

NUCLEAR, PLASMA, AND RADIOLOGICAL ENGINEERING: POWER, SAFETY & ENVIRONMENT, BS

for the degree of Bachelor of Science in Nuclear, Plasma, & Radiological Engineering with a concentration in Power, Safety & Environment

Nuclear, plasma, and radiological engineering encompasses a broad and diverse but complimentary set of engineering disciplines with a wide variety of applications. The first two years of the NPRE curriculum provides a strong foundation in sciences (physics, mathematics, and chemistry), in engineering (mechanics and thermodynamics), in computer use, and in nuclear energy systems. Most of the technical core and concentration coursework takes place in the third and fourth years of the curriculum. Students choose from among three concentrations: power, safety and the environment; plasma and fusion science and engineering; and radiological, medical and instrumentation applications. Each concentration requires students acquire a depth of understanding of the area but with flexibility to develop advanced technical expertise depending upon the student's specific educational and professional interests. Students demonstrate proficiency in the engineering design process in a senior design capstone course.

The power, safety and the environment concentration focuses on continued safe and reliable nuclear energy production. This relies on multifaceted engineering disciplines for design and analysis of large complex systems. Areas of scholarship and research in which students are involved include but are not limited to: advanced reactor design and safety, reactor physics and thermal-hydraulics, nuclear materials, instrumentation and controls, training and education, fuel design and performance, waste management, reactor accident analysis, risk and reliability, probabilistic risk assessment, human factors, validation and verification, uncertainty analysis, energy and security, and nonproliferation. Cross-cutting areas of study and research include modeling and simulation and numerical analysis and computational methods. Students confer with their academic advisor on a chosen course set to ensure that a strong program is achieved. Technical electives are chosen from among NPRE courses and courses outside the department in the subfields of: thermal sciences; power and control systems; solid, fluid and continuum mechanics; computational sciences and engineering, and environmental engineering and science. The program prepares graduates for positions in industry, research laboratories, federal and regulatory agencies, as well for further graduate study.

Current Program Educational Objectives

for the degree of Bachelor of Science in Nuclear, Plasma, & Radiological Engineering with a concentration in Power, Safety & Environment

Graduation Requirements

Minimum Technical GPA (<https://go.grainger.illinois.edu/TechnicalGPA/>): **2.0**

TGPA is required for NPRE 200 and NPRE 247. See Technical GPA (<https://go.grainger.illinois.edu/TechnicalGPA/>) to clarify requirements.

Minimum Overall GPA: 2.0

Minimum hours required for graduation: 128 hours, to include a minimum of 40 hours of upper-division coursework generally at the 300- and 400-level. These hours can be drawn from all elements of the degree.

General education: Students must complete the Campus General Education (<https://courses.illinois.edu/gened/DEFAULT/DEFAULT/>) requirements including the campus general education language requirement. One of the SBS courses must be an introductory economics course (ECON 102 or ECON 103). NPRE 481 will satisfy a technical elective requirement in the Professional Concentration Area and the Campus General Education Advanced Composition requirement.

Orientation and Professional Development

Code	Title	Hours
ENG 100	Grainger Engineering Orientation Seminar (External transfer students take ENG 300.)	1
NPRE 100	Orientation to NPRE	1
Total Hours		2

Foundational Mathematics and Science

Code	Title	Hours
CHEM 102	General Chemistry I	3
CHEM 103	General Chemistry Lab I	1
MATH 221	Calculus I (MATH 220 may be substituted. MATH 220 is appropriate for students with no background in calculus. 4 of 5 credit hours count towards degree.)	4
MATH 231	Calculus II	3
MATH 241	Calculus III	4
MATH 257	Linear Algebra with Computational Applications	3
MATH 285	Intro Differential Equations	3
PHYS 211	University Physics: Mechanics	4
PHYS 212	University Physics: Elec & Mag	4
Total Hours		29

