transmission	3
E C E 434	Photonics	3
E C E/N E/ PHYSICS 525	Introduction to Plasmas	3
E C E/N E/ PHYSICS 527	Plasma Confinement and Heating	3
E C E/N E 528	Plasma Processing and Technology	3
E C E 536	Integrated Optics and Optoelectronics	3
E C E/PHYSICS 546	Lasers	2-3
E C E 547	Advanced Communications Circuit Design [1]	3

1

Designated as a capstone course. Students can also take E C E 491 Senior Design Project for capstone credit.

Systems & Control

Code	Title	Credits
E C E 332	Feedback Control Systems	3
E C E 334	State Space Systems Analysis	3
E C E/M E 439	Introduction to Robotics [1]	3
E C E/M E 577	Automatic Controls Laboratory [1]	4

1

Designated as a capstone course. Students can also take E C E 491 Senior Design Project for capstone credit.

Power & Machines

Code	Title	Credits
E C E 355	Electromechanical Energy Conversion	3
E C E 356	Electric Power Processing for Alternative Energy Systems	3
E C E 411	Introduction to Electric Drive Systems	3
E C E 412	Power Electronic Circuits [1]	3
E C E 427	Electric Power Systems [1]	3
E C E 504	Electric Machine & Drive System Laboratory	2-3

E C E 511	Theory and Control of Synchronous Machines	3
E C E 512	Power Electronics Laboratory [1]	3

1

Designated as a capstone course. Students can also take E C E 491 Senior Design Project for capstone credit.

Communications & Signal Processing

Code	Title	Credits
E C E 331	Introduction to Random Signal Analysis and Statistics	3
E C E 401	Electro-Acoustical Engineering	3
E C E 431	Digital Signal Processing [1]	3
E C E 432	Digital Signal Processing Laboratory [1]	3
E C E/COMP SCI/ MATH 435	Introduction to Cryptography	3
E C E 436	Communication Systems I [1]	3
E C E 437	Communication Systems II [1]	3
E C E 447	Applied Communications Systems [1]	3
E C E/COMP SCI/ M E 532	Matrix Methods in Machine Learning [1]	3
E C E/ COMP SCI 533	Image Processing [1]	3
E C E 537	Communication Networks [1]	3
E C E/COMP SCI/ M E 539	Introduction to Artificial Neural Networks [1]	3
E C E/MATH 641	Introduction to Error-Correcting Codes	3

1

Designated as a capstone course. Students can also take E C E 491 Senior Design Project for capstone credit.

Circuits & Devices

Code	Title	Credits
E C E 335	Microelectronic Devices	3
E C E 342	Electronic Circuits II	3
E C E 445	Semiconductor Physics and Devices	3
E C E/B M E 462	Medical Instrumentation [1]	3
E C E 466	Electronics of Solids	3
E C E 541	Analog MOS Integrated Circuit Design [1]	3
E C E 542	Introduction to Microelectromechanical Systems [1]	3
E C E 545	Advanced Microwave Measurements for Communications [1]	3
E C E 548	Integrated Circuit Design [1]	3
E C E 549	Integrated Circuit Fabrication Laboratory [1]	3
E C E 555	Digital Circuits and Components [1]	3

1

Designated as a capstone course. Students can also take E C E 491 Senior Design Project for capstone credit.

Computers & Computing

Code	Title	Credits
E C E 353	Introduction to Microprocessor Systems	3
E C E/ COMP SCI 354	Machine Organization and Programming	3
E C E 453	Embedded Microprocessor System Design [1]	4
E C E 454	Mobile Computing Laboratory [1]	4
E C E/B M E 463	Computers in Medicine	3
E C E/ COMP SCI 506	Software Engineering	3
E C E 551	Digital System Design and Synthesis [1]	3
E C E/ COMP SCI 552	Introduction to Computer Architecture	3
E C E 553	Testing and Testable Design of Digital Systems [1]	3
E C E 554	Digital Engineering Laboratory [1]	4
E C E 556	Design Automation of Digital Systems [1]	3

1

Designated as a capstone course. Students can also take E C E 491 Senior Design Project for capstone credit.

PROFESSIONAL ELECTIVES

Code	Title	Credits
Classes to be taken in an area of professional interest. The following courses are acceptable as professional electives if the courses are not used to meet any other degree requirements.		9
MATH/ COMP SCI 240	Introduction to Discrete Mathematics	
E C E 204	Data Science & Engineering	
E C E 320	Electrodynamics II	
E C E 331	Introduction to Random Signal Analysis and Statistics	
E C E 332	Feedback Control Systems	
E C E 334	State Space Systems Analysis	
E C E 335	Microelectronic Devices	
E C E 342	Electronic Circuits II	
E C E 353	Introduction to Microprocessor Systems	
E C E/ COMP SCI 354	Machine Organization and Programming	
E C E 355	Electromechanical Energy Conversion	
E C E 356	Electric Power Processing for Alternative Energy Systems	
E C E courses numbered 399 and higher		
COMP SCI courses numbered 400 and higher		
MATH 319	Techniques in Ordinary Differential Equations	
MATH 320	Linear Algebra and Differential Equations [1]	

MATH 321	Applied Mathematical Analysis
MATH 322	Applied Mathematical Analysis
MATH 340	Elementary Matrix and Linear Algebra [1]
MATH 341	Linear Algebra
MATH courses numbered 400 and higher	
STATS courses numbered 400 and higher	
Any biological science course that is designated as intermediate or advanced	
Any physical science course that is designated as intermediate or advanced (except PHYSICS 241)	
Any natural science course that is designated as advanced except that Math, Computer Sciences, and Statistics courses must follow the above criteria	
Engineering courses numbered 300 and higher that are not E C E or cross-listed with E C E	
Up to six credits of Professional Electives can be taken from School of Business classes numbered 300 and higher.	
DS 501	Special Topics (Wearable Technologies)
DANCE 560	Current Topics in Dance: Workshop (Making Digital Lighting Controls)

1

Students may only earn degree credit for MATH 320 Linear Algebra and Differential Equations or MATH 340 Elementary Matrix and Linear Algebra, not both.

