Nuclear Engineering (NU_ENG)

NU_ENG 2201: Topics in Nuclear Engineering
Current and new developments in nuclear engineering.

Credit Hours: 3
Prerequisites: sophomore standing; PHYSCS 1210 and PHYSCS 1220 and MATH 1100 or MATH 1120 or instructor's consent

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NU_ENG 2303: Harnessing the Atom in Everyday Life: Fulfill M Curie's Dream
(same as CH_ENG 2303). Introduction to applications of nuclear science and technology, utilizing web-based learning scenarios.

Credit Hours: 3

NU_ENG 4001: Topics in Nuclear Engineering
Current and new developments in nuclear engineering. May be repeated for credit.

Credit Hour: 2-5
Prerequisites: instructor's consent

NU_ENG 4303: Radiation Safety
(same as RA_SCI 4303; cross-leveled with RA_SCI 7303, NU_ENG 7303). Types and origins of radiation; radiation detection and measurement; radiation interactions; shielding; dose calculations; federal, state and local regulations; and procedures for safe uses of radiation. Laboratory experiments in radiation measurements and protection.

Credit Hours: 3
Prerequisites: college physics, calculus based

NU_ENG 4305: Survey of Nuclear Engineering
Introductory topics in nuclear engineering. Atomic and nuclear physics; nuclear reactor principles under steady-state and transient conditions; heat removal; shielding; instrumentation; power generation; fusion.

Credit Hours: 3
Prerequisites: concurrent with MATH 4100

NU_ENG 4315: Energy Systems and Resources
(same as ECE 4020, MAE 4371; cross-leveled with ECE 7020, NU_ENG 7315, MAE 7371). Analysis of present energy usage in Missouri, USA and the world, evaluation of emerging energy technologies and trends for the future. Economics and environmental impact of the developed technologies. Prerequisites: C- or better in ENGINR 2300

Credit Hours: 3

NU_ENG 4315W: Energy Systems and Resources - Writing Intensive
(cross-leveled with ECE 7020, NU_ENG 7315, MAE 7315). Analysis of present energy usage in Missouri, USA and the world, evaluation of emerging energy technologies and trends for the future. Economics and environmental impact of the developed technologies.

Credit Hours: 3
Prerequisites: ENGINR 2300 or equivalent

NU_ENG 4319: Physics and Chemistry of Materials
(same as PHYSCS 4190, BIOL_EN 4480, CHEM 4490, BME 4480; cross-leveled with NU_ENG 7319, PHYSCS 7190, BIOL_EN 7480, CHEM 7490). Physics and Chemistry of Materials is a 3 credit hours course offered every spring semester for students from Physics, Chemistry, Engineering and Medical Departments and consists of lectures, laboratory demonstrations, two mid-term and one final exam. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: PHYSCS 2750, CHEM 1320 or equivalent, or instructor's consent

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NU_ENG 4328: Introductory Radiation Biology
(same as BIO_SC 4328, RADIOL 4328; cross-leveled with BIO_SC 7328, RADIOL 7328, V_M_S 7328, NU_ENG 7328). Concepts of ionizing radiations, their actions on matter through effects on simple chemical systems, biological molecules, cell, organisms, man.

Credit Hours: 3
Prerequisites: junior standing, Sciences/Engineering; one course in Biological Sciences and Physics/Chemistry; or instructor's consent

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NU_ENG 4330: Science and Technology of Terrorism and Counter Terrorism
(same as PEA_ST 4330; cross-leveled with NU_ENG 7330, PUB_AF 7330). Terrorism has been a familiar tool of political conflict, and it has assumed greater importance during the past twenty years. This subject has been treated by political scientists in various forms, but the scientific and technological aspects of different forms of terrorism cannot be found in a single place. It is important for persons who propose counter measures to understand the basics of different types of terrorism such as for instance the nature of chemical agents, their properties such as toxicity, etc. in order to build better defense systems.

Credit Hours: 3

NU_ENG 4331: Nonproliferation Issues for Weapons of Mass Destruction
(same as PEA_ST 4331; cross-leveled with NU_ENG 7331). Nonproliferation and impact on technology and world events.

