NUCLEAR, PLASMA, AND RADIOLOGICAL ENGINEERING + DATA SCIENCE, BS

for the degree of Bachelor of Science in Nuclear, Plasma, and Radiological Engineering + Data Science

This major is sponsored by the Department of Nuclear, Plasma, and Radiological Engineering within the Grainger College of Engineering, in collaboration with the Siebel School of Computer and Data Science, the iSchool, and the Departments of Mathematics and Statistics.

Nuclear, plasma, and radiological engineering encompasses a broad and diverse but complementary set of engineering disciplines with a wide variety of applications – in energy production, plasma processing of materials, fusion technology development, biomedical research and healthcare, and nuclear safeguards and radiation detection.

A digital transformation is impacting all fields of science and engineering. The areas of study and research in nuclear, plasma, and radiological engineering increasingly involve modeling, simulation, numerical analysis, and computational methods. The subsequent massive quantity of data produced creates a demand for students with a mastery of data collection, management, analysis, machine learning, and other data science topics. The Nuclear, Plasma, and Radiological Engineering + Data Science major is designed for students wanting a specialized foundation in the NPRE disciplines supplemented with a strong background in data science.

The first two years of the NPRE + DS curriculum provides a strong foundation in general areas of science and engineering and data science as well as in nuclear energy systems. Most of the core technical NPRE and more advanced data methods coursework takes place in the third and fourth years. Students demonstrate proficiency in the engineering design process in a design capstone course which involves data science. The program prepares graduates for positions in industry, research laboratories, federal and regulatory agencies, as well as for further graduate study. The supplemental distinction of a data science background increases graduates' competitiveness and widens their opportunities as they enter a data-driven economy.

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Graduation Requirements

Minimum hours required for graduation: 128 hours.

Minimum Overall GPA: 2.0

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.

University Requirements

Minimum of 40 hours of upper-division coursework, generally at the 300- or 400-level. These hours can be drawn from all elements of the degree. Students should consult their academic advisor for additional guidance in fulfilling this requirement.

The university and residency requirements can be found in the Student Code (https://studentcode.illinois.edu/article3/part8/3-801/) (§ 3-801) and in the Academic Catalog (http://catalog.illinois.edu/general-information/degree-general-education-requirements/).

General Education Requirements

Follows the campus General Education (Gen Ed) requirements (https://courses.illinois.edu/gened/DEFAULT/DEFAULT/). Some Gen Ed requirements may be met by courses required and/or electives in the program.

Code	Title	Hours
Composition I		4-6
Advanced Composition		3
Humanities & the Arts (6 hours)		6
Natural Sciences & Technology (6 hours)		6
fulfilled by CHEM 102, PHYS 211, PHYS 212		
Social & Behavioral Sciences (6 hours)		6
fulfilled by ECON 102 or ECON 103 and any other course approved as Social & Behavioral Sciences		
Cultural Studies: Non-Western Cultures (1 course)		3
Cultural Studies: US Minority Cultures (1 course)		3
Cultural Studies: Western/Comparative Cultures (1 course)		3
Quantitative Reasoning (2 courses, at least one course must be Quantitative Reasoning I)		6-10
fulfilled by MATH 220 or MATH 221; and MATH 231, MATH 241, MATH 285, PHYS 211, PHYS 212, STAT/CS/IS 107, and STAT 207		
Language Requirement (Completion of the third semester or equivalent of a language other than English is required)		0-15

Nuclear, Plasma, and Radiological Engineering Orientation and Professional Development

Code	Title	Hours
ENG 100	Grainger Engineering Orientation Seminar	1
NPRE 100	Orientation to NPRE	1
Total Hours		**2**

Introductory Economics Elective

Code	Title	Hours
ECON 102	Microeconomic Principles	3
or ECON 103	Macroeconomic Principles	
Total Hours		**3**

Nuclear, Plasma, and Radiological Engineering Mathematics and Science Foundations

Code	Title	Hours
CHEM 102	General Chemistry I	3
CHEM 103	General Chemistry Lab I	1
MATH 231	Calculus II	3
MATH 241	Calculus III	4

