NUEN - NUCLEAR ENGINEERING (NUEN)

NUEN 101 Principles of Nuclear Engineering
Credit 1. 1 Lecture Hour. Introduction to nuclear engineering including global and national energy requirements, radioactivity, radiation protection, and fission and fusion reactor concepts.

NUEN 102 Nuclear Engineering Practice
Credits 0. 0 Other Hours. Participation in an approved high-impact learning practice; reflection on professional outcomes from engineering body of knowledge; documentation and self-assessment of learning experience at mid-curriculum point. Prerequisite: NUEN 101.

NUEN 201 Introduction to Nuclear Engineering I
Credits 3. 3 Lecture Hours. Atomic and nuclear physics discoveries that have led to the development of nuclear engineering, atomic models, relativity, x-rays, types of nuclear reactors; problem solving techniques. Prerequisites: MATH 251 or registration therein; PHYS 208.

NUEN 265 Materials Science for Nuclear Energy Applications
Credits 3. 3 Lecture Hours. Materials science fundamentals with an emphasis on nuclear applications; topics will include bonding, crystal structures, crystalline defects, mechanical properties and radiation effects in metal, ceramic and polymer materials. Prerequisites: CHEM 102, or CHEM 104 and CHEM 114, or CHEM 107; PHYS 218.

NUEN 289 Special Topics in...
Credits 1 to 4. 1 to 4 Lecture Hours. Selected topics in an identified area of nuclear engineering. May be repeated for credit. Prerequisite: Approval of department head.

NUEN 301 Nuclear Reactor Theory
Credits 3. 3 Lecture Hours. An introduction to neutron diffusion theory, neutron moderation, conditions for criticality of nuclear reactors. Prerequisites: NUEN 302.

NUEN 302 Introduction to Nuclear Engineering II
Credits 3. 3 Lecture Hours. Basic radioactivity, nuclear and neutron physics as applied to nuclear engineering. Prerequisites: NUEN 201; MATH 308 or registration therein.

NUEN 303 Radiation Detection and Isotope Technology Laboratory
Credits 3. 2 Lecture Hours. 3 Lab Hours. Interaction of radiation with matter; behavior of various nuclear radiation detectors studied both theoretically and experimentally in laboratory; properties of radionuclides useful to industry considered and evaluated from engineering point of view; writing intensive course. Prerequisite: Grade of C or better in NUEN 309/SENG 309.

NUEN 304 Nuclear Reactor Analysis
Credits 3. 3 Lecture Hours. The group diffusion method, multi-region reactors, heterogeneous reactors, reactor kinetics, changes in reactivity. Prerequisite: NUEN 301; MATH 309.

NUEN 309/SENG 309 Radiological Safety
Credits 3. 3 Lecture Hours. Interactions of nuclear radiations with matter and biological systems; theory and practice of radiation dosimetry as applied to radiation protection; design and application of radiation dosimetry systems for personnel monitoring, area radiation monitoring and accident situation; includes external and internal dosimetry as well as long-term risk analysis. Prerequisite: NUEN 302. Cross Listing: SENG 309/NUEN 309.

NUEN 315 Thermodynamics in Nuclear Systems
Credits 3. 3 Lecture Hours. Introduction of thermodynamic theory and application; thermodynamic properties and conservation of mass and energy; first and second laws of thermodynamics; energy transfer by heat, work and mass; analysis of open and closed systems; key thermodynamic components in nuclear systems including BWR, PWR and other types of reactors; application of thermodynamic cycles to nuclear power systems; and heat and mass balances throughout nuclear systems. Prerequisites: MEEN 221; MATH 251 or MATH 253.

NUEN 329 Analytical and Numerical Methods
Credits 3. 3 Lecture Hours. Introduction to use of numerical analysis and advanced analytical techniques for obtaining nuclear reactor flux distributions, temperatures and transients; use of digital computer in obtaining nuclear reactor design information. Prerequisites: MATH 309 and NUEN 301.

