

# NUCLEAR ENGINEERING (NE)

## NE 400 (s) Seminar (1-16 credits)

Credit arranged

## NE 404 (s) Special Topics (1-16 credits)

Credit arranged

## NE 438 Fundamentals of Nuclear Materials (3 credits)

Cross-listed with MSE 438

Joint-listed with MSE 538 and NE 538

This course is designed for students who wish to learn about nuclear materials and fuels from a materials science viewpoint. Topics to be covered include crystal structure, diffusion, radiation damage processes etc. Term projects and advanced problems required for graduate credit. (Spring only)

**Prereqs:** MSE 201 or NE 450; or Permission

## NE 450 Principles of Nuclear Engineering (3 credits)

Basic nuclear and atomic processes; radioactive decay, binding energy, radiation interactions, reaction cross sections. Neutron diffusion, radiation sources. Idaho Falls only.

**Prereqs:** MATH 310, ENGR 320, or Permission

## NE 498 (s) Internship (1-16 credits)

Credit arranged

## NE 499 (s) Directed Study (1-16 credits)

Credit arranged

## NE 500 Master's Research and Thesis (1-16 credits)

Credit arranged Course offered only in Idaho Falls.

## NE 501 (s) Seminar (1-16 credits)

Credit arranged Course offered only in Idaho Falls.

## NE 502 (s) Directed Study (1-16 credits)

Credit arranged

## NE 504 (s) Special Topics (1-16 credits)

Credit arranged

## NE 505 (s) Professional Development (1-16 credits)

Credit arranged

## NE 512 Nuclear Components Inspection (3 credits)

Cross-listed with MSE 512

This course will cover various non-destructive testing techniques to evaluate the environmental degradation of the nuclear structural components. Remnant life estimation of structural components exposed to fatigue, creep, and stress corrosion cracking service conditions will be discussed.

**Prereqs:** Graduate standing or Permission

## NE 513 Nuclear Security Science (3 credits)

An engineering course on threat and risk informed nuclear security covering topics including: physical protection, facility characterization, consequence analysis, access control/delay, insider threats, security culture, transportation security, radiological crime scene, and nuclear forensics.

**Prereqs:** Science or Engineering background or instructor permission

## NE 514 Nuclear Safety (3 credits)

Cross-listed with TM 514

An in-depth technical study of safety issues within the nuclear fuel cycle and within various reactor types. Evaluation methods, system disturbances, safety criteria, containment, NRC licensing, and codes for safety analysis will be presented. Case studies of reactor accidents and corrective measures included.

**Prereqs:** Permission.

## NE 516 Nuclear Rules and Regulations (3 credits)

Cross-listed with TM 516

An in-depth examination of nuclear regulatory agencies; major nuclear legislation; current radiation protection standards and organizational responsibility for their implementation.

**Prereqs:** Permission.

## NE 520 Thermodynamics of Nuclear Power Plants (3 credits)

Course covers applications of First Law to power nuclear plants: boiling water, pressurized, high temperature gas, small modular and advanced nuclear power plants. Nuclear power plant applications of pressurizers, suppression pools, nuclear containment, the application of the Second Law to exergy analysis of advanced fuel cycles.

**Prereqs:** Permission

## NE 524 Heat Exchanger Design (3 credits)

This course will cover advanced heat exchanger design and apply that knowledge to the design of the following heat exchangers: tube-in-tube heat exchanger, air cooler, compact heat exchanger, feedwater heater, and condenser.

**Prereqs:** Permission

## NE 527 Nuclear Material Storage, Transportation, and Disposal (3 credits)

There is a wide range of nuclear materials that are stored, transported and disposed of each day. The materials include medical radioisotopes, new fuel pellets, used fuel, and industrial radioisotopes. This course will cover the regulations that govern nuclear material storage, transportation and disposal, as well as the engineering requirements and practical aspects of handling these materials.

## NE 528 Management of Nuclear Facilities (3 credits)

Cross-listed with TM 538

Nuclear facilities need a sustainable management system to make sure that matters of importance are not dealt with in isolation of other issues in the decision making process. Integrating all relevant issues, ranging from safety, security and safeguards to health and economic and environmental questions, leads to well-informed and balanced decisions. This course addresses from a practical point of view the safety and regulatory issues of operating and planned reactors in the U. S. and other countries.

## NE 529 Risk Assessment (3 credits)

Cross-listed with TM 529

In-depth evaluation and analysis techniques used to determine the risk of industrial, process, nuclear, and aviation industries; fault tree analysis; human reliability analysis; failure mode and effect analysis.

