NUCLEAR ENGINEERING (N E)

N E 1 — COOPERATIVE EDUCATION PROGRAM
1 credit.

Work experience which combines classroom theory with practical knowledge of operations to provide students with a background upon which to base a professional career. Enroll Info: None
Requisites: Sophomore standing
Course Designation: Workplace - Workplace Experience Course
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2022

N E 231 — INTRODUCTION TO NUCLEAR ENGINEERING
3 credits.

Nuclear fission/fusion, medical applications of radiation, radiation safety. Socio-economic topics including environmental justice, community engagement, nuclear policy. Brief history of and controversies in nuclear engineering. Career paths and ethics in engineering, and introduction to professional communication. Enroll Info: None
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2022

N E 234 — PRINCIPLES AND PRACTICE OF NUCLEAR REACTOR OPERATIONS
4 credits.

Presents the theoretical and practical information required to understand operation of nuclear reactors. Content includes all subjects which must be known by a person seeking an operating license for the university reactor. Instructors integrate information on similar operations and systems in a nuclear power plant. Enroll Info: None
Requisites: Declared in Nuclear Engineering
Repeatable for Credit: No
Last Taught: Fall 2021

N E 305 — FUNDAMENTALS OF NUCLEAR ENGINEERING
3 credits.

Properties of nuclei, nuclear structure, radioactivity, nuclear reactions, fission, resonance reactions, moderation of neutrons. Enroll Info: None
Requisites: PHYSICS 205, 241, 244, or 249, or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2021

N E 405 — NUCLEAR REACTOR THEORY
3 credits.

The neutronics behavior of fission reactors, primarily from a theoretical, one-speed perspective. Criticality, fission product poisoning, reactivity control, reactor stability and introductory concepts in fuel management, followed by slowing down and one-speed diffusion theory. Enroll Info: None
Requisites: N E 305 and (MATH 319, 320, 321, or 375), or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2022

N E 406 — NUCLEAR REACTOR ANALYSIS
3 credits.

The neutronics behavior of fission reactors, both from a theoretical and computational multi-group perspective. Multi-group diffusion theory, finite-difference and nodal methods, core heterogeneous effects, pin power reconstruction, thermal neutron spectra, fine group whole spectrum calculations and coarse group constant generation. Enroll Info: None
Requisites: N E 405, graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2021

N E 408 — IONIZING RADIATION
3 credits.

Sources, interactions, and detection of ionizing radiation. Biological effects, shielding, standards of radiation protection. Enroll Info: None
Requisites: N E 305, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2022

N E 411 — NUCLEAR REACTOR ENGINEERING
3 credits.

Reactor heat generation and removal; steady- and unsteady-state conduction in reactor elements; single phase, two-phase, and liquid metal cooling, core thermal design. Enroll Info: None
Requisites: N E 305, M E 361, and (M E 363 and M E 364 or CBE 320) or graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2021
N E 412 — NUCLEAR REACTOR DESIGN
5 credits.
Reactor design projects, reactor hazards, economics. Enroll Info: None
Requisites: N E 405 and (E P 271 or COMP SCI 300, 302, or 310), or
graduate/professional standing
Repeatable for Credit: No
Last Taught: Spring 2022

N E/M S & E 423 — NUCLEAR ENGINEERING MATERIALS
3 credits.
Fundamentals of fuel and cladding behavior in terms of thermal
properties, chemical behavior and radiation damage. Enroll Info: None
Requisites: M S & E 350 or 351, or graduate/professional standing, or
member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2021

N E 424 — NUCLEAR MATERIALS LABORATORY
1 credit.
Practical application of materials issues for nuclear systems including
welding, non-destructive examination, optical microscopy, electron
microscopy, to understand radiation damage and corrosion. Enroll Info: None
Requisites: M S & E 350 or 351, or graduate/professional standing, or
member of Engineering Guest Students
Repeatable for Credit: No
Last Taught: Spring 2022

N E 427 — NUCLEAR INSTRUMENTATION LABORATORY
2 credits.
Experiments on nuclear instrumentation, counting, data analysis. Enroll
Info: None
Requisites: N E 305 or graduate/professional standing
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci
req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2022

