NUCLEAR ENGINEERING, B.S.

Nuclear engineers harness the strongest forces of nature to tackle some of society's biggest challenges. Our curriculum gives students depth and breadth to keep up with rapidly changing technology, and our close-knit learning community supports our students' success during their degree and as they launch their careers. The radiation sciences option (http://guide.wisc.edu/undergraduate/engineering/nuclear-engineering-engineering-physics/nuclear-engineering-bs/nuclear-engineering-radiation-sciences-bs/) provides a pathway for careers in medical applications of radiation.

Nuclear energy is the largest source of clean electricity in the United States and new technologies will allow its impact to grow as we decarbonize our economy. Most nuclear engineers design, build and operate nuclear power plants—today based on fission of uranium, but in the future, based on fusion of hydrogen. With no greenhouse gas emissions, nuclear energy is a reliable and predictable partner to other clean electricity, like wind, solar and hydro. Nuclear power sources have even more potential as new technologies and are deployed to remove carbon emissions from industrial processes like hydrogen production, water desalination, and steel manufacturing.

With radiation from man-made radioisotopes and particle accelerators, we can diagnose and treat cancer and other diseases. Nuclear engineers in the radiation sciences option (http://guide.wisc.edu/undergraduate/engineering/nuclear-engineering-engineering-physics/nuclear-engineering-bs/nuclear-engineering-radiation-sciences-bs/) design systems to generate radioactive tracers that can be injected into patients to pinpoint tumors, stress fractures, and cardiac diseases, while others build accelerators that deliver radiation precisely to diseased tissue while avoiding sensitive organs. Talk to your academic advisor about declaring the Radiation Sciences option. Students must have, and are expected to maintain, a 3.0 cumulative GPA.

Today's rovers on Mars are powered by nuclear power sources and tomorrow's spacecrafts will need nuclear power to transport humans far into space. Nuclear engineers build radioisotope thermal generators that provide nonstop power with no moving parts to deep-space probes and planetary vehicles, allowing missions that last for many years. Nuclear space propulsion cuts the travel time to other planets by months and surface power ensures reliable energy once the spacecraft lands.

Using advanced radiation detection systems, we can seek out explosives and nuclear weapons being smuggled in shipping containers. Nuclear engineers combine sources and detectors that use penetrating radiation that not only can see objects through thick shields, but can also determine the composition of the items inside. Additionally, they use machine learning and artificial intelligence to combine the signals from these systems for even more insight.

Our curriculum starts with an Introduction to Nuclear Engineering designed for first year students to learn about a variety of technical nuclear topics and also to engage with some societal challenges. Later on, the curriculum focuses on the deepest physics and math base in the College of Engineering to prepare our graduates for careers with constantly evolving technologies based on the newest scientific discoveries. We transition from these fundamentals to more applied topics in radiation transport, thermal systems, materials science, imaging and detectors, while students build skills in computational modeling and simulation. All of our students also take at least one course that offers an experience with the UW Nuclear Reactor. Students in the radiation sciences option will complete their degree with graduate courses from the internationally recognized Medical Physics program. This interdisciplinary degree program overlaps with other engineering disciplines, allowing our graduates to transition into a variety of industries and careers.

Small class sizes allow students and professors to get to know each other in a supportive learning community starting in their first year. Many students participate in undergraduate research across one of the biggest research portfolios in the College of Engineering. Faculty collaborations with companies in nuclear science and technology—both established and newcomers, as well as the country's national laboratories—provide a professional network that helps students find internships and launch their careers.

NUCLEAR ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES

The faculty recognize that our graduates will choose to use the knowledge and skills they have acquired during their undergraduate years to pursue a wide variety of career and life goals and we encourage this diversity of paths. Regarding the Nuclear Engineering program, we initially expect graduates will begin their careers in fields that utilize their knowledge, education and training in the interaction of radiation with matter as it applies to power generation, health and medical physics, security and safeguards and other engineering fields.

Whatever path our graduates choose to pursue, our educational objectives for the nuclear engineering program are to allow them to:

1. Exhibit strong performance and continuous development in problem-solving, leadership, teamwork, and communication, initially applied to nuclear engineering, and demonstrating an unwavering commitment to excellence.
2. Demonstrate continuing commitment to, and interest in, his or her training and education, as well as those of others.
3. Transition seamlessly into a professional environment and make continuing, well-informed career choices.
4. Contribute to their communities.

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.

RADIATION SCIENCES DECLARATION

Talk to your academic advisor about declaring the Radiation Sciences (http://guide.wisc.edu/undergraduate/engineering/nuclear-engineering-engineering-physics/nuclear-engineering-bs/nuclear-engineering-radiation-sciences-bs/) option. Students must have and are expected to maintain a 3.0 cumulative GPA.

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.

The nuclear engineering curriculum emphasizes nuclear power and is appropriate for students seeking careers in the nuclear power industry.

There is also a Radiation Sciences option (p. 4) available for students interested in medical and other non-power applications.

