

NUCLEAR ENGINEERING, B.S.

Begin Campus: Any Penn State Campus

End Campus: University Park

Program Description

The overall educational objective of the Nuclear Engineering program is to help prepare our graduates to function effectively in the marketplace in a wide range of career paths in Nuclear Engineering. The technical part of the curriculum, emphasizes nuclear power engineering, which refers to complex systems used to generate electricity. Because of our strong educational and research emphasis in nuclear power engineering, and because a shortage for this expertise exists in the industry, generally the industry values our graduates highly. We recognize that nuclear science, including nuclear security and non-proliferation, is an important growth area. We constantly assess and review the needs of our undergraduate students and their most frequent employers and use this feedback to consider revisions to our curriculum so that it is responsive to the needs of our constituents.

The first two years of the program stress fundamentals in mathematics, chemistry, physics, computer programming, and engineering sciences such as mechanics, materials, and thermodynamics. The last two years provide the breadth and depth in nuclear science, behavior of heat and fluids, reactor theory and engineering, and radiation measurement. The laboratory work includes experiments using the University's 1,000-kilowatt research reactor. Engineering design is incorporated in many courses from the freshman year to the senior year, but is particularly emphasized in the senior capstone design course, which integrates the critical elements of reactor theory, reactor engineering, safety considerations and economic optimization into a reactor design.

Many graduates are employed by electric power companies that use nuclear power plants, or by companies that help service and maintain those plants. They use their knowledge of engineering principles, radioactive decay, interactions of radiation with matter, and nuclear reactor behavior to help assure that the power plants meet the demand for reliable, economic electricity while ensuring a safe environment. To do this, graduates must be problem solvers who can develop and use complex computer models and sophisticated monitoring systems, design systems to handle radioactive waste, determine if the materials in the plant are becoming brittle or corroded, or manage the fuel in the reactor to get the maximum energy from it. Other graduates work in industries that use radioactivity or radiation to detect problems or monitor processes. Jobs are also found in branches of the government as designers of the next generation of reactors for submarines, aircraft carriers, or space probes, or to manage and clean up contaminated wastes. They could also be involved with regulation of nuclear power or radiation uses, or in research to develop advanced technologies that will be used in next-generation power plants. Graduates who want to further their education in the fields of health physics, radiation biology, or nuclear medical applications find this degree to be a useful preparation.

What is Nuclear Engineering?

Nuclear Engineering is a multidisciplinary field that goes beyond providing nuclear power for electrical production. Nuclear engineers may apply their knowledge in various fields, including disease treatment, safeguarding food supplies, operate nuclear energy systems, develop regulations to ensure safety, or facilitate space exploration.

You Might Like This Program If...

You are interested in using basic science to make the world a better place for humankind through the production of clean energy, keeping the country safe from nuclear attack, and the application of nuclear science.

Entrance to Major

In order to be eligible for entrance to this major, students must satisfy the following requirements by the end of the semester during which the admission to major process is carried out.

- Completed 29-55 cumulative credits (credits completed at Penn State for which a quality letter grade was earned)
 - Completed with a C or better the following courses: EDSGN 100, CHEM 110, MATH 140, MATH 141, and PHYS 211
 - Attained at least a 2.6 cumulative grade point average
- * In the event that the major is under enrollment control, a higher minimum cumulative grade-point average is likely to be needed and students must be enrolled in the College of Engineering or Division of Undergraduate Studies at the time of confirming their major choice.

Degree Requirements

For the Bachelor of Science degree in Nuclear Engineering, a minimum of 129 credits is required:

Requirement	Credits
General Education	45
Requirements for the Major	111

27 of the 45 credits for General Education are included in the Requirements for the Major. This includes: 9 credits of GN courses; 6 credits of GQ courses; 3 credits of GS courses; 9 credits of GWS courses.

General Education

Connecting career and curiosity, the General Education curriculum provides the opportunity for students to acquire transferable skills necessary to be successful in the future and to thrive while living in interconnected contexts. General Education aids students in developing intellectual curiosity, a strengthened ability to think, and a deeper sense of aesthetic appreciation. These are requirements for all baccalaureate students and are often partially incorporated into the requirements of a program. For additional information, see the General Education Requirements (<http://bulletins.psu.edu/undergraduate/general-education/baccalaureate-degree-general-education-program/>) section of the Bulletin and consult your academic adviser.

The keystone symbol appears next to the title of any course that is designated as a General Education course. Program requirements may also satisfy General Education requirements and vary for each program.