COMMUNICATION SKILLS

Code	Title	Credits
ENGL 100	Introduction to College Composition	3
or LSC 100	Science and Storytelling	
or COM ARTS 100	Introduction to Speech Composition	
or COM ARTS 181	Elements of Speech-Honors Course	
or ESL 118	Academic Writing II	
INTEREGR 397	Engineering Communication	3
Total Credits		**6**

LIBERAL STUDIES ELECTIVES

Code	Title	Credits
College of Engineering Liberal Studies Requirements		
Complete requirements (http://guide.wisc.edu/undergraduate/engineering/#requirementstext) [1]		15
Total Credits		**15**

1

All liberal studies credits must be identified with the letter H, S, L, or Z. Language courses are acceptable without the letter and are considered humanities. **Note**: See an E C E advisor and/or the EE Curriculum Guide for additional information.

HONORS IN UNDERGRADUATE RESEARCH PROGRAM

Qualified undergraduates may earn an Honors in Research designation on their transcript and diploma by completing 8 credits of undergraduate honors research, including a senior thesis. Further information is available in the department office.

NAMED OPTION

View as listView as grid

- ELECTRICAL ENGINEERING: MACHINE LEARNING AND DATA SCIENCE, B.S. **(**HTTP://GUIDE.WISC.EDU/UNDERGRADUATE/ENGINEERING/ELECTRICAL-COMPUTER-ENGINEERING/ELECTRICAL-ENGINEERING-BS/ELECTRICAL-ENGINEERING-MACHINE-LEARNING-DATA-SCIENCE-BS/**)**

TOTAL DEGREE 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. 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.

FOUR-YEAR PLAN

SAMPLE FOUR-YEAR PLAN

First Year

Fall	Credits	Spring	Credits
MATH 221	5	E C E/COMP SCI 252	3
CHEM 103, 104, or 109	4-5	PHYSICS 201	5
E C E 210	2	MATH 222	4
or Communication A		Communication A or	3
Liberal Studies Elective	3	E C E 210	
	14-15		**15**

Second Year

Fall	Credits	Spring	Credits
PHYSICS 202	5	E C E 219	2
MATH 234	4	COMP SCI 300	3
E C E 203	3	E C E 230	4
Liberal Studies Elective	3	E C E 270	1
		E C E 330	3
	15		**13**

Third Year

Fall	Credits	Spring	Credits
E C E/PHYSICS 235	3	ECE Advanced Elective	3
Statistics/Probability Elective	3	ECE Advanced Elective	3
E C E 340	3	INTEREGR 397	3
E C E 271	1	EE Advanced Lab (3XX)	1
E C E/COMP SCI 352	3	Liberal Studies Elective	3
E C E 220	3	Professional Elective (Adv Math)	3
	16		**16**

Fourth Year

Fall	Credits	Spring	Credits
Liberal Studies Elective	3	Professional Elective	3
ECE Advanced Elective	3	ECE Advanced Elective (4XX)	3
ECE Advanced Elective	4	ECE Advanced Elective (4XX)	3
EE Advanced Lab (3XX)	1	ECE Capstone Design	3
E C E 370	2	Liberal Studies Elective	3
Professional Elective	3		
	16		**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

Susan Hagness (Chair)
Nader Behdad
Daniel Botez
Azadeh Davoodi
John A. Gubner (Associate Chair for Operations)
Yu Hen Hu
Hongrui Jiang (Associate Chair for Graduate Studies)
Irena Knezevic
Bernard Lesieutre (Associate Chair for Undergraduate Studies)
Mikko Lipasti
Zhenqiang Ma
Luke J. Mawst
Robert Nowak
Parameswaran Ramanathan
Bulent Sarlioglu
William A. Sethares
Daniel van der Weide
Giri Venkataramanan
Amy E. Wendt
Zongfu Yu

ASSOCIATE PROFESSORS

Mikhail Kats
Daniel Ludois
Paul H. Milenkovic
Umit Ogras
Dimitris Papailiopoulos
Andreas Velten

ASSISTANT PROFESSORS

Joseph Andrews
Jennifer Choy
Jeremy Coulson
Kassem Fawaz
Dominic Gross
Chirag Gupta
Robert Jacobberger
Younghyun Kim
Bhuvana Krishnaswamy
Kangwook Lee

Chu Ma
Pedro Morgado
Shubhra Pasayat
Line Roald
Jinia Roy
Joshua San Miguel
Eric Severson
Eric Tervo
Ramya Korlakai Vinayak
Ying Wang

TEACHING FACULTY

Mark C. Allie
Setareh Behroozi
Eric Hoffman
Joe Krachey
Srdjan Milicic

TEACHING PROFESSOR

Eduardo Arvelo
Steven Fredette
Nathan Strachen

See also Electrical and Computer Engineering Faculty Directory (https://directory.engr.wisc.edu/ece/faculty/).

ACCREDITATION

Accreditation.

Accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org (http://www.abet.org/).

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.")