Credit Hours: 3
Prerequisites: junior/senior standing or instructor's consent. May be repeated for credit

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NU_ENG 4331W: Nonproliferation Issues for Weapons of Mass Destruction - Writing Intensive
(same as PEA_ST 4331W; cross-leveled with NU_ENG 7331). Nonproliferation and impact on technology and world events.

Credit Hours: 3
Prerequisites: junior/senior standing or instructor's consent. May be repeated for credit

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NU_ENG 4346: Introduction to Nuclear Reactor Engineering I
(same as ECE 4030; cross-leveled with NU_ENG 7346, ECE 7030). Engineering principles of nuclear power systems, primarily for the production of electrical energy.

Credit Hours: 3
Prerequisites: ENGINR 1200, ENGINR 2300 or equivalent

NU_ENG 4369: Principles of Direct Energy Conversion
(cross-leveled with NU_ENG 7369). Principles and utilization of thermoelectric, thermionic, photovoltaic, magnetohydrodynamic generators and fuel cells.

Credit Hours: 3
Prerequisites: ENGINR 2300, MAE 3400, or equivalent

NU_ENG 4375: Introduction to Plasmas
(same as ECE 4550; cross-leveled with NU_ENG 7375, ECE 7550). Equations of plasma physics, interaction of waves and plasmas; plasma sheaths and oscillations; measurements and applications.

Credit Hours: 3
Prerequisites: ECE 4930 or instructor's consent

NU_ENG 4391: Nuclear Radiation Detection
(cross-leveled with NU_ENG 7391). Principles and application of radiation detectors and analyzers: ionization, Geiger-Muller, proportional, liquid and solid scintillation, semiconductor, pulse height analyzers, coincidence circuits, data reduction, tracer applications, activation analysis. Lectures, laboratory.

Credit Hours: 3
Prerequisites: senior standing or instructor's consent

NU_ENG 7001: Topics in Nuclear Science and Engineering
Current and new developments in nuclear engineering.

Credit Hour: 2-5
Prerequisites: instructor's consent

NU_ENG 7080: Medical Ethics for Medical Physics
This course will start with an introduction into medical ethics then transitions into research procedures with humans and animals. This course will cover research ethics, professional conduct, authorship, publishing, and plagiarism.

Credit Hour: 1

NU_ENG 7085: Special Problems in Nuclear Science and Engineering
Special Problems in Nuclear Science and Engineering.

Credit Hour: 1-5

NU_ENG 7087: Seminar in Nuclear Science and Engineering
Reviews of investigations and projects of importance in nuclear engineering.

Credit Hour: 1

NU_ENG 7302: Safe Handling of Radioisotopes
Introduction of methods and procedures for safe handling of radioisotopes in the research laboratory. Intensive lecture and laboratory training sessions designed for persons planning to use radioisotopes at the University.

Credit Hour: 1
Prerequisites: instructor's consent

NU_ENG 7303: Radiation Safety
(same as RA_SCI 7303; cross-leveled with NU_ENG 4303, RA_SCI 4303). Types and origins of radiation; radiation detection and measurement; radiation interactions; shielding; dose calculations; federal, state and local regulations; and procedures for safe uses of radiation. Laboratory experiments in radiation measurements and protection.

Credit Hours: 3
Prerequisites: college physics, calculus based

NU_ENG 7306: Advanced Engineering Math
(cross-leveled with NU_ENG 4306, CH_ENG 4306). Applies ordinary and partial differential equations to engineering problems; Fourier's series; determinants and matrices; Laplace transforms; analog computer techniques.

Credit Hours: 3
Prerequisites: MATH 4100

NU_ENG 7313: Nuclear Science for Engineering for Secondary Science Teachers
This one-week course is for high school science and math teachers, and provides basic of nuclear scheme concepts and their applications, types of radiation (including radiation detection and protection), and industrial, medical and nuclear power generation application.

Credit Hours: 3
Prerequisites: instructor's consent; actively engaged in STEM teaching at the secondary level

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NU_ENG 7315: Energy Systems and Resources
(same as ECE 7020, MAE 7371; cross-leveled with ECE 4020, MAE 4371, NU_ENG 4315). Analysis of present energy usage in Missouri, USA and the world, evaluation of emerging energy technologies and trends for the future. Economics and environmental impact of the developed technologies.