NUEN 330 Monte Carlo Radiation Transport and MCNP Code
Credits 3. 2 Lecture Hours. 2 Lab Hours. Principles of Monte Carlo method; statistical methods in Monte Carlo; random number generation; sampling methods for physical processes represented by Boltzmann transport equation; particle tracking in combinatorial geometry; ACE format cross-sections; introduction to MCNP code; MCNP applied to radiation shielding, criticality safety, reactor physics and detector modeling problems; MCNP output analysis; MCNP statistical tests; MCNP tallying procedures; Variance reduction techniques; introduction to develop Monte Carlo algorithms. Prerequisite: Grade of C or better in NUEN 302; grade of C or better or concurrent enrollment in NUEN 301; MCNP code single user license from RSICC, ORNL, USA; junior or senior classification.

NUEN 405 Nuclear Engineering Experiments
Credits 3. 2 Lecture Hours. 3 Lab Hours. Experimental measurements of basic nuclear reactor parameters; reactor operation and reactor safety. Prerequisites: NUEN 303; NUEN 304 or senior classification.
NUEN 406 Nuclear Engineering Systems and Design
Credits 3.3 Lecture Hours. Nuclear plant systems; conventional and advanced generation power reactors, nuclear simulators, transient analysis using available software for reactor simulators; nuclear engineering design methodology; problem formulation, criteria, trade-off decisions and design optimization; case studies. Prerequisite: NUEN 304; MEEN 461 or approval of instructor.

NUEN 410 The Design of Nuclear Reactors
Credits 4.4 Lecture Hours. Application of reactor theory and other engineering disciplines in fundamental and practical design of nuclear reactor systems for power applications; use of computer in design operations. Prerequisites: NUEN 304 and NUEN 406; MEEN 461.

NUEN 417/MEEN 417 Basics of Plasma Engineering and Applications
Credits 3.3 Lecture Hours. Basic plasma properties and confinement techniques; single particle orbits in electric and magnetic fields, moments of Boltzmann equation and introduction to fluid theory; wave phenomena in plasmas and introduction to plasma kinetic theory; analysis of laboratory plasmas and plasma applications including fusion, electric propulsion, materials processing and plasma enhanced chemistry. Prerequisites: Grade of C or better in PHYS 208 or equivalent; senior classification in nuclear, mechanical or aerospace engineering, or physics. Cross Listing: MEEN 417/NUEN 417.

NUEN 418 Fuel Assembly and 3-D Reactor Core Design and Modeling
Credits 3.3 Lecture Hours. Application of state-of-the-art engineering-grade codes in the neutronic design, analysis and modeling of nuclear fuel assembly and core. Prerequisites: NUEN 304 and junior or senior classification.

NUEN 428 Computational Fluid Dynamics in Nuclear Thermal Hydraulics
Credits 3.3 Lecture Hours. Computational fluid dynamics (CFD) as it relates to thermal hydraulics in nuclear power generation; computational model of important flow scenarios using appropriate mesh generation techniques; assessment of result validity through standard verification and validation practices. Prerequisite: Grade C or better in NUEN 329, MEEN 344, or equivalent.

NUEN 430 Computer Applications in Nuclear Engineering
Credits 3.3 Lecture Hours. Applications of digital computers to solve nuclear engineering problems; nuclear data and cross-section libraries; deterministic methods for linear and non-linear nuclear systems, and Monte Carlo methods for linear nuclear systems. Prerequisites: NUEN 304, NUEN 329.

NUEN 431 Technical Communications Issues in the Nuclear Industries
Credit 1.1 Lecture Hour. Introduction to a variety of topics that present communication challenges; opportunities to learn from a variety of visiting experts concerning the nuances and challenges of, as well as successful methods for, communicating with concerned audiences about technically challenging topics. Prerequisite: Junior or senior classification or approval of instructor.

