

# NUCLEAR AND RADIOLOGICAL ENGINEERING

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Not all courses are offered every semester. Refer to the schedule of courses for each term's specific offerings.

More Info (<https://one.ufl.edu/soc/>)

*Unless otherwise indicated in the course description, all courses at the University of Florida are taught in English, with the exception of specific foreign language courses.*

## Department Information

The Department of Materials Science and Engineering strives to serve the scientific and engineering community of the state and nation by providing quality education in the field, conducting basic and applied research to enhance science in the field, and supplying short courses, technology transfer, industrial consulting, and distance learning to promote engineering in the field.

**Website** (<https://mse.ufl.edu/>)

### CONTACT

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Map (<http://campusmap.ufl.edu/#/index/0184>)

### Curriculum

- /UGRD/colleges-schools/UGENG/ENG\_UCT02/
- /UGRD/colleges-schools/UGENG/ENG\_UCT03/
- /UGRD/colleges-schools/UGENG/ENG\_UCT06/
- /UGRD/colleges-schools/UGENG/ENG\_UCT07/
- Combination Degrees
- Materials Science and Engineering
- Materials Science and Engineering Minor
- Nuclear and Radiological Engineering Minor
- Nuclear Engineering

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## Courses

### EGN 4912 Engineering Directed Independent Research 0-3 Credits

**Grading Scheme:** S/U

Provides firsthand, supervised research with a faculty advisor or postdoctoral or graduate student mentor. Projects may involve inquiry, design, investigation, scholarship, discovery, or application.

**Prerequisite:** Department permission.

### ENU 1000 Introduction to Nuclear Engineering 1 Credit

**Grading Scheme:** Letter Grade

Introduction to the nuclear engineering field and careers in the nuclear industry. Topics include engineering ethics, nuclear history, elementary nuclear and reactor physics, reactor types, nuclear safety, nuclear fuel cycle and radiation protection.

### ENU 2002 Fundamentals of Nuclear Engineering 2 Credits

**Grading Scheme:** Letter Grade

Two one-hour lectures discussing fundamental concepts in nuclear engineering, including nuclear physics, nuclear reactors, careers in nuclear engineering and related fields, and current issues in nuclear engineering.

### ENU 3132 Reactor Thermal Engineering 1 4 Credits

**Grading Scheme:** Letter Grade

Covers the first and second laws of thermodynamics and their applications to nuclear fission reactor systems, including power cycle analysis; steady-state and transient conduction with applications; and the current regulatory structure for nuclear fission reactors.

**Prerequisite:** MAC 2313 and PHY 2048.

**ENU 4001 Nuclear Engineering Analysis 1 4 Credits****Grading Scheme:** Letter Grade

Continuous and discrete variable solution methods for the statistical, algebraic, differential and integral equations important in nuclear engineering. Topics covered include probabilities and statistics, basic programming, linear algebra.

**Prerequisite:** MAC 2313;**Corequisite:** MAP 2302.**Attributes:** Artificial Intelligence**ENU 4003 Nuclear Engineering Analysis 2 4 Credits****Grading Scheme:** Letter Grade

A continuation of ENU 4001. Nuclear application contents: finite diff./geometries, numerical methods, differential equations and solution methods of relevance to nuclear problems, basic AI-components.

**Prerequisite:** ENU 4001 with a minimum grade of C.**ENU 4103 Reactor Analysis and Computation I 4 Credits****Grading Scheme:** Letter Grade

Three one-hour lectures discussing neutron reactions, fission chain and criticality and neutron transport/diffusion for nuclear reactors. Neutron thermalization and thermal scattering kernels. Dynamic analysis of reactors including point and space-time models. Feedback and reactor dynamics and control. Short-term transient analysis and long-term time-dependence.

**ENU 4104 Reactor Analysis and Computation 2 3 Credits****Grading Scheme:** Letter Grade

Continuation of ENU 4103. Three one-hour lectures discussing neutron thermalization and thermal scattering kernels. Treatment of resonances and Doppler broadening. Dynamic analysis of reactors including point model and space-time models. Feedback and reactor dynamics and control. Short-term transient analysis and long-term time dependence.

**Prerequisite:** ENU 4103.**ENU 4110 Power Plant Simulation 3 Credits****Grading Scheme:** Letter Grade

Instruction and practical experience in the operation and interpretation of results from major nuclear reactor simulation codes, such as TRACE, RELAP5, RETRAN, CATHARE, and SAM.