Credit Hours: 3

NU_ENG 7319: Physics and Chemistry of Materials
(same as PHYSCS 7190, BIOL_EN 7480, CHEM 7490; cross-leveled with NU_ENG 4319, PHYSCS 4190, BIOL_EN 4480, CHEM 4490, BME 4480). Physics and Chemistry of Materials is a 3 credit hours course offered every spring semester for students from Physics, Chemistry, Engineering and Medical Departments and consists of lectures, laboratory demonstrations, two mid-term and one final exam. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: PHYSCS 2750, CHEM 1320 or equivalent, or instructor's consent

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NU_ENG 7320: Natural Resources and Nuclear Energy
Not for engineering students. Lecture, demonstration; describes physical environment, energy, power plants, nuclear reactors; radioactivity, its biological effects; health physics measures, rad-waste disposal; nuclear safeguards, nuclear explosives, societal implications.

Credit Hours: 3
Prerequisites: high school algebra

NU_ENG 7328: Introductory Radiation Biology
(same as BIO_SC 7328, RADIOL 7328, V_M_S 7328; cross-leveled with BIO_SC 4328, RADIOL 4328, NU_ENG 4328). Concepts of ionizing radiations, their actions on matter through effects on simple chemical systems, biological molecules, cell, organisms, man.

Credit Hours: 3
Prerequisites: Sciences/Engineering; one course in Biological Sciences and Physics/Chemistry; or instructor's consent

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NU_ENG 7330: Science and Technology of Terrorism and Counter Terrorism
(same as PUB_AF 7330; cross-leveled with NU_ENG 4330, PEA_ST 4330). Terrorism has been a familiar tool of political conflict, and it has assumed greater importance during the past twenty years. This subject has been treated by political scientists in various forms, but the scientific and technological aspects of different forms of terrorism cannot be found in a single place. It is important for persons who propose counter measures to understand the basics of different types of terrorism such as for instance the nature of chemical agents, their properties such as toxicity, etc. in order to build better defense systems.

Credit Hours: 3

NU_ENG 7331: Nonproliferation Issues for Weapons of Mass Destruction
(cross-leveled with NU_ENG 4331, PEA_ST 4331). Nonproliferation and impact on technology and world events.

Credit Hours: 3
Prerequisites: junior or senior standing or instructor's consent

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NU_ENG 7335: Nuclear Safeguards Science and Technology
(same as ECE 7335). This course provides an overview of nuclear materials management and safeguards, including physical protection systems, material accounting and control, monitoring, and regulatory issues.

Credit Hours: 3
Prerequisites: NU_ENG 4303 or NU_ENG 7303

NU_ENG 7341: Nuclear Chemical Engineering
Principles and processes of importance in the field of nuclear technology.

Credit Hours: 3

NU_ENG 7346: Introduction to Nuclear Reactor Engineering I
(same as ECE 7030; cross-leveled with NU_ENG 4346, ECE 4030). Engineering principles of nuclear power systems, primarily for the production of electrical energy.

Credit Hours: 3
Prerequisites: ENGINR 1200, ENGINR 2300 or equivalent

NU_ENG 7349: Nuclear Engineering Materials
Properties of materials for reactor components; radiation damage and corrosion; metallurgy of reactor materials.

Credit Hours: 3
Prerequisites: upper division or graduate standing in Physical Sciences or Engineering, or instructor's consent

NU_ENG 7353: Introduction to Fusion
Basic plasma physics, principles of thermonuclear fusion, plasma confinement and heating, and devices.

Credit Hours: 3
Prerequisites: graduate standing in Engineering or Science or instructor's consent

NU_ENG 7357: Nuclear Heat Transport
Principles of heat transport in nuclear reactors. Brief review of the theory of flow coast down and convective heat transfer. Heat transfer loop experiments on flow coast down, steady state and transient forced convection heat transfer, boiling heat transfer.

Credit Hours: 2
Prerequisites: NU_ENG 4305, NU_ENG 4346 or instructor's consent

NU_ENG 7365: Nuclear Power Engineering
(cross-leveled with NU_ENG 4365). Nuclear reactor heat generation and removal; nuclear reactor coolants; analysis of nuclear reactor power plants.

Credit Hours: 3
Prerequisites: ENGINR 2300

NU_ENG 7369: Principles of Direct Energy Conversion
(cross-leveled with NU_ENG 4369). Principles and utilization of thermoelectric, thermionic, photovoltaic, magnetohydrodynamic generators and fuel cells.

