ENGINEERING PHYSICS, B.S.

The Department of Engineering Physics offers the B.S. degree in engineering physics. The degree is designed to provide graduates with skills in emerging technological areas. They are well prepared for pursuing advanced graduate degrees and for employment in high-tech startup companies and traditional engineering firms, as well as positions in academia, government, and national laboratories.

Students specialize in one of three technological focus areas: nanoengineering, plasma science and engineering, and scientific computing.

Distinguishing features of the engineering physics degree include a strong emphasis on math, physics, and engineering fundamentals; choice of a technical focus area; and emphasis on research as part of a campus research group or through individually mentored research with a faculty member, culminating in a senior thesis.

THE OBJECTIVES OF THE ENGINEERING PHYSICS PROGRAM ARE TO:

- Educate students to think and participate deeply, creatively, and analytically in emerging areas of engineering technology.
- Educate students in the basics of instrumentation, design of laboratory techniques, measurement, data acquisition, interpretation, and analysis.
- Educate students in the methodology of research.
- Provide and facilitate teamwork and multidisciplinary experiences throughout the curriculum.
- Foster the development of effective oral and written communication skills.
- Expose students to environmental, ethical and contemporary issues.

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://www.engr.wisc.edu/academics/undergraduate-academics/choosing-a-major/) 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://www.engr.wisc.edu/academics/student-services/academic-advising/first-year-undergraduate-students/progression-requirements/) 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 the course and credit requirements for admission to engineering degree granting classifications specified in the general college requirements (https://www.engr.wisc.edu/academics/student-services/academic-advising/cross-campus-students/). The requirements are the minimum for admission consideration. 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://www.engr.wisc.edu/academics/student-services/academic-advising/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://www.engr.wisc.edu/academics/student-services/academic-advising/transfer-students/) 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 earned more than 80 transferable semester credits 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 students (https://www.engr.wisc.edu/admissions/undergraduate-admissions/returning-adults-second-degree-students/) 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 entered the program after fall 2018.

Code	Title	Credits
Mathematics and Statistics		25
Science		28
Engineering Science		25
Focus Area		22
Technical Electives		6
Communication Skills		8
Liberal Studies		16
Total Credits		130

MATHEMATICS AND STATISTICS

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	4
MATH 319	Techniques in Ordinary Differential Equations	3
MATH 321	Applied Mathematical Analysis	3
MATH 340	Elementary Matrix and Linear Algebra	3
or MATH 341	Linear Algebra	
STAT 324	Introductory Applied Statistics for Engineers	3
or STAT 311	Introduction to Theory and Methods of Mathematical Statistics I	
or STAT/MATH 431	Introduction to the Theory of Probability	
Total Credits		25

SCIENCE

Code	Title	Credits
Select one of the following:		5-10
CHEM 109	Advanced General Chemistry	
CHEM 103 & CHEM 104	General Chemistry I and General Chemistry II	
PHYSICS 202	General Physics	5
or PHYSICS 208	General Physics	
PHYSICS 241	Introduction to Modern Physics	3
or PHYSICS 205	Modern Physics for Engineers	
PHYSICS 322	Electromagnetic Fields	3
E P 271	Engineering Problem Solving I	3
or COMP SCI 310	Problem Solving Using Computers	
M S & E 351	Materials Science-Structure and Property Relations in Solids	3
or CBE 440	Chemical Engineering Materials	
N E 305	Fundamentals of Nuclear Engineering	3
or PHYSICS 531	Introduction to Quantum Mechanics	
Computing Elective (select one)		3
COMP SCI 300	Programming II	
COMP SCI 412	Introduction to Numerical Methods (required for students in Scientific Computing Focus Area)	
E P/E M A 471	Intermediate Problem Solving for Engineers	
E P/E M A 476	Introduction to Scientific Computing for Engineering Physics	
Total Credits		28-33

ENGINEERING SCIENCE

Code	Title	Credits
E M A 201	Statics	3
or PHYSICS 201	General Physics	
or PHYSICS 207	General Physics	
PHYSICS 311	Mechanics	3
or E M A 202	Dynamics	
or M E 240	Dynamics	
E M A 303	Mechanics of Materials	3
or M E 306	Mechanics of Materials	
E M A/M E 307	Mechanics of Materials Lab	1
M E 361	Thermodynamics	3
or M S & E 330	Thermodynamics of Materials	
E C E 376	Electrical and Electronic Circuits	3
or PHYSICS 321	Electric Circuits and Electronics	
M E 363	Fluid Dynamics	3
M E 364	Elementary Heat Transfer	3
or M S & E 331	Transport Phenomena in Materials	
INTEREGR 170	Design Practicum	3
Total Credits		25

FOCUS AREA

Research and Development/Senior Thesis

Expectations for Research Projects

Completion of the engineering physics degree program requires satisfactory completion of the E P 468 Introduction to Engineering Research, E P 469 Research Proposal in Engineering Physics, E P 568 Research Practicum in Engineering Physics I, and E P 569 Research Practicum in Engineering Physics II coursework sequence, which

culminates in a senior research thesis. The research topic chosen by the student and agreed upon by the advisor should be on a topic connected to the chosen Focus Area. The research conducted should be such that the student participates in the creation of new knowledge, experiences the excitement of the research process, and makes a contribution so that it would be appropriate to include the student's name on a scholarly publication if one results from the research.

Senior Thesis

A senior thesis, completed during enrollment in E P 569 Research Practicum in Engineering Physics II is required. The senior thesis is a written document reporting on a substantial piece of work. It should be written in the style of a graduate thesis. The faculty advisor, in consultation with a research mentor, determines the grade which the student receives for the thesis. A bound copy of the thesis must be submitted to the engineering physics department office.

On or before the Friday of finals week of the semester in which E P 569 Research Practicum in Engineering Physics II is taken, the senior thesis must be presented orally by the student to a committee of three professors in a publicly announced seminar. Interested faculty and students will be invited to attend.

Research and Development

Code	Title	Credits
Research and Development		*8*
E P 468	Introduction to Engineering Research	1
E P 469	Research Proposal in Engineering Physics	1
E P 568	Research Practicum in Engineering Physics I	3
E P 569	Research Practicum in Engineering Physics II	3

Focus Area Electives

Nanoengineering

Code	Title	Credits
Focus Area Total Credits:		*14*
Required:		
PHYSICS 551	Solid State Physics	3
At Least One of:		
E P/E M A 615	Micro- and Nanoscale Mechanics	3
M S & E 553	Nanomaterials & Nanotechnology	3
At Least One of:		
E M A 506	Advanced Mechanics of Materials I	3
E M A 622	Mechanics of Continua	3
E M A 519	Fracture Mechanics	3
At Least One of:		
M S & E 448	Crystallography and X-Ray Diffraction	3
E M A 611	Advanced Mechanical Testing of Materials	3
M E 601	Special Topics in Mechanical Engineering (Micro & Nano Fabrication)	1-3
N E 602	Special Topics in Reactor Engineering (Vacuum Technology Lab)	0-3
PHYSICS 623	Electronic Aids to Measurement	4
PHYSICS 625	Applied Optics	4
M S & E 748	Structural Analysis of Materials	3
Open Electives:		
M S & E 333	Microprocessing of Materials	3
E C E 335	Microelectronic Devices	3
M S & E 434	Introduction to Thin-Film Deposition Processes	3
M S & E 441	Deformation of Solids	3
E C E 445	Semiconductor Physics and Devices	3
M S & E 451	Introduction to Ceramic Materials	3
E M A/M S & E 541	Heterogeneous and Multiphase Materials	3
M S & E 560	Fundamentals of Atomistic Modeling	3
M S & E 570	Properties of Solid Surfaces	3
CHEM 630	Selected Topics in Analytical Chemistry	1-3
M S & E 756	Structure and Properties of Advanced Electronic Materials	3