MATH 285	Intro Differential Equations	3
PHYS 211	University Physics: Mechanics	4
PHYS 212	University Physics: Elec & Mag	4
Total Hours		**22**

Nuclear, Plasma, and Radiological Engineering Core

Code	Title	Hours
ME 200	Thermodynamics	3
ME 310	Fundamentals of Fluid Dynamics	4
or TAM 335	Introductory Fluid Mechanics	
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
TAM 210	Introduction to Statics	2
TAM 212	Introductory Dynamics	3
Total Hours		**46**

Data Science Core

Code	Title	Hours
Mathematical Foundations		**7**
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 227	Linear Algebra for Data Science	3
or MATH 257	Linear Algebra with Computational Applications	
Data Science Fundamentals		**12**
STAT/CS/IS 107	Data Science Discovery	4
STAT 207	Data Science Exploration	4
CS 307	Modeling and Learning in Data Science	4
Computational Fundamentals		**4**
CS 277	Algorithms and Data Structures for Data Science	4
Social Impact in Data Science		**6**
IS 467	Ethics and Policy for Data Science	3
IS 477	Data Management, Curation & Reproducibility	3
Research or Discovery Experience		**4**
NPRE 458	Design in NPRE	4
Total Hours		**33**

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/)		12
Total Hours of Curriculum to Graduate		**128**

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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.

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 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	MATH 231	3
MATH 221 (MATH 220 may be substituted)	4	PHYS 211	4
ENG 100	1	Composition I or Language other than English (3rd level) course	4
Composition I or Language other than English (3rd level) course	4	STAT 107	4
CHEM 102	3		
CHEM 103	1		
ECON 102 or 103	3		
	17		**15**

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	2	TAM 212	3

STAT 207	4	MATH 227 or 257	3
	16		**15**

Third Year

First Semester	Hours	Second Semester	Hours
NPRE 330	3	NPRE 349	2
NPRE 445	4	NPRE 451	3
TAM 335 (ME 310 may be substituted)	4	NPRE 455	4
CS 277	4	CS 307	4
Free Elective Course	2	General Education course (choose a Humanities or Social/Behavioral Science course with Cultural Studies designation)	3
	17		**16**

Fourth Year

First Semester	Hours	Second Semester	Hours
NPRE 321	3	NPRE 441	4
NPRE 449	3	NPRE 458	4
IS 467	3	IS 477	3
General Education course (choose a Humanities or Social/Behavioral Science course with Cultural Studies designation)	3	General Education course (choose a Humanities or Social/Behavioral Science course with Cultural Studies designation)	3
General Education course (Advanced Composition)	3	Free Elective Course	3
	15		**17**

Total Hours 128

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Student learning outcomes are based on learning outcomes in line with the ABET accreditation process for Nuclear Engineering.

Nuclear, Plasma, & Radiological Engineering + Data Science graduates will have:

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.

Further, the Department of Nuclear, Plasma, and Radiological Engineering has undergraduate curriculum program education objectives (PEOs) that prepare our graduates to succeed in early career (two to five years post-graduation) professional activities in paths related to the NPRE discipline. Student learning outcomes represent process-orientated activities that either directly or in combination prepare students to satisfy all program educational objectives upon completion of the BS NPRE + Data Science degree program. These PEOs are:

1. To succeed as engineers in the 21st Century in a globally-connected technological environment in which best practices are shared internationally free of borders.
2. To advance in career paths associated with the NPRE disciplines, including commercial nuclear power, plasma sciences and technology, and radiological sciences related opportunities.
3. To pursue further academic growth, obtaining advanced degrees in disciplines related, but not limited, to the disciplines associated with NPRE technical areas.
4. To provide leadership to professional and societal communities in a general way and in ways specific to the NPRE disciplines.
5. To engage in life-long learning and professional development, staying abreast of the ever-evolving technological landscape related to the NPRE disciplines.
6. To contribute to society in a professional, responsible and ethical manner.

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Nuclear, Plasma, & Radiological Website (https://npre.illinois.edu/)
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 (https://grainger.illinois.edu/)