The following curriculum applies to students who entered the program starting in Fall 2020.

SUMMARY OF REQUIREMENTS

Code	Title	Credits
Mathematics and Statistics		22
Science		13
Engineering Science		31
Nuclear Engineering Core		28
Nuclear Engineering Electives		8
Introduction to Engineering		3
Communication Skills		8
Liberal Studies		16
Total Credits		**129**

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 320	Linear Algebra and Differential Equations	3
MATH 321	Applied Mathematical Analysis	3

STAT 324	Introductory Applied Statistics for Engineers	3
Total Credits		**22**

SCIENCE

Code	Title	Credits
Select one of the following:		5-9
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	
Total Credits		**13-17**

ENGINEERING SCIENCE

Code	Title	Credits
E M A 201	Statics	3
E M A 202	Dynamics	3
or M E 240	Dynamics	
E M A 303	Mechanics of Materials	3
or M E 306	Mechanics of Materials	
E P 271	Engineering Problem Solving I	3-4
or COMP SCI 200	Programming I	
or COMP SCI 220	Data Science Programming I	
or COMP SCI 310	Problem Solving Using Computers	
M S & E 350	Introduction to Materials Science	3
M E 231	Geometric Modeling for Design and Manufacturing	3
M E 361	Thermodynamics	3
Select one of the following:		4-6
CBE 320	Introductory Transport Phenomena	
M E 363 & M E 364	Fluid Dynamics and Elementary Heat Transfer	
E C E 376	Electrical and Electronic Circuits [1]	3
Computing Elective (select one of the following):		3
COMP SCI 300	Programming II	
COMP SCI 412	Introduction to Numerical Methods	
E M A/E P 471	Intermediate Problem Solving for Engineers	
E M A/E P 476	Introduction to Scientific Computing for Engineering Physics	
Total Credits		**31-34**

1

PHYSICS 321 Electric Circuits and Electronics is an acceptable substitute for E C E 376 Electrical and Electronic Circuits.

NUCLEAR ENGINEERING CORE

Code	Title	Credits
N E 305	Fundamentals of Nuclear Engineering	3
N E 405	Nuclear Reactor Theory	3
N E 408	Ionizing Radiation	3
N E 411	Nuclear Reactor Engineering	3
N E 412	Nuclear Reactor Design	5
N E/M S & E 423	Nuclear Engineering Materials	3
N E 424	Nuclear Materials Laboratory	1
N E 427	Nuclear Instrumentation Laboratory	2
N E 428	Nuclear Reactor Laboratory	2
N E 571	Economic and Environmental Aspects of Nuclear Energy	3
Total Credits		**28**

NUCLEAR ENGINEERING ELECTIVES

Code	Title	Credits
Nuclear Engineering Electives		*6*
Select credits from Nuclear Engineering Electives Course List below		
Technical Electives (not to be confused with Nuclear Engineering Electives) choose 2 credits from:		*2*
N E 1	Cooperative Education Program (no more than 3 credits)	
Courses numbered 300+ in the CoE except for E P D/ INTEREGR		
Courses numbered 300+ in MATH, PHYSICS, COMP SCI, STAT (except STAT 301), ASTRON, MED PHYS, and CHEM departments		
Students may also propose any class that they feel will benefit their education path with pre-requisite of two physics or calculus classes. For these courses the advisor will review the request and if approved, recommend a DARS substitution.		
Total Credits		**8**

Nuclear Engineering Electives Course List [1]

Code	Title	Credits
N E 234	Principles and Practice of Nuclear Reactor Operations	4
N E 406	Nuclear Reactor Analysis	3
N E/M S & E 433	Principles of Corrosion	3
N E/MED PHYS 506	Monte Carlo Radiation Transport	3
M E/N E 520	Two-Phase Flow and Heat Transfer	3
N E/E C E/ PHYSICS 525	Introduction to Plasmas	3
N E 536	Feasibility St of Power from Controlled Thermonuclear Fusion	3
N E 541	Radiation Damage in Metals	3
N E 545	Materials Degradation in Advanced Nuclear Reactor Environments	3
N E 550	Advanced Nuclear Power Engineering	3
N E 555	Nuclear Reactor Dynamics	3
N E/M E 565	Power Plant Technology	3
N E/MED PHYS 569	Health Physics and Biological Effects	3-4
N E/I SY E 574	Methods for Probabilistic Risk Analysis of Nuclear Power Plants	3

N E 602	Special Topics in Reactor Engineering	3

Students are encouraged to access the online N E future course offering grid to plan their future course schedules and to confirm the offering of a course in the table.

1

Courses meeting the Nuclear Engineering Electives requirement are all N E courses numbered above 200 that are not part of the required curriculum. No more than 3 credits of N E 699 Advanced Independent Study may be used to meet this requirement. (Refer to the NE handbook under Degree Information on the NEEP department website (https://docs.google.com/document/u/1/d/e/2PACX-1vRMi-zHWwv19rf6wMx2E5Nzdn1Awf0ZHG6pK-QXTSRfsD-I3kYuBBCOMZbiWt9vcLejeTxBQQHEjZVs/pub/)).