Plasma Science and Engineering

Code	Title	Credits
Focus Area Total Credits:		*14*
Required:		
N E/E C E/ PHYSICS 525	Introduction to Plasmas	3
At Least One of:		
N E/E C E/ PHYSICS 527	Plasma Confinement and Heating	3
N E/E C E 528	Plasma Processing and Technology	3
At Least One of:		
N E 526	Laboratory Course in Plasmas	3
Open Electives:		
N E 408	Ionizing Radiation	3
N E 536	Feasibility St of Power from Controlled Thermonuclear Fusion	3
Any plasma-related special topics course in NE		
PHYSICS 415	Thermal Physics	3
PHYSICS 623	Electronic Aids to Measurement	4
PHYSICS 625	Applied Optics	4
N E/E C E/ PHYSICS 724	Waves and Instabilities in Plasmas	3
N E/E C E/ PHYSICS 725	Plasma Kinetic Theory and Radiation Processes	3
N E/E C E/ PHYSICS 726	Plasma Magnetohydrodynamics	3

Scientific Computing

Code	Title	Credits
Focus Area Total Credits:		*14*
At Least One of:		
N E/MED PHYS 506	Monte Carlo Radiation Transport	3
M E 573	Computational Fluid Dynamics	3

E M A 605	Introduction to Finite Elements	3
E C E 742	Computational Methods in Electromagnetics	3
At Least One of:		
Students must take at least two credits of laboratory experience in the Physical or Biological Sciences beyond the required chemistry and mechanics of materials courses		
Open Electives:		
E P/E M A 476	Introduction to Scientific Computing for Engineering Physics	3
COMP SCI 300	Programming II	3
COMP SCI/ MATH 513	Numerical Linear Algebra	3
COMP SCI/ MATH 514	Numerical Analysis	3
COMP SCI/I SY E/ MATH/STAT 525	Linear Optimization	3
COMP SCI 577	Introduction to Algorithms	4
COMP SCI/ MATH 714	Methods of Computational Mathematics I	3
COMP SCI/ MATH 715	Methods of Computational Mathematics II	3
M S & E 560	Fundamentals of Atomistic Modeling	3
M E/COMP SCI/ E C E/E M A/E P 759	High Performance Computing for Applications in Engineering	3
Any scientific-computing-related special topics course in NE		

TECHNICAL ELECTIVE

Select 6 credits at a level that requires two semesters of calculus or two semesters of physics as a prerequisite.

COMMUNICATION SKILLS

Code	Title	Credits
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	
E P D 275	Technical Presentations	2
INTEREGR 397	Engineering Communication (was EPD 397 before Fall 2020)	3
Total Credits		8

LIBERAL STUDIES

Code	Title	Credits
Complete Requirements (http://guide.wisc.edu/undergraduate/engineering/#requirementstext) [1]		

[1] Students must take 16 credits that carry H, S, L, or Z breadth designators. These credits must fulfill the following subrequirements:

1. A minimum of two courses from the same department or program. At least one of these two courses must be designated as above the elementary level (I, A, or D) in the course listing.
2. A minimum of 6 credits designated as humanities (H, L, or Z in the course listing), and an additional minimum of 3 credits designated as social science (S or Z in the course listing). Foreign language courses count as H credits. Retroactive credits for language courses may not be used to meet the Liberal Studies credit requirement (they can be used for subrequirement 1 above).
3. At least 3 credits in courses designated as ethnic studies (lower case "e" in the course listing). These courses may help satisfy subrequirements 1 and 2 above, but theyonly count once toward the total required. Note: Some courses may have "e" designation but not have H, S, L, or Z designation; these courses do not count toward the Liberal Studies requirement.

TOTAL CREDITS: 130–132

For information on credit load, adding or dropping courses, course substitutions, pass/fail, auditing courses, dean's honor list, repeating courses, probation, and graduation, see the College of Engineering Official Regulations (http://guide.wisc.edu/undergraduate/engineering/#policiesandregulationstext).

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 research practices to produce results 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 apply experimental, theoretical, and computational methods to address scientific and engineering objectives
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
CHEM 109[1]	5	E M A 201	3
MATH 221	5	MATH 222	4
Communications A	3	PHYSICS 202	5
INTEREGR 170[2]	3	Liberal Studies Elective	3
	16		15

Second Year

Fall	Credits	Spring	Credits
MATH 319	3	MATH 234	4
PHYSICS 241 or 205	3	PHYSICS 322[4]	3
PHYSICS 311	3	M S & E 351 or CBE 440	3
E P 271 or COMP SCI 310	3	E M A 303	3
E P D 275 or COM ARTS 105	2	E M A/M E 307	1
STAT 324	3	Liberal Studies Elective	3
E P 468[3]	1	E P 469	1
	18		18

Third Year

Fall	Credits	Spring	Credits
N E 305 or PHYSICS 531[5]	3	Technical Elective	3
E P Focus Area Course	3	INTEREGR 397 (was EPD 397)	3
MATH 321	3	E C E 376 or PHYSICS 321	3-4
M E 361 or M S E 330	3-4	MATH 340 or 341	3
Computing Elective	3	Liberal Studies Elective	3
	15-16		15-16

Fourth Year

Fall	Credits	Spring	Credits
E P 568	3	E P 569	3
M E 363	3	E P Focus Area Course	2
E P Focus Area Course	3	M E 364 or M S E 331	3
E P Focus Area Course	3	Technical Elective	3
Liberal Studies Elective	4	E P Focus Area Course	3
		Liberal Studies Elective	3
	16		17

Total Credits 130-132

1 It is recommended that students take CHEM 109 Advanced General Chemistry for 5 credits. However, depending on their high school chemistry experience, students may substitute this with CHEM 103 General Chemistry I and CHEM 104 General Chemistry II for a total of 9 credits.

2 Students who were not able to take INTEREGR 170 Design Practicum as freshmen may, with the approval of their advisor, substitute a course offered in the College of Engineering or in the departments of Chemistry, Computer Sciences, Mathematics, and Physics.

3 Students are encouraged to take E P 468 Introduction to Engineering Research during their second year to allow for more flexibility in the research sequence.

4 Topics from MATH 321 Applied Mathematical Analysis are applied in PHYSICS 322 Electromagnetic Fields, and some students may find it helpful to take PHYSICS 322 Electromagnetic Fields after MATH 321 Applied Mathematical Analysis if PHYSICS 322 Electromagnetic Fields is not required for focus area courses.

5 Students in the nanoengineering focus area should take PHYSICS 531 Introduction to Quantum Mechanics.

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.

Continuing students who have fulfilled the progression requirements will also be assigned an Engineering Physics faculty advisor. Before enrolling in courses each semester, students must meet with their faculty advisor for assistance in planning courses and reviewing degree requirements. Faculty advisors are a valuable resource, as they can provide students with in-depth guidance on course content, internship and job opportunities, research, and more.

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

Paul Wilson (Chair)
Matt Allen
James Blanchard
Riccardo Bonazza
Curt A. Bronkhorst
Wendy Crone
Chris Hegna
Douglass Henderson
Roderic Lakes
Oliver Schmitz
Leslie Smith

Carl Sovinec
Kumar Sridharan
Fabian Waleffe

ASSOCIATE PROFESSOR

Robert J. Witt

ASSISTANT PROFESSORS

Jennifer Choy
Adrien Couet
Stephanie Diem
Jennifer Franck
Benedikt Geiger
Jacob Notbohm
Ramathasan Thevamaran
Yongfeng Zhang

See also Engineering Physics Faculty Directory (https://directory.engr.wisc.edu/ep/faculty/).

RESOURCES AND SCHOLARSHIPS

FACILITIES

Facilities available for instruction and research include:

Fluid Mechanics and Heat Transfer Laboratories
Instructional Computing Labs (in Computer Aided Engineering)
Nanomechanics Laboratory
Nuclear Instrumentation Laboratory
Plasma Physics Laboratories
Superconductivity and Cryogenics Laboratories

SCHOLARSHIPS

Most financial assistance is awarded through the Office of Student Financial Aid (333 E. Campus Mall RM 9701, 262-3060). Some financial assistance is also available from the College of Engineering. Please see your academic advisor or Student Services Center, 1410 Engineering Drive, for more information. The Department has a limited amount of scholarship funds that are awarded on a merit basis, usually at the beginning of the fall semester. An application for departmental scholarships is not necessary; all students are automatically considered in the competition for departmental scholarships.