Nuclear, Plasma, and Radiological Engineering Technical Core

Code	Title	Hours
CS 101	Intro Computing: Engrg & Sci (CS 124 may be taken instead of CS 101.)	3
ECE 205	Electrical and Electronic Circuits	3
ME 200	Thermodynamics	3
ME 310 or TAM 335	Fundamentals of Fluid Dynamics Introductory Fluid Mechanics	4
NPRE 200	Mathematics for Nuclear, Plasma, and Radiological Engineering	2
NPRE 247	Modeling Nuclear Energy System	3
NPRE 321	Introduction to Plasmas and Applications	3
NPRE 330	Materials in Nuclear Engineering	3
NPRE 349	Introduction to NPRE Heat Transfer	2
NPRE 441	Radiation Protection	4

NPRE 445	Interaction of Radiation with Matter	4
NPRE 449	Nuclear Systems Engineering and Design	3
NPRE 451	NPRE Laboratory	3
NPRE 455	Neutron Diffusion & Transport	4
NPRE 458	Design in NPRE	4
TAM 210	Introduction to Statics (TAM 211 may be taken instead of TAM 210. The extra hour may be applied towards the Professional Concentration Area electives.)	2
TAM 212	Introductory Dynamics (PHYS 325 may be taken instead of TAM 212 for students pursuing the PHYS minor.)	3

Total Hours 53

Professional Concentration Area

Code	Title	Hours
Required Course		2
NPRE 432	Nuclear Engrg Materials Lab	2

Technical Electives 15

From Departmentally Approved List of Technical Electives - students are to take at least 6 hours from the NPRE Power Concentration Electives list. The remaining hours may be taken from any course on the Technical Electives list. The student is to confer with their academic adviser on a chosen course set to ensure that a strong program is achieved.

NPRE Power Concentration Electives List

NPRE 412	Nuclear Power Econ & Fuel Mgmt	3 or 4
NPRE 413	Nuclear Separations and Fuel Reprocessing	2 or 3
NPRE 430	Advanced Materials in Nuclear Engineering	3
NPRE 442	Radioactive Waste Management	3
NPRE 457	Safety Anlys Nucl Reactor Syst	3 or 4
NPRE 461	Probabilistic Risk Assessment	3 or 4
NPRE 480	Energy and Security	3
NPRE 498	Special Topics	1 to 4

Other Technical Electives

Technical Electives from NPRE or from other departments in the subfields: Thermal Sciences; Power and Control Systems; Solid, Fluid and Continuum Mechanics; Computational Sciences and Engineering; Environmental Engineering and Science.

NPRE 199	Undergraduate Open Seminar (May be repeated in separate terms to a maximum of 2 times.)	1
NPRE 201	Energy Systems	2 or 3
NPRE 398	Special Topics	1 to 4
NPRE 470	Fuel Cells & Hydrogen Sources	3
NPRE 475	Wind Power Systems	3 or 4
NPRE 481	Writing on Technol & Security	3 or 4
NPRE 483	Seminar on Security	1

Thermal Sciences

ME 320	Heat Transfer	4
ME 400	Energy Conversion Systems	3 or 4
ME 402	Design of Thermal Systems	3 or 4
ME 404	Intermediate Thermodynamics	4

ME 410	Intermediate Gas Dynamics	3 or 4
ME 411	Viscous Flow & Heat Transfer	4
ME 420	Intermediate Heat Transfer	4

Power and Control Systems

ECE 329	Fields and Waves I	3
ECE 310	Digital Signal Processing	3
ECE 330	Power Ckts & Electromechanics	3
ECE 476	Power System Analysis	3
ECE 486	Control Systems	4

Solid, Fluid and Continuum Mechanics

TAM 251	Introductory Solid Mechanics	3
TAM 252	Solid Mechanics Design	1
TAM 424	Mechanics of Structural Metals	3 or 4
TAM 435	Intermediate Fluid Mechanics	4
TAM 445	Continuum Mechanics	4
TAM 451	Intermediate Solid Mechanics	4
TAM 456	Experimental Stress Analysis	3

Computational Sciences and Engineering

CS 357	Numerical Methods I	3
CS 450	Numerical Analysis	3 or 4
ME 471	Finite Element Analysis	3 or 4
STAT 400	Statistics and Probability I	4

Environmental Engineering and Science

CEE 201	Systems Engrg & Economics	3
CEE 330	Environmental Engineering	3
CEE 437	Water Quality Engineering	3
CEE 443	Env Eng Principles, Chemical	4
CEE 444	Env Eng Principles, Biological	4
CEE 447	Atmospheric Chemistry	4

Total Hours 17

Free Electives

Code	Title	Hours
Additional course work, subject to the Grainger College of Engineering restrictions to Free Electives, so that there are at least 128 credit hours earned toward the degree. (https://go.grainger.illinois.edu/FreeElectives/)		11

Total Hours of Curriculum to Graduate 128

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Sample Sequence

This sample sequence is intended to be used only as a guide for degree completion. All students should work individually with their academic advisors to decide the actual course selection and sequence that works best for them based on their academic preparation and goals. Enrichment programming such as study abroad, minors, internships, and so on may impact the structure of this four-year plan. Course availability is not guaranteed during the semester indicated in the sample sequence. The curriculum sequence can also be viewed via dynamic and static curricular maps (<https://grainger.illinois.edu/academics/undergraduate/majors-and-minors/npre-power-map/>), which include prerequisite sequencing.

Students must fulfill their Language Other Than English requirement by successfully completing a third level of a language other than English. See the corresponding section on the Degree and General Education Requirements (<http://catalog.illinois.edu/general-information/degree-general-education-requirements/>). One of the SBS courses must be an introductory economics course (ECON 102 or ECON 103). NPRE 481 will satisfy a technical elective requirement in the Professional Concentration Area and the Campus General Education Advanced Composition requirement. If NPRE 481 is not selected, a separate Advanced Composition course must be taken.

Free Electives: Additional course work, subject to the Grainger College of Engineering restrictions to Free Electives (<https://go.grainger.illinois.edu/FreeElectives/>), so that there are at least 128 credit hours earned toward the degree.

First Year

First Semester	Hours	Second Semester	Hours
NPRE 100		1 CS 101 (CS 124 may be substituted)	3
MATH 221 (MATH 220 may be substituted)		4 MATH 231	3
ENG 100		1 PHYS 211	4
CHEM 102		3 Language Other Than English (3rd level) or Composition I course	4
Composition I or Language Other Than English (3rd level) course		4 ECON 102 or ECON 103 (counts as General Education course)	3
CHEM 103		1	
General Education course (choose a Humanities or Social/Behavioral Science course with Cultural Studies designation)		3	
		17	17

Second Year

First Semester	Hours	Second Semester	Hours
NPRE 200		2 NPRE 247	3
MATH 241		4 MATH 285	3
PHYS 212		4 ME 200	3
TAM 210 (TAM 211 may be substituted)		2 TAM 212 (PHYS 325 may be substituted)	3

General Education course (choose a Humanities or Social/Behavioral Science course with Cultural Studies designation)	3 Free elective course	3
Free elective course	2	
		17
		15

Third Year

First Semester	Hours	Second Semester	Hours
NPRE 330 (or NPRE 321)		3 NPRE 349	2
MATH 257		3 NPRE 451	3
NPRE 445		4 NPRE 455	4
TAM 335 (ME 310 may be substituted)		4 ECE 205	3
General Education course (choose a Humanities or Social/Behavioral Science course with Cultural Studies designation)		3 Technical elective course	3
		17	15

Fourth Year

First Semester	Hours	Second Semester	Hours
NPRE 321 (or NPRE 330)		3 NPRE 441	4
NPRE 432		2 NPRE 458	4
Technical Elective		3 Technical elective course	3
NPRE 449		3 Technical elective course	3
Technical elective course		3	
Free elective course		2	
		16	14

Total Hours 128

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Nuclear, Plasma, & Radiological Website

Nuclear, Plasma, & Radiological Engineering Faculty (<https://npre.illinois.edu/directory/faculty/>)

The Grainger College of Engineering Admissions (<https://grainger.illinois.edu/admissions/>)

The Grainger College of Engineering