Credit Hours: 3
Prerequisites: ENGINR 2300, MAE 3400, or equivalent

NU_ENG 7375: Introduction to Plasmas
(same as ECE 7550; cross-leveled with NU_ENG 4375, ECE 4550). Equations of plasma physics, interaction of waves and plasmas; plasma sheaths and oscillations; measurements and applications.

Credit Hours: 3
Prerequisites: ECE 4930 or instructor's consent

NU_ENG 7391: Nuclear Radiation Detection
(cross-leveled with NU_ENG 4391). Principles and application of radiation detectors and analyzers: ionization, Geiger-Muller, proportional, liquid and solid scintillation, semiconductor, pulse height analyzers, coincidence circuits, data reduction, tracer applications, activation analysis. Lectures, laboratory.

Credit Hours: 3

NU_ENG 8001: Advanced Topics in Nuclear Science and Engineering
Advanced developments in nuclear engineering.

Credit Hours: 3
Prerequisites: instructor's consent

NU_ENG 8085: Problems in Nuclear Science and Engineering
Supervised investigation in nuclear engineering to be presented in the form of a report.

Credit Hour: 1-6

NU_ENG 8090: Research in Nuclear Science and Engineering
Independent investigation in nuclear engineering to be presented as a thesis. Graded on an S/U basis only.

Credit Hour: 1-99

NU_ENG 8402: Nuclear Fuel Cycle
Covers the nuclear fuel cycle from mine through enrichment, fuel element burn-up reactor physics, chemical reprocessing, waste disposal, with special emphasis on the newer proliferation-resistant fuel cycles.

Credit Hours: 3
Prerequisites: NU_ENG 4346 or NU_ENG 4305 and instructor's consent

NU_ENG 8403: Applied Topics in Medical Physics and Health Physics
Directed observations and experience in scientific aspects of daily operations in nuclear medicine, diagnostic radiology, radiotherapy and health physics.

Credit Hour: 1-6
Prerequisites: departmental consent

NU_ENG 8404: Nuclear Reactor Laboratory I
Application of reactor physics principals to operation of and experiments with the University of Missouri Research Reactor. Neutron activation analysis, instrumentation, reactivity evaluation.

Credit Hours: 3
Prerequisites: NU_ENG 4346 or NU_ENG 8411

NU_ENG 8409: Interaction of Radiation with Matter
Theory/applications of radiation interaction processes. Reviews nuclear physics concepts; radioactive decay; sources/ spectra of ionizing radiation; collision mechanisms for changed particles, electromagnetic radiation, neutrons for interaction with matter.

Credit Hours: 3
Prerequisites: Entrance requirements

NU_ENG 8412: Nuclear Reactor Theory II
Linear and non-linear reactor kinetics; perturbation theory; temperature and fission product effects; control rod theory; transport theory.

Credit Hours: 3
Prerequisites: NU_ENG 8411 or NU_ENG 4346

NU_ENG 8422: Radiation Shielding
Fundamentals of radiation interactions stressing neutron and gamma radiation transport; ray theory, removal theory, multi-group transport shield design principles.

Credit Hours: 3
Prerequisites: NU_ENG 8409 or instructor's consent

NU_ENG 8429: Radiation Dosimetry
Basis and applications of conventional and microscopic radiation dosimetry. Dose concepts and quantities; biological dose-response models; dose measurement principles; photon, charged particle, and neutron dosimetry.

Credit Hours: 3
Prerequisites: NU_ENG 8409
Recommended: NU_ENG 4328

NU_ENG 8432: Nuclear Thermal Hydraulics and Safety
Engineering topics from reactor heat transfer and thermal stresses, fuel cycle analysis, power plant thermodynamics, shielding, and reactor safety analysis.

Credit Hours: 3
Prerequisites: NU_ENG 8411 or NU_ENG 4346, or instructor's consent

NU_ENG 8434: Fracture Mechanics I
(same as MAE 8220). Mechanics of flawed structure. Concepts include Griffith theory, Barenblatt's theory, Irwin analysis, energy analysis of cracked bodies, fracture toughness testing, plane strain, plane stress, transition temperature concepts, subcritical flaw growth.

Credit Hours: