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 radiation in disease treatment and food supplies, operate nuclear energy systems, develop regulations to ensure safety, or facilitate space exploration.

You Might Like This Program If...

You’d like the opportunity to help mold the future in exciting new ways. Nuclear technology touches our lives in many ways and nuclear engineers solve everyday problems in health and safety.

Entrance to Major

This program currently has administrative enrollment controls. Administrative Enrollment Controls are initiated when limitations of space, faculty, or other resources in a major prevent accommodating all students who request them. Students must follow the administrative enrollment controls that are in effect for the semester that they enter the university.

First-Year Students Entering Summer 2018, Fall 2018, Spring 2019

In order to be eligible for entrance to this major, students must satisfy the following requirements:

• completed 40-59 credits at Penn State (actual credits taken at the University)
• completed with a grade of C or better: CHEM 110, MATH 140, MATH 141, MATH 250 or MATH 251, PHYS 211, and PHYS 212
• earned a minimum of 2.60 cumulative GPA

Students Who Entered Prior to Summer 2018

Students who entered the University prior to the summer 2018 semester should view the administrative enrollment controls for the semester that they entered the university (http://advising.psu.edu/entrance-major-requirements) on the Academic Advising Portal.

Degree Requirements

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

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education</td>
<td>45</td>
</tr>
<tr>
<td>Requirements for the Major</td>
<td>111</td>
</tr>
</tbody>
</table>

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
Integrative Studies (may also complete a Knowledge Domain requirement)

- Inter-Domain or Approved Linked Courses: 6 credits

27 of these 45 credits are included in the Requirements for the Major.

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/#82-44). For more information, check the Suggested Academic Plan for your intended program.

Requirements for the Major

This includes 27 credits of General Education courses: 9 credits of GN courses; 6 credits of GQ courses; 3 credits of GS courses; 9 credits of GWS courses.

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-

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 111</td>
<td>Experimental Chemistry I</td>
<td>1</td>
</tr>
<tr>
<td>EDSGN 100</td>
<td>Introduction to Engineering Design</td>
<td>3</td>
</tr>
<tr>
<td>EMCH 211</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>EMCH 212</td>
<td>Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>EMCH 213</td>
<td>Strength of Materials</td>
<td>3</td>
</tr>
<tr>
<td>ME 300</td>
<td>Engineering Thermodynamics I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 230</td>
<td>Calculus and Vector Analysis</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 214</td>
<td>General Physics: Wave Motion and Quantum Physics</td>
<td>2</td>
</tr>
<tr>
<td>EE 212</td>
<td>Introduction to Electronic Measuring Systems</td>
<td>3</td>
</tr>
<tr>
<td>EMCH 315</td>
<td>Mechanical Response of Engineering Materials</td>
<td>2</td>
</tr>
<tr>
<td>EMCH 316</td>
<td>Experimental Determination of Mechanical Response of Materials</td>
<td>1</td>
</tr>
<tr>
<td>ME 320</td>
<td>Fluid Flow</td>
<td>3</td>
</tr>
<tr>
<td>ME 410</td>
<td>Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 202C</td>
<td>Effective Writing: Technical Writing</td>
<td>3</td>
</tr>
<tr>
<td>NUCE 310</td>
<td>Issues in Nuclear Engineering</td>
<td>2</td>
</tr>
<tr>
<td>NUCE 403</td>
<td>Advanced Reactor Design</td>
<td>3</td>
</tr>
<tr>
<td>NUCE 431</td>
<td>Nuclear Reactor Core Design Synthesis</td>
<td>4</td>
</tr>
<tr>
<td>NUCE 451</td>
<td>Experiments in Reactor Physics</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 110</td>
<td>Chemical Principles I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 140</td>
<td>Calculus With Analytic Geometry I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 141</td>
<td>Calculus With Analytic Geometry II</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 211</td>
<td>General Physics: Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 212</td>
<td>General Physics: Electricity and Magnetism</td>
<td>4</td>
</tr>
<tr>
<td>MATH 251</td>
<td>Ordinary and Partial Differential Equations</td>
<td>4</td>
</tr>
<tr>
<td>NUCE 301</td>
<td>Fundamentals of Reactor Physics</td>
<td>4</td>
</tr>
<tr>
<td>NUCE 302</td>
<td>Introduction to Reactor Design</td>
<td>4</td>
</tr>
<tr>
<td>NUCE 309</td>
<td>Analytical Techniques for Nuclear Concept</td>
<td>3</td>
</tr>
<tr>
<td>NUCE 450</td>
<td>Radiation Detection and Measurement</td>
<td>3</td>
</tr>
<tr>
<td>NUCE 430</td>
<td>Design Principles of Reactor Systems</td>
<td>3</td>
</tr>
</tbody>
</table>