INTRODUCTION TO ENGINEERING

Code	Title	Credits
N E 231	Introduction to Nuclear Engineering	3
Total Credits		**3**

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 ESL 118	Academic Writing II	
E P D 275	Technical Presentations	2
INTEREGR 397	Engineering Communication	3
Total Credits		**8**

LIBERAL STUDIES ELECTIVES

Code	Title	Credits
College of Engineering Liberal Studies Requirements		
Complete Requirements (http://guide.wisc.edu/undergraduate/engineering/#requirementstext) [1]		16
Total Credits		**16**

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 subject area (https://registrar.wisc.edu/subjectarea/) (the description before the course number). 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 they only 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.

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).

NAMED OPTION

Talk to your academic advisor about declaring the Radiation Sciences option. Students must have and are expected to maintain a 3.0 cumulative GPA.

View as listView as grid

- NUCLEAR ENGINEERING: RADIATION SCIENCES **(**HTTP://GUIDE.WISC.EDU/UNDERGRADUATE/ENGINEERING/NUCLEAR-ENGINEERING-ENGINEERING-PHYSICS/NUCLEAR-ENGINEERING-BS/NUCLEAR-ENGINEERING-RADIATION-SCIENCES-BS/**)**

HONORS IN UNDERGRADUATE RESEARCH PROGRAM

Qualified undergraduates may earn an Honor 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.

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
CHEM 109[1]	5	E M A 201[3]	3
MATH 221	5	MATH 222	4
Communication A	3	M E 231	3
Liberal Studies Elective	3	M S & E 350	3
		N E 231	3
	16		**16**

Second Year

Fall	Credits	Spring	Credits
MATH 234	4	MATH 320	3
PHYSICS 202	5	PHYSICS 241 or 205	3
E M A 202[4]	3	M E 361	3
E P 271 or COMP SCI 310	3	E M A 303[4]	3
E P D 275 or COM ARTS 105	2	N E 424	1
		Liberal Studies Elective	3
	17		**16**

Third Year

Fall	Credits	Spring	Credits
N E 305	3	N E 405	3
MATH 321	3	N E 408	3
STAT 324[5]	3	CBE 320[6]	4
Technical Elective	2	Computing Elective	3
Liberal Studies Elective	4	E C E 376	3
	15		**16**

Fourth Year

Fall	Credits	Spring	Credits
N E 411	3	N E 412	5
N E 427	2	N E 428	2
N E/M S & E 423	3	N E 571	3
Nuclear Engineering Elective	3	Nuclear Engineering Elective	3
Liberal Studies Elective	3	Liberal Studies Elective	3
INTEREGR 397	3		
	17		**16**

Total Credits 129

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 CHEM 103 General Chemistry I and CHEM 104 General Chemistry II for a total of 9 credits. Three credits of CHEM 103/CHEM 104 may be counted towards Technical Electives credits.

2

Students who were not able to take N E 231 Introduction to Nuclear Engineering 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 may substitute PHYSICS 201 General Physics, 5 credits, for E M A 201 Statics, 3 credits, with the approval of their advisor.

4

After completing E M A 201 Statics, students may take E M A 202 Dynamics and E M A 303 Mechanics of Materials in either order or concurrently.

5

STAT 311 Introduction to Theory and Methods of Mathematical Statistics I or STAT/M E 424 Statistical Experimental Design are acceptable substitutes.

6

M E 363 Fluid Dynamics and M E 364 Elementary Heat Transfer are acceptable substitutions for CBE 320 Introductory Transport Phenomena.

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 a Nuclear Engineering 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)
Wendy Crone
Chris Hegna
Oliver Schmitz
Carl Sovinec
Kumar Sridharan

ASSOCIATE PROFESSORS

Adrien Couet

ASSISTANT PROFESSORS

Stephanie Diem
Juliana Pacheco Duarte
Benedikt Geiger
Ben Lindley
Yongfeng Zhang

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

RESOURCES AND SCHOLARSHIPS

FACILITIES

Facilities available for instruction and research include:

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

SCHOLARSHIPS

The Department of Nuclear Engineering & Engineering Physics & the College of Engineering have several types of scholarships available to incoming and current engineering students. Students should explore the Wisconsin Scholarship Hub (WiSH), where you can apply to and find specific information on scholarships at UW-Madison. You can use WiSH to find engineering scholarships available through the College of Engineering; the Inclusion, Equity, and Diversity in Engineering Student Center; the Nuclear Engineering & Engineering Physics Department; and other UW and external organizations. (Please note: students must be currently enrolled in, or have applied to, the College of Engineering to be considered for engineering scholarships.) To be matched with these available scholarship funds an application is required and the system is typically open to students in the spring of each year. Questions on the process can be directed to: coescholarships@engr.wisc.edu. Additional financial assistance may be awarded through the Office of Student Financial Aid (333 E. Campus Mall RM 9701, 262-3060).

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.")