Foundations (grade of C or better is required.)

- **Quantification (GQ):** 6 credits
- **Writing and Speaking (GWS):** 9 credits

Knowledge Domains

- **Arts (GA):** 6 credits
- **Health and Wellness (GHW):** 3 credits
- **Humanities (GH):** 6 credits

- **Social and Behavioral Sciences (GS):** 6 credits
- **Natural Sciences (GN):** 9 credits

Integrative Studies (may also complete a Knowledge Domain requirement)

- **Inter-Domain or Approved Linked Courses:** 6 credits

University Degree Requirements

First Year Engagement

All students enrolled in a college or the Division of Undergraduate Studies at University Park, and the World Campus are required to take 1 to 3 credits of the First-Year Seminar, as specified by their college First-Year Engagement Plan.

Other Penn State colleges and campuses may require the First-Year Seminar; colleges and campuses that do not require a First-Year Seminar provide students with a first-year engagement experience.

First-year baccalaureate students entering Penn State should consult their academic adviser for these requirements.

Cultures Requirement

6 credits are required and may satisfy other requirements

- United States Cultures: 3 credits
- International Cultures: 3 credits

Writing Across the Curriculum

3 credits required from the college of graduation and likely prescribed as part of major requirements.

Total Minimum Credits

A minimum of 120 degree credits must be earned for a baccalaureate degree. The requirements for some programs may exceed 120 credits. Students should consult with their college or department adviser for information on specific credit requirements.

Quality of Work

Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

Limitations on Source and Time for Credit Acquisition

The college dean or campus chancellor and program faculty may require up to 24 credits of course work in the major to be taken at the location or in the college or program where the degree is earned. Credit used toward degree programs may need to be earned from a particular source or within time constraints (see Senate Policy 83-80 (<http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#83-80>)). For more information, check the Suggested Academic Plan for your intended program.

Requirements for the Major

To graduate, a student enrolled in the major must earn a grade of C or better in each course designated by the major as a C-required course, as specified by Senate Policy 82-44 (<http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44>).

Code	Title	Credits
Prescribed Courses		
CHEM 111	Experimental Chemistry I	1
EE 212	Introduction to Electronic Measuring Systems	3

EMCH 211	Statics	3
EMCH 212	Dynamics	3
EMCH 213	Strength of Materials	3
EMCH 315	Mechanical Response of Engineering Materials	2
EMCH 316	Experimental Determination of Mechanical Response of Materials	1
MATH 230	Calculus and Vector Analysis	4
ME 300	Engineering Thermodynamics I	3
ME 320	Fluid Flow	3
ME 410	Heat Transfer	3
NUCE 310W	Issues in Nuclear Engineering	2
NUCE 403	Advanced Reactor Design	3
NUCE 451	Experiments in Reactor Physics	3
NUCE 431W	Nuclear Reactor Core Design Synthesis	4
PHYS 214	General Physics: Wave Motion and Quantum Physics	2

Prescribed Courses: Require a grade of C or better

CHEM 110	Chemical Principles I	3
EDSGN 100	Cornerstone Engineering Design	3
ENGL 202C	Effective Writing: Technical Writing	3
MATH 140	Calculus With Analytic Geometry I	4
MATH 141	Calculus with Analytic Geometry II	4
MATH 251	Ordinary and Partial Differential Equations	4
NUCE 301	Fundamentals of Reactor Physics	4
NUCE 302	Introduction to Reactor Design	4
NUCE 309	Analytical Techniques for Nuclear Concept	3
NUCE 430	Design Principles of Reactor Systems	3
NUCE 450	Radiation Detection and Measurement	3
PHYS 211	General Physics: Mechanics	4
PHYS 212	General Physics: Electricity and Magnetism	4

Additional Courses

Select 1 credit of First-Year Seminar		1
CMPSC 200	Programming for Engineers with MATLAB	3
or CMPSC 201	Programming for Engineers with C++	
Select one of the following:		3
ECON 102	Introductory Microeconomic Analysis and Policy	
ECON 104	Introductory Macroeconomic Analysis and Policy	
EBF 200	Introduction to Energy and Earth Sciences Economics	

Select 6 credits, of which 3 credits must be designated as design, from the following:

BME 406	Medical Imaging	
NUCE 405	Nuclear and Radiochemistry	
NUCE 408	Radiation Shielding	
NUCE 409	Nuclear Materials	
NUCE 420	Radiological Safety	
NUCE 428	Radioactive Waste Control	
NUCE 470	Power Plant Simulation	
NUCE 490	Introduction to Plasmas	
NUCE 496	Independent studies	
NUCE 497	Special Topics	

500-level NUCE courses with approval of adviser

Additional Courses: Require a grade of C or better

CAS 100A	Effective Speech	3
or CAS 100B	Effective Speech	
ENGL 15	Rhetoric and Composition	3
or ENGL 30H	Honors Rhetoric and Composition	

Supporting Courses and Related Areas

Select 3 credits in General Technical Elective (GTE) courses from department list^{1,2} 3

¹ These courses may have to be chosen so that the engineering design or engineering science requirements for the major are met.