**Prerequisite:** ENU 4103.**Corequisite:** ENU 4134.**ENU 4133 Reactor Thermal Engineering 2 4 Credits****Grading Scheme:** Letter Grade

Covers single-phase flow and convective and radiative heat transfer topics for the analysis and design of light water reactors, as well the technology of existing pressurized water reactors

**Prerequisite:** ENU 3132.**ENU 4134 Reactor Thermal Engineering 3 4 Credits****Grading Scheme:** Letter Grade

Covers two-phase flow and heat transfer topics for the analysis and design of light water reactors, single-channel analysis, boiling water reactors, steam generators, natural circulation, and accident scenarios in nuclear fission energy systems.

**Prerequisite:** ENU 4133 or EGN 3353C and EML 4140.**ENU 4144 Nuclear Power Plant Reactor Systems 1 3 Credits****Grading Scheme:** Letter Grade

Three one-hour lectures discussing the basis for light water reactor (LWR) design; the NRC design criteria for LWRs. Study of the major systems, components and performance characteristics of LWRs including fuels, primary and secondary coolant systems, emergency and auxiliary systems.

**Prerequisite:** EML 3100 and ENU 4605 and ENU 4001 with minimum grades of C.**ENU 4145 Risk Assessment and Economic Analysis of Nuclear Systems 3 Credits****Grading Scheme:** Letter Grade

Probabilistic risk assessment, including fault trees, event trees, reliability block diagrams, component reliability modeling; and economic analysis, including sensitivity studies, capital cost, levelized cost of electricity, of nuclear systems.

**Prerequisite:** ENU 4104 and ENU 4134.**ENU 4180 Introduction to the Nuclear Fuel Cycle 3 Credits****Grading Scheme:** Letter Grade

Fuel cycle from mining through waste management including economics and policy concerns/constraints. Physical and chemical processes in the conventional nuclear fuel cycle: uranium mining and milling, conversion, enrichment, fuel fabrication, reactor operations, interim storage, reprocessing and recycling, waste treatment and disposal. Nonproliferation, nuclear forensics, alternative fuel cycles and future prospects will also be considered.

**Prerequisite:** ENU 4103

**ENU 4191 Elements of Nuclear and Radiological Engineering Design 1 Credit****Grading Scheme:** Letter Grade

The first of a two-course capstone design sequence. A one-hour lecture that provides preparatory work for ENU 4192. Identification of initial design project(s) and areas of work, selection/assignment of groups to areas of work/tasks, accumulation of reference materials and computer codes and development of initial timelines/milestones.

**Prerequisite:** ENU 4103 & ENU 4133.**ENU 4192 Nuclear and Radiological Engineering Design 3 Credits****Grading Scheme:** Letter Grade

Continuation of ENU 4191. Nuclear reactor theory and engineering as applied to design synthesis of reactors. Nuclear, material, thermo-fluid and/or mechanical design considerations of nuclear reactors with particular emphasis on design characteristics. Analytical methods and application of computer codes for design analysis and evaluation. Individual and/or group design involving integration of reactor neutronics, dynamics and control, thermal hydraulics, transient analysis and safety, power production, instrumentation, control, radiation shielding and protection, fuel cycle, fuel behavior and/or cost.

**Prerequisite:** ENU 4191 with a minimum grade of C & ENU 4134 & ENU 4612 & ENU 4630.**ENU 4300 Radiochemistry 3 Credits****Grading Scheme:** Letter Grade

Basic concepts of the fundamental behavior of radionuclides, radioanalytical techniques, and applications to nuclear fuel cycle.

**Prerequisite:** (CHM 2046 or CHM 2096) & ENU 4605.**ENU 4370 Nuclear Security Science 3 Credits****Grading Scheme:** Letter Grade

The nuclear fuel cycle from the perspective of nuclear forensics, security, nonproliferation, and safeguards and in the context of international nuclear policies. Nuclear threats are balanced with the past history of nuclear weapons use, current nonproliferation technology, and the growth of the international nuclear industry. Signatures including radiological and morphological characteristics of nuclear material is introduced as well as the techniques for the detection of special nuclear mater.