N E 428 — NUCLEAR REACTOR LABORATORY
2 credits.
Experiments on reactor operation, flux measurement, measurements of
reactor parameters, using pool type reactor. Enroll Info: None
Requisites: NE 405 and NE 427, or graduate/professional standing
Repeatable for Credit: No
Last Taught: Spring 2022

N E/M S & E 433 — PRINCIPLES OF CORROSION
3 credits.
Thermodynamics and kinetics of metallic corrosion. The common
forms of corrosion and corrosion susceptibility tests. Electrochemical
measurement of corrosion rates. Corrosion prevention, economic
considerations. High temperature oxidation and sulphidation. Corrosion
case histories. Enroll Info: None
Requisites: M S & E 330, or graduate/professional standing, or member of
Engineering Guest Students
Repeatable for Credit: No
Last Taught: Fall 2021

N E/CIV ENGR/I SY E 460 — UNCERTAINTY ANALYSIS FOR ENGINEERS
3 credits.
Introduction to approaches for quantifying uncertainty in engineering
analyses. Both analytical and computational methods are demonstrated.
Enroll Info: None
Requisites: (STAT/MATH 309, STAT 311, 224, 324, or STAT/MATH 431),
graduate/professional standing, or member of Engineering Guest Students
Repeatable for Credit: No

N E 489 — HONORS IN RESEARCH
1-3 credits.
Undergraduate research and senior honors thesis in nuclear engineering.
Enroll Info: None
Requisites: Declared in Nuclear Engineering Honors in Undergraduate
Research program
Course Designation: Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2014

N E/MED PHYS 506 — MONTE CARLO RADIATION TRANSPORT
3 credits.
Use of Monte Carlo technique for applications in nuclear engineering and
medical physics. Major theory of Monte Carlo neutral particle transport is
discussed. Standard Monte Carlo transport software is used for exercises
and projects. Major emphasis is on analysis of real-world problems. Enroll
Info: None
Requisites: N E 305 and (N E 405, N E 408, PHYSICS/B M E/H ONCOL/
MED PHYS 501 or N E/MED PHYS 569) or graduate/professional
standing
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci
req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% -_counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022
N E/M E 520 — TWO-PHASE FLOW AND HEAT TRANSFER
3 credits.

Two-phase flow and heat transfer in engineering systems. Pool boiling and flow boiling. Phenomenological modeling. Enroll Info: None
Requisites: M E 361 and (M E 364 or B M E 320), or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

N E/E C E/PHYSICS 525 — INTRODUCTION TO PLASMAS
3 credits.

Basic description of plasmas: collective phenomena and sheaths, collisional processes, single particle motions, fluid models, equilibria, waves, electromagnetic properties, instabilities, and introduction to kinetic theory and nonlinear processes. Examples from fusion, astrophysical and materials processing processing plasmas. Enroll Info: None
Requisites: (E C E 320 or PHYSICS 322), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

N E 526 — LABORATORY COURSE IN PLASMAS
3 credits.

Provides a background in the techniques for creating, exciting, and measuring the properties of lab plasmas and using the associated apparatus. Enroll Info: None
Requisites: PHYSICS/E C E/N E 525 or graduate/professional standing
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

N E/E C E/PHYSICS 527 — PLASMA CONFINEMENT AND HEATING
3 credits.

Principles of magnetic confinement and heating of plasmas for controlled thermonuclear fusion: magnetic field structures, single particle orbits, equilibrium, stability, collisions, transport, heating, modeling and diagnostics. Discussion of current leading confinement concepts: tokamaks, tandem mirrors, stellarators, reversed field pinches, etc. Enroll Info: None
Requisites: E C E/N E/PHYSICS 525, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Sustain - Sustainability
Repeatable for Credit: No
Last Taught: Spring 2022

N E/E C E 528 — PLASMA PROCESSING AND TECHNOLOGY
3 credits.

Introduction to basic understanding and techniques. Plasma processing of materials for semiconductors, polymers, plasma spray coatings, ion implantation, etching, arcs, extractive metallurgy and welding. Plasma and materials diagnostics. Enroll Info: None
Requisites: PHYSICS 322 or E C E 320, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2021

N E 536 — FEASIBILITY ST OF POWER FROM CONTROLLED THERMONUCLEAR FUSION
3 credits.