² Students who complete Basic ROTC may substitute 6 of the ROTC credits for 3 credits of GTE and 3 credits of GHW.

Program Educational Objectives

Accordingly, we will endeavor to maintain and provide a curriculum that prepares our graduates such that:

- Within two to three years of graduation, we expect the majority of our B.S. graduates to:
 - be working in industry, especially related to nuclear power engineering,
 - be working in government agencies or national laboratories,
 - be pursuing advanced degrees.
- We expect that our students will continue to develop professionally and establish themselves in their careers and in this way may take the opportunity to further their education and training by attending graduate school or by pursuing other professional development.

Student Outcomes

Student outcomes describe what students are expected to know and be able to do by the time of graduation. The Nuclear Engineering program is designed to enable students to:

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.

Academic Advising

The objectives of the university's academic advising program are to help advisees identify and achieve their academic goals, to promote their intellectual discovery, and to encourage students to take advantage of both in-and-out-of class educational opportunities in order that they become self-directed learners and decision makers.

Both advisers and advisees share responsibility for making the advising relationship succeed. By encouraging their advisees to become engaged in their education, to meet their educational goals, and to develop the habit of learning, advisers assume a significant educational role. The advisee's unit of enrollment will provide each advisee with a primary academic adviser, the information needed to plan the chosen program of study, and referrals to other specialized resources.

READ SENATE POLICY 32-00: ADVISING POLICY (<http://senate.psu.edu/policies-and-rules-for-undergraduate-students/32-00-advising-policy/>)

University Park

Arthur Motta

Professor and Chair of Nuclear Engineering
138 Reber Building
University Park, PA 16802
814-865-0036
atm2@psu.edu

Suggested Academic Plan

The suggested academic plan(s) listed on this page are the plan(s) that are in effect during the 2020-21 academic year. To access previous years' suggested academic plans, please visit the archive (<https://bulletins.psu.edu/undergraduate/archive/>) to view the appropriate Undergraduate Bulletin edition (*Note: the archive only contain suggested academic plans beginning with the 2018-19 edition of the Undergraduate Bulletin*).

University Park Campus

The course series listed below provides **only one** of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an **Academic Requirements** or **What If** report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.

If you are starting at a campus other than the one this plan is ending at, please refer to: <http://advising.engr.psu.edu/degree-requirements/academic-plans-by-major.aspx>

First Year

Fall	Credits Spring	Credits
CHEM 110 (GN) ^{*#†}	3 ENGL 15, 30H, or ESL 15 (GWS) ^{††}	3
CHEM 111 (GN)	1 MATH 141 or 141E (GQ) ^{*†#†}	4
ECON 102 or 104 (GS) [†]	3 PHYS 211 (GN, PHYSICS 211L & PHYSICS 211R) ^{*#†}	4
EDSGN 100 ^{*#}	3 First Year Seminar [†]	1
MATH 140 or 140E (GQ) ^{*†#†}	4 General Education Course [†]	3
General Education Course [†]	3 General Education Course (GHW) [†]	1.5
	17	16.5

Second Year

Fall	Credits Spring	Credits
CMPSC 201 (CMPSC 200 acceptable)	3 EMCH 212	3
EMCH 211	3 EMCH 213 or 213D	3
MATH 251 [*]	4 MATH 230	4

PHYS 212 (GN, PHYSICS 212L & PHYSICS 212R) ^{††}	4 ME 300	3
General Education Course [†]	3 PHYS 214	2
	General Education Course (GHW) [†]	1.5
	17	16.5

Third Year

Fall	Credits Spring	Credits
CAS 100A or 100B (GWS) ^{††}	3 EE 212	3
ME 320	3 EMCH 315	2
NUCE 301 [*]	4 EMCH 316	1
NUCE 309 [*]	3 ME 410	3
NUCE 310W	2 NUCE 302 [*]	4
	NUCE 450 [*]	3
	15	16