Select 1 credit of First-Year Seminar

Select one of the following:

- ECON 102 Introductory Microeconomic Analysis and Policy
- ECON 104 Introductory Macroeconomic Analysis and Policy
- EBF 200 Introduction to Energy and Earth Sciences Economics
- ENGL 15 Rhetoric and Composition
- or ENGL 30 Honors Freshman Composition
- CAS 100A Effective Speech
- or CAS 100B Effective Speech

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

- CMPSC 200 Programming for Engineers with MATLAB
- or CMPSC 201 Programming for Engineers with C++
- BME 406 Medical Imaging
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.

Program Outcomes (Student Outcomes)
The Program outcomes are knowledge, skills, and/or behavior that are derived from the program educational objectives.

a. Students will demonstrate a knowledge of the fundamentals in mathematics, physics, chemistry and the engineering sciences necessary to the nuclear engineering profession.
b. Students will demonstrate an ability to apply the fundamentals to understand, analyze and design nuclear systems; demonstrate knowledge of the contemporary issues affecting the nuclear engineering profession.
c. Students will demonstrate the ability to use appropriate methods and technology for detection and measurement of radiation and for nuclear science.
d. Students will be proficient in the oral and written communication of their work and ideas; show the ability to learn independently using appropriate technology; show ability to work well in teams.
e. Students will demonstrate the ability to operate in a modern, diverse work environment; understand their professional and ethical responsibilities; and be aware of the safety, environmental, and societal consequences of their work in a global contexts.

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 need 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
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Suggested Academic Plan
Nuclear Engineering - Ending at 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 here:
http://advising.engr.psu.edu/degree-requirements/academic-plans-by-major.aspx

First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 110 (GN) *<em>†</em></td>
<td>3 ENGL 15, 30, or ESL 15 (GWS)**†</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CHEM 111 (GN)</td>
<td>1 MATH 141 or 141E (GQ) *<em>†</em></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>ECON 102 or 104 (GS) †</td>
<td>3 PHYS 211 (GN, PHYSICS 211R)**†</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>EDSGN 100</td>
<td>3 First Year Seminar†</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>MATH 140 or 140E (GO) *<em>†</em></td>
<td>4 General Education Course†</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>General Education Course†</td>
<td>3 General Education Course (GHW)†</td>
<td>1.5</td>
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<td></td>
<td></td>
<td>17</td>
<td>16.5</td>
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Second Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPSC 201</td>
<td>3 EMCH 212</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EMCH 211</td>
<td>3 EMCH 213 or 213D</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MATH 251**†*</td>
<td>4 MATH 230</td>
<td>4</td>
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</tr>
</tbody>
</table>
Park will take ENGL/CAS 137 in the fall semester and ENGL/CAS 138 in the spring semester. These courses carry the GWS designation and replace both ENGL 30 and CAS 100. Each course is 3 credits.

College Note

General Technical Elective (GTE): Select from NUC E 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 NUC E program lists.

These courses offered at University Park in fall semester only:
- NUC E 301
- NUC E 309
- NUC E 310
- NUC E 431
- NUC E 451

These courses offered at University Park in spring semester only:
- NUC E 302
- NUC E 309
- NUC E 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 undergrad students can work with a functioning nuclear reactor. The Breazeale Nuclear Reactor is the longest operating licensed research reactor in the country. Students also gain professional experience with an industry-sponsored project through our capstone design course. Penn State’s collaboration with Westinghouse as well as other nuclear companies and agencies, will give you an unmatched educational experience using the simulation and analysis codes currently used in industry.

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 are: energy, government, medicine, agriculture, and space.

MORE INFORMATION (http://mne.psu.edu/students/undergraduate/what-is-an-engineer.aspx#NuclearEngineer)

Opportunities for Graduate Studies

We are one of the few universities in the U.S. with a research reactor on campus. 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, and nuclear materials.

MORE INFORMATION (http://mne.psu.edu/students/graduate/prospective.aspx)

Accreditation
The baccalaureate program in Nuclear Engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org).

MORE INFORMATION (http://www.abet.org)

Contact
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