Introduction to the use and design of possible fusion reactors. Problems of the plasma confinement and energy density, neutronics of blanket design, and radiation damage. Enroll Info: None
Requisites: N E 405 and 411, or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2020
N E 541 — RADIATION DAMAGE IN METALS
3 credits.

A survey of the nature of point defects, how these defects are produced, how the defects migrate and cluster, and what effects point defects and defect clusters have on the physical and mechanical properties of metals. Enroll Info: None
Requisites: M S & E 350 or 351, or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2021

N E 545 — MATERIALS DEGRADATION IN ADVANCED NUCLEAR REACTOR ENVIRONMENTS
3 credits.

Overview of materials (cladding and structural materials) used in advanced reactor systems and the associated degradation. Interactions between the advanced nuclear reactor environment and materials. Surface degradation, corrosion, oxidation, dissolution, vaporization, mass transfer, diffusion, and hands-on examples related to advanced reactors. Enroll Info: None
Requisites: M S & E 350, 351, or 352, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2021

N E 550 — ADVANCED NUCLEAR POWER ENGINEERING
3 credits.

Analysis of nuclear systems for the production of useful power. Emphasis: thermodynamic cycles, reactor types, coupling of reactor and power plant, design synthesis, and plant economics. Enroll Info: None
Requisites: N E 405 and 411, or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2020

N E 555 — NUCLEAR REACTOR DYNAMICS
3 credits.

Basic equations and physical parameters of point reactor kinetics without feedback effects; the nuclear reactor as a total system; reactor excursions, Fuchs-Nordheim and Bethe-Tait models; space-time reactor dynamics; synthesis methods. Enroll Info: None
Requisites: N E 405, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2020

N E/M E 565 — POWER PLANT TECHNOLOGY
3 credits.

Design and performance of power plants for the generation of electric power; fossil and nuclear fuels, cycle analysis, component design and performance, plant operation, control, economics and environmental impact. Advanced concepts. Enroll Info: None
Requisites: M E 361, or graduate/professional standing, or member of Engineering Guest Students
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2021

N E/MED PHYS 569 — HEALTH PHYSICS AND BIOLOGICAL EFFECTS
3-4 credits.

Physical and biological aspects of the use of ionizing radiation in industrial and academic institutions; physical principles underlying shielding instrumentation, waste disposal; biological effects of low levels of ionizing radiation; lecture and lab. Enroll Info: None
Requisites: MATH 234 and (PHYSICS 241 or 249) or graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2021

N E 571 — ECONOMIC AND ENVIRONMENTAL ASPECTS OF NUCLEAR ENERGY
3 credits.

Economics of the nuclear fuel cycle. Economic and environmental impact the nuclear fuel cycle. Impact on design, plant siting and regulation. Enroll Info: None
Requisites: N E 405, graduate/professional standing, or member of Engineering Guest Students
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Sustain - Sustainability
Repeatable for Credit: No
Last Taught: Spring 2022

N E/I SY E 574 — METHODS FOR PROBABILISTIC RISK ANALYSIS OF NUCLEAR POWER PLANTS
3 credits.

Methods for risk and reliability analysis of engineered systems, particularly as applied in the nuclear power industry. Fault trees and event trees, Bayesian data analysis, probabilistic risk management. Some familiarity with nuclear plant safety systems is helpful, but not required. Enroll Info: None
Requisites: (STAT/MATH 309, STAT 311, 224, 324, or STAT/MATH 431), graduate/professional standing, or member of Engineering Guest Students
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2018
N E 602 — SPECIAL TOPICS IN REACTOR ENGINEERING
0-3 credits.

Special Topics in Reactor Engineering. Enroll Info: None
Requisites: None
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2021

N E 699 — ADVANCED INDEPENDENT STUDY
0-3 credits.

Directed study projects as arranged with instructor. Enroll Info: None
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit: Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2022

N E 705 — ADVANCED REACTOR THEORY
3 credits.

Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

N E/C&E SOC/I SY/E/SOC 708 — SOCIETAL RISK MANAGEMENT OF TECHNOLOGICAL HAZARDS
3 credits.

Issues involved in decision-making regarding technological risks and risk management in areas such as nuclear power, hazardous waste disposal, and pollution control. Risk perception and cognitive biases; risk analysis and decision analysis; political issues in risk management; regulatory mechanisms; and risk communication. Selected case studies. Enroll Info: None
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2020

N E/E C/E PHYSICS 724 — WAVES AND INSTABILITIES IN PLASMAS
3 credits.

Waves in a cold plasma, wave-plasma interactions, waves in a hot plasma, Landau damping, cyclotron damping, magneto-hydrodynamic equilibria and instabilities, microinstabilities, introduction to nonlinear processes, and experimental applications. Enroll Info: Basic knowledge of plasmas [such as PHYSICS/E C/E/N E 525] and advanced electromagnetics [such as PHYSICS 721 or E C/E 740] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2022

N E/E C/E PHYSICS 725 — PLASMA KINETIC THEORY AND RADIATION PROCESSES
3 credits.

Coulomb Collisions, Boltzmann equation, Fokker-Planck methods, dynamical friction, neoclassical diffusion, collision operators radiation processes and experimental applications. Enroll Info: Basic knowledge of plasmas [such as PHYSICS/E C/E/N E 525] and advanced electromagnetics [such as PHYSICS 721 or E C/E 740] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2021

N E/E C/E PHYSICS 726 — PLASMA MAGNETOHYDRODYNAMICS
3 credits.

MHD equations and validity in hot plasmas; magnetic structure and magnetic flux coordinates; equilibrium in various configurations; stability formulation, energy principle, classification of instabilities; ideal and resistive instability in various configurations, evolution of nonlinear tearing modes; force-free equilibria, helicity, MHD dynamo; experimental applications. Enroll Info: Basic knowledge of plasmas [such as PHYSICS/E C/E/N E 525] and advanced electromagnetics [such as PHYSICS 721 or E C/E 740] strongly encouraged.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2021

N E 741 — INTERACTION OF RADIATION WITH MATTER
3 credits.

Review of topics in electrodynamics and special relativity; ionization and energy loss during scattering of charged particles; radiation from charged particles including Bremstrahlung, Cerenkov, and Synchrotron radiation; Thomson scattering of electromagnetic waves by charged particles. Enroll Info: Knowledge of Dynamics [such as EMA 202 or PHYSICS 311] and Electromagnetics [such as PHYSICS 322] required.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2021
N E/E C/E/PHYSICS 749 — COHERENT GENERATION AND PARTICLE BEAMS
3 credits.

Fundamental theory and recent advances in coherent radiation charged particle beam sources (microwave to X-ray wavelengths) including free electron lasers, wigglers/wave-particle dynamics, Cerenkov masers, gyrotrons, coherent gain and efficiency, spontaneous emission, beam sources and quality, related accelerator concepts experimental results and applications. Enroll Info: None

Requisites: E C E 740

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2019

N E 790 — MASTER’S RESEARCH AND THESIS
1-9 credits.

Directed study projects as arranged with instructor. Enroll Info: None

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Summer 2022

N E 890 — PRE-DISSERTATOR’S RESEARCH
1-9 credits.

Research by the Ph.D. students prior to becoming dissertators. Enroll Info: None

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Summer 2022

N E 903 — SPECIAL TOPICS-PLASMA PHYSICS
0-3 credits.

Special Topics in Plasma Physics. Enroll Info: Knowledge of Plasma Physics [such as PHYSICS/E C/E/N E 525] required

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2021

N E/E C/E/PHYSICS 922 — SEMINAR IN PLASMA PHYSICS
0-1 credits.

Current topics in plasma physics. Enroll Info: None

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2022

N E 990 — RESEARCH AND THESIS
1-6 credits.

Directed study projects as arranged with instructor. Enroll Info: None

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Summer 2022

N E 999 — ADVANCED INDEPENDENT STUDY
1-3 credits.

Directed study projects as arranged with instructor. Enroll Info: None

Requisites: Consent of instructor

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Fall 2021