**Prerequisite:** ENU 4605.**ENU 4505L Nuclear and Radiological Engineering Laboratory 1 3 Credits****Grading Scheme:** Letter Grade

Two one-hour lectures discussing experimental procedures used in reactor operation, personnel monitoring, radiation detection devices and the statistics of nuclear counting systems. Also includes a four-hour laboratory experience that integrates practical applications of radiation sources, radiation interactions, radiation transport and radiation detection. (WR)

**Prerequisite:** ENU 4612.**Attributes:** Satisfies 4000 Words of Writing Requirement**ENU 4605 Radiation Interactions and Sources 1 4 Credits****Grading Scheme:** Letter Grade

Three one-hour lectures discussing interaction of ionizing radiation with matter; cross sections and radiation fields with emphasis on photons, heavy charged particles and electrons.

**Prerequisite:** PHY 2049.**ENU 4612 Nuclear Radiation Detection and Instrumentation 3 Credits****Grading Scheme:** Letter Grade

Three one-hour lectures discussing the physics and electronics of radiation detection and instrumentation systems for application to nuclear energy, radiological sciences, radiation protection, medical physics and imaging, and industrial safety and control systems.

**Prerequisite:** ENU 4605.**ENU 4612L Nuclear Radiation Detection and Instrumentation Laboratory 1 Credit****Grading Scheme:** Letter Grade

Laboratory experiments related to the physics and electronics of radiation detection and instrumentation systems for application to nuclear energy, radiological sciences, radiation protection, medical physics and imaging, and industrial safety and control systems.

**Prerequisite:** ENU 4605.**ENU 4630 Fundamental Aspects of Radiation Shielding 3 Credits****Grading Scheme:** Letter Grade

Basic principles of radiation shielding and applied radiation safety. The course material will include study of radiation sources, shielding design of radiation facilities, radiation protection, and regulations for radiation protection.

**Prerequisite:** ENU 4605 with a minimum grade of C.

**ENU 4641C Applied Radiation Protection 2 Credits**

**Grading Scheme:** Letter Grade

Two one-hour lectures of introduction to practical radiation protection techniques and practices, including laboratory experiences. Examination of pertinent regulations, current practice, ethics and instrumentation/measurement practices. Design of facilities and controls to optimize benefits of radiation applications and minimize exposure risks. (WR)

**Prerequisite:** ENU 4605 with a minimum grade of C and ENU 4630.

**Attributes:** Satisfies 2000 Words of Writing Requirement

**ENU 4710 Plasma and Fusion 3 Credits**

**Grading Scheme:** Letter Grade

Introduces plasma physics along with its application to fusion science.

**Prerequisite:** PHY 2049 and ENU 4001.

**ENU 4800 Introduction to Nuclear Reactor Materials 3 Credits**

**Grading Scheme:** Letter Grade

Provides a comprehensive knowledge on the types of materials used in nuclear reactors, their response to the reactor environments and most of the materials problems encountered in the operation of nuclear power reactors for energy production.

**Prerequisite:** EMA 3050 or ENU 4605.

**ENU 4905 Special Problems in Nuclear and Radiological Engineering 1-6 Credits**

**Grading Scheme:** Letter Grade

Individually selected problems or projects in the students' major field of engineering study.

**Prerequisite:** department chair recommendation.

**ENU 4906 Special Problems in Nuclear and Radiological Engineering Design 1-6 Credits**

**Grading Scheme:** Letter Grade

Individually selected design problems or design projects in the student's major field of engineering study.

**Prerequisite:** department chair recommendation.

**ENU 4930 Special Topics in Nuclear and Radiological Engineering 1-4 Credits**

**Grading Scheme:** Letter Grade

Special courses covering selected topics in nuclear engineering.

**Prerequisite:** instructor permission.

**ENU 4934 Fundamentals of Nuclear and Radiological Engineering 1 Credit**

**Grading Scheme:** Letter Grade

Presentations and discussions on topics of current and continuing interest in nuclear engineering sciences.

**Prerequisite:** Nuclear Engineering major of junior standing or higher.

**ENU 4944 Practical Work in Nuclear and Radiological Engineering 1-5 Credits**

**Grading Scheme:** Letter Grade

Practical engineering work under industrial supervision, as set forth in the Herbert Wertheim College of Engineering regulations.

**Prerequisite:** NUE\_BSNE Nuclear Engineering Major.

**ENU 4949 Co-op Work Experience 1 Credit**

**Grading Scheme:** S/U

Three-hour laboratory of practical engineering work under industrial supervision, as set forth in the Herbert Wertheim College of Engineering regulations.

**Prerequisite:** 4EG classification and one term of industrial employment, including extra work according to a pre-approved outline.