## NE 530 Two-Phase Flow (3 credits, max 3)

Course offered only in Idaho Falls. Treatment of fluid mechanics and heat transfer in conjunction with nuclear reactors where two-phase flow problems are found.

**Prereqs:** Permission

**NE 535 Nuclear Criticality Safety (3 credits)**

Cross-listed with TM 513

Nuclear criticality safety including nuclear physics, fusion and neutron multiplication, moderation and reflection of neutrons, criticality issues in the fuel cycle, critical experiments and sub-critical limits, calculations of criticality, nuclear criticality safety practices, emergency procedures, and nuclear regulations and standards.

**Prereqs:** NE 450 or Permission.

**NE 536 Electrochemical Engineering (3 credits)**

Cross-listed with CHE 536

Application of chemical engineering principles to electrochemical systems; thermodynamics, kinetics, and mass transport in electrochemical systems; electrochemical process design.

**NE 537 Radiation Effects on Materials (3 credits)**

Cross-listed with MSE 537

Interactions between radiation and solids.

**Prereqs:** MSE 201 or Permission.

**NE 538 Fundamentals of Nuclear Materials (3 credits)**

Cross-listed with MSE 538

Joint-listed with MSE 438 and NE 438

This course is designed for students who wish to learn about nuclear materials and fuels from a materials science viewpoint. Topics to be covered include crystal structure, diffusion, radiation damage processes etc. Students who wish to receive credit for the 500 level course are required to do term-projects and advanced problems. (Spring only)

**Prereqs:** MSE 201 or NE 450; or Permission

**NE 544 Reactor Analysis - Statics and Kinetics (3 credits)**

Course offered only in Idaho Falls. Behavior of nuclear reactors in steady state and transient conditions. Calculation of varying power conditions, fuel burn-up, coolant perturbations, and other reactor parameters.

Typically Offered: Fall.

**Prereqs:** Permission

**NE 548 Modeling of Thermal and Chemical Systems (3 credits)**

The course introduces students to methods, techniques, and process modeling software for modeling of thermal and chemical systems. The basic concepts and principles include power generation, refrigeration, cooling towers, air separation, hydrogen and ammonia production. Components such as compressors, turbines, pumps, heat exchangers, piping, fluid and gas mixtures, and chemical reactors are modeled. Economics and dynamic systems modeling are also covered.

**Prereqs:** ME 322, ME 345, ME 420 or Permission

**NE 551 Nuclear Reactor Fuels (3 credits)**

Selection of materials and design of nuclear fuels, light water reactor fuels, metal and oxide dispersed fuels, high temperature ceramic fuels.

**Prereqs:** Permission

**NE 554 Radiation Detection and Shielding (3 credits)**

Cross-listed with TM 535

Radiation transport and shielding concepts. Methods for quantifying attenuation of nuclear particles and electromagnetic radiation. Radiation detection methods, data acquisition and processing.

**Prereqs:** MATH 310 or Permission

**NE 555 Nuclear Criticality Safety II (3 credits)**

Applications of criticality safety techniques to facility design and review, requirements for unique isotopes, criticality safety evaluations, connections to nuclear materials management, applications of Monte Carlo analysis. Idaho Falls only.

**Prereqs:** NE 535 or Permission

**NE 575 Advanced Nuclear Power Engineering (3 credits)**

Present and advanced nuclear power plant descriptions and analysis. Engineering aspects of converting nuclear fission energy to useful work. Group project design. Idaho Falls only.

**Prereqs:** Permission

**NE 582 Spent Nuclear Fuel Management and Disposition (3 credits)**

Joint-listed with CHE 582

The management of nuclear fuel after removal from a nuclear reactor; storage options, recycle and recovery of uranium and other radionuclides, geological repositories, and related topics.

**Prereqs:** Permission

**NE 585 Nuclear Fuel Cycles (3 credits)**

Cross-listed with MSE 585

Processes to support the existing LWR fuel cycle. Alternative fuel cycles including U-233, Pu239 and mixed oxide fuels, and advanced reactor concepts. Recycling and recovery of nuclear materials, with emphasis on traditional fast reactor recycle. Typically Offered: Fall.

**Prereqs:** Permission

**NE 587 Nuclear Decommissioning (3 credits)**

Concepts and strategies for decommissioning nuclear facilities including project and program management, waste management, and site environmental restorations.

**Prereqs:** NE 450

**NE 598 (s) Internship (1-16 credits)**

Credit arranged

**NE 599 (s) Research (1-16 credits)**

Credit arranged

**NE 600 Doctoral Research & Dissertation (1-45 credits)**

Credit arranged