Fourth Year

Fall	Credits Spring	Credits
ENGL 202C (GWS) ^{††}	3 NUCE 431W	4
NUCE 403	3 General Technical Elective (GTE)	3
NUCE 430 [*]	3 Nuclear Engineering Elective (NETE)	3
NUCE 451	3 General Education Course [†]	3
Nuclear Engineering Elective (NETE)	3 General Education Course [†]	3
	15	16

Total Credits 129

- * Course requires a grade of C or better for the major
- ‡ Course requires a grade of C or better for General Education
- # Course is an Entrance to Major requirement
- † Course satisfies General Education and degree requirement

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of 'C' or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL 137H/CAS 137H in the fall semester and ENGL 138T/CAS 138T in the spring semester. These courses carry the GWS designation and replace both ENGL 30H and CAS 100. Each course is 3 credits.

College Notes:

- **General Technical Elective (GTE):** Select from NUCE program lists. Students who complete the ROTC Program may substitute 3 ROTC credits for the GHW requirement and 3 ROTC credits for the GTE requirement. Students who complete three co-op rotations may substitute 3 co-op credits for the GTE requirement.
- **Health and Physical Activity Elective:** Students who complete the ROTC Program may substitute 3 ROTC credits for the GHW requirement and 3 ROTC credits for the GTE requirement.
- **Nuclear Engineering Elective (NETE):** Select from NUCE program lists.
- **These courses offered at University Park in fall semester only:**
 - NUCE 301
 - NUCE 309
 - NUCE 310W
 - NUCE 403
 - NUCE 430
 - NUCE 451
- **These courses offered at University Park in spring semester only:**
 - NUCE 302
 - NUCE 431W
 - NUCE 450

Career Paths

Penn State's nuclear engineering program relates theory to practice in a way that most universities cannot. Penn State is one of the few universities where undergraduate students can work with a functioning nuclear reactor. The Breazeale Nuclear Reactor is the longest operating licensed research reactor in the country and is one of the premier nuclear research facilities in the world. In addition to University facilities, students also gain professional experience through an industry-sponsored project in their capstone design course. Penn State's collaboration with Westinghouse, as well as other nuclear companies and agencies, provides an unmatched educational experience using the simulation and analysis codes currently used in industry. Penn State also collaborates effectively with industry, the military, and government as sponsors of the capstone design project.

Careers

Many nuclear engineering graduates work for electric power companies that use nuclear power plants or help service and maintain these plants. Other graduates work in industries that use radioactivity or radiation, such as medicine, food, and agriculture. These fields need nuclear engineers to detect problems, monitor processes, and protect the public. The federal government also hires nuclear engineers to design next-generation reactors for submarines, aircraft carriers, and space probes; regulate nuclear power or radiation uses; and develop advanced technologies that will be used in future power plants. Other industries where nuclear engineers may work include energy, government, medicine, agriculture, and space.

MORE INFORMATION ABOUT POTENTIAL CAREER OPTIONS FOR GRADUATES OF THE NUCLEAR ENGINEERING PROGRAM (<https://www.nuce.psu.edu/industry/>)

Opportunities for Graduate Studies

Penn State University is home to the Breazeale Nuclear Reactor, one of the premier reactor research facilities in the country. Our students have the unique opportunity to learn and research in state-of-the-art experimental facilities under the supervision of internationally renowned

faculty, scientists, and engineers. We have especially strong research programs in nuclear power, reactor design, nuclear science, and nuclear materials.

MORE INFORMATION ABOUT OPPORTUNITIES FOR GRADUATE STUDIES (<https://www.nuce.psu.edu/students/graduate/prospective.aspx>)

Accreditation

The baccalaureate program in Nuclear Engineering is accredited by the Engineering Accreditation Commission of ABET, <https://www.abet.org/>.

MORE INFORMATION ABOUT ABET ACCREDITATION (<https://www.abet.org/>)

Professional Licensure/Certification

Many U.S. states and territories require professional licensure/certification to be employed. If you plan to pursue employment in a licensed profession after completing this program, please visit the Professional Licensure/Certification Disclosures by State (<https://psu.edu/state-licensure-disclosures/>) interactive map.

Contact

University Park

DEPARTMENT OF NUCLEAR ENGINEERING
205 Hallowell Building
University Park, PA 16802
814-863-6938
bah41@psu.edu

<https://www.nuce.psu.edu/>