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: So st
Requisites: None
Course Designation: Workplace - Workplace Experience Course
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2017

N E 231 — SURVEY OF NUCLEAR ENGINEERING
1 credit.
Consideration of work done by nuclear engineers; relevance of nuclear energy to society; environmental and other problems. Open to all students. Offered on a pass-fail basis only. Enroll Info: None
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2018

N E 234 — PRINCIPLES AND PRACTICE OF NUCLEAR REACTOR OPERATIONS
4 credits.
This course presents the theoretical and practical information required to understand operation of nuclear reactors. The course 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: None
Repeatable for Credit: No
Last Taught: Fall 2017

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: PHYSICS 205, 241, 244, 249 or declared in a Civil and Environmental Engineering, Nuclear Engineering and Engineering Physics, Electrical Engineering, Mechanical Engineering, or Physics graduate program
Requisites: PHYSICS 205, 241, 244, 249 or declared in a Civil and Environmental Engineering, Nuclear Engineering and Engineering Physics, Electrical Engineering, Mechanical Engineering or Physics graduate program
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 2017

N E 373 — NUCLEAR ENERGY AND THE ENVIRONMENT
3 credits.
Fission and fusion processes, nuclear reactors, power plants, radioactivity, biological effects, radiation and thermal releases, governmental regulations' impact on society. Enroll Info: HS physics or chem; knowledge of basic biology or consent of instructor; not open to NEEP stdts
Requisites: None
Course Designation: Breadth - Natural Science
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S Repeatable for Credit: No
Last Taught: Fall 2009

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, MATH 319 and MATH 320 or declared in a Civil and Environmental Engineering, Nuclear Engineering and Engineering Physics, Electrical Engineering, Mechanical Engineering or Physics graduate program
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 2018

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: NEEP 405
Requisites: None
Repeatable for Credit: No
Last Taught: Fall 2017

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 or declared in a Civil and Environmental Engineering, Nuclear Engineering and Engineering Physics, Electrical Engineering, Mechanical Engineering or Physics graduate program
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 2018
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, CBE/B M E 320 or M E 364 or declared in a Civil and Environmental Engineering, Nuclear Engineering and Engineering Physics, Electrical Engineering, Mechanical Engineering or Physics graduate program
Repeatable for Credit: No
Last Taught: Fall 2017

N E 412 — NUCLEAR REACTOR DESIGN
3-5 credits.
Reactor design projects, reactor hazards, economics. Enroll Info: NEEP 405, 411, Comp Sci 302 or NEEP 271
Requisites: None
Repeatable for Credit: No

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: MSE 350 or 351
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2016

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: M S & E 350, N E/M S & E 423 and/or N E 541 recommended
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2017

N E 427 — NUCLEAR INSTRUMENTATION LABORATORY
2 credits.
Experiments on nuclear instrumentation, counting, data analysis. One three-hour lab, one lecture per week. Enroll Info: None
Requisites: N E 305 or declared in a Civil and Environmental Engineering, Nuclear Engineering and Engineering Physics, Electrical Engineering, Mechanical Engineering or Physics graduate program
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 2018

N E 428 — NUCLEAR REACTOR LABORATORY
2 credits.
Experiments on reactor operation, flux measurement, measurements of reactor parameters, using pool type reactor. One three-hour lab per week. Enroll Info: None
Requisites: N E 405 and N E 427 or declared in a Civil and Environmental Engineering, Nuclear Engineering and Engineering Physics, Electrical Engineering, Mechanical Engineering or Physics graduate program
Repeatable for Credit: No
Last Taught: Spring 2018

N E/M S & E 433 — PRINCIPLES OF CORROSION
3 credits.
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2016

N E/CIV ENGR/I SY E 460 — UNCERTAINTY ANALYSIS FOR ENGINEERS
3 credits.
This course introduces undergraduates to approaches for quantifying uncertainty in engineering analyses. Both analytical and computational methods are demonstrated. Enroll Info: Statistics 311, MATH/STAT 431, or consent of instructor
Requisites: None

N E 489 — HONORS IN RESEARCH
1-3 credits.
Undergraduate research and senior honors thesis in nuclear engineering. Enroll Info: Honors candidacy in nuclear engineering
Requisites: Consent of instructor
Course Designation: Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions

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: NEEP 305 or equiv and one of NEEP 405, 408, MED PHYS/B M E/ H ONCOL/PHYSICS 501 or 569, or consent of instructor
Requisites: None
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 2018
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: ME 361 or Ch E 310 or equiv, Ch E 320 or ME 364 or equiv

Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2014

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: One crse in electromagnetic fields beyond elem physics

Requisites: None
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 2018

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: NEEP, Physics or ECE 525 or consent of instructor

Requisites: None
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 2018

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: PHYSICS/E C E/N E 525 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 2018

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: PHYSICS 322 or ECE 320 or equiv or cons inst

Requisites: None
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

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: NEEP 405, 411

Requisites: None
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 2014

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: MSE 350 or 351

Requisites: None
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: Fall 2017

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: NEEP 405 and 411

Requisites: None
Repeatable for Credit: No
Last Taught: Fall 2016
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: NEEP 405

Requisites: None

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

Repeatable for Credit: No

Last Taught: Fall 2016

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: ME 361 or consent of instructor

Requisites: None

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Fall 2017

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: None

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

Repeatable for Credit: No

Last Taught: Spring 2018

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: NEEP 405 NEEP 411

Requisites: None

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 2018

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: Stat 224

Requisites: None

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
3 credits.

Enroll Info: None

Requisites: None

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2017

N E 699 — ADVANCED INDEPENDENT STUDY
3 credits.

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

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: STAT 311 or MATH/STAT 431 or SOC/C&E SOC 360, IE 516, Grad st; or cons inst

Requisites: Graduate/professional standing

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

Repeatable for Credit: No

Last Taught: Spring 2015
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: PHYSICS/E C E/N E 525 PHYSICS 721 or ECE 740 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

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: Physics, ECE, NEEP 525 PHYSICS 721 or ECE 740 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2018

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: PHYSICS/E C E/N E 525 PHYSICS 721 or ECE 740 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

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 Bremsstrahlung, Cerenkov, and Synchrotron radiation; Thomson scattering of electromagnetic waves by charged particles. Enroll Info: Engr Mech 202 or Phys 311; Phys 322
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2017

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, wiggler/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: ECE 740 or PHYSICS 721, or equiv, or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2014

N E 790 — MASTER'S RESEARCH AND THESIS
1-9 credits.
Enroll Info: Master’s candidates only
Requisites: Declared in Nuclear Engineering and Engineering Physics graduate program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

N E 890 — PRE-DISSERTATOR'S RESEARCH
1-9 credits.
Research by the Ph.D. students prior to becoming dissertators. Enroll Info: None
Requisites: Declared in Nuclear Engineering and Engineering Physics graduate program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

N E 903 — SPECIAL TOPICS-PLASMA PHYSICS
3 credits.
Enroll Info: NEEP or ECE or PHYSICS/E C E/N E 724 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions

N E/E C E/PHYSICS 922 — SEMINAR IN PLASMA PHYSICS
1 credit.
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

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: PHYSICS/E C E/N E 525 PHYSICS 721 or ECE 740 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2017

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: Physics, ECE, NEEP 525 PHYSICS 721 or ECE 740 or cons inst
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2018
**N E 990 — RESEARCH AND THESIS**
1-6 credits.

Enroll Info: For students with dissertator status only

Requisites: Declared in Nuclear Engineering and Engineering Physics PhD

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

Repeatable for Credit: Yes, unlimited number of completions

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

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