NUEN 432 Nuclear Power Plant Fundamentals
Credits 3.3 Lecture Hours. Understanding the operation of a nuclear electric general station; includes reactor water chemistry, material science, electrical science; mechanical science, civil engineering for nuclear power plant engineers, and digital process control systems. Prerequisite: Junior or senior classification in the college of engineering; non-NUEN majors.

NUEN 436 Human Performance for Nuclear Power Plant Engineers
Credits 2.2 Lecture Hours. Six modules: human performance fundamentals, the organization and the processes, the individual worker, the engineer, corrective action programs and root cause analysis, and case studies including TMI-2, Chernobyl, Davis-Besse, and Fukushima Daiichi. Prerequisites: NUEN 432; junior or senior classification in the college of engineering.

NUEN 451 Nuclear Security System Design
Credits 3.3 Lecture Hours. The science and engineering associated with the design, evaluation and implementation of systems to secure nuclear and radiological materials; adversary characterization, categorization of nuclear and radiological targets, calculation of consequences associated with failure to protect targets, detection and delay technologies, and mathematical methods for evaluation and managing risk. Prerequisites: NUEN 303 and NUEN 309/SENG 309 or equivalent, or approval of instructor.

NUEN 460 Nuclear Plant Systems and Transients
Credits 3.3 Lecture Hours. Use of engineering principles to elucidate the nuclear, mechanical, electrical and functional interactions among nuclear plant components and systems; reactor protection systems, alarm and trip setpoints, normal and accident transients; components studied in detail include core, control rod drive mechanism, neutron source, neutron detectors, primary coolant system, and emergency core cooling system. Prerequisites: NUEN 301, NUEN 302, NUEN 304, NUEN 406, NUEN 430 or equivalents; MEEN 315, MEEN 344, MEEN 461 or equivalents; junior or senior classification.

NUEN 465 Nuclear Materials Engineering
Credits 3.3 Lecture Hours. Explore applications of materials science principles in nuclear energy systems; includes crystal structures and defects, metallurgy, and materials thermochemistry; emphasis on nuclear fuel performance, structural material changes, and waste materials; laboratory demonstrations on materials behavior. Prerequisites: NUEN 265, MEEN 222/MSEN 222 or equivalent and NUEN 302.
NUEN 475 Environmental Nuclear Engineering
Credits 3. 3 Lecture Hours. Environmental aspects of nuclear power; natural radiation environment and the distribution of radioactivity added to the environment by human activities; evaluation of effects of radiation and radioactivity on the environment and on humans. Prerequisite: Grade of C or better in NUEN 309/SENG 309.

NUEN 479 Radiation Protection Engineering
Credits 3. 2 Lecture Hours. 3 Lab Hours. Analysis of radiation hazard situations and design of nuclear facilities from a safety standpoint. Prerequisite: NUEN 475.

NUEN 481 Seminar
Credit 1. 1 Lecture Hour. Designed to broaden the student's capability, performance and perspective in nuclear engineering through faculty, student and guest presentations. Prerequisite: NUEN 410 or registration therein or NUEN 479 or registration therein.

NUEN 485 Directed Studies
Credits 1 to 6. 1 to 6 Other Hours. Problems of limited scope approved on an individual basis intended to promote independent study; program enrichment for capable students; results presented in writing to staff. Prerequisites: Junior or senior classification and approval of department head.

NUEN 489 Special Topics in...
Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 4 Lab Hours. Selected topics in an identified area of nuclear engineering. May be repeated for credit. Prerequisite: Approval of instructor.

NUEN 491 Research
Credits 1 to 4. 1 to 4 Other Hours. Research conducted under the direction of a faculty member in Nuclear Engineering. May be repeated 2 times for credit. Registration in multiple sections of this course is possible within a given semester provided that the per semester credit hour limit is not exceeded. Prerequisites: Junior or senior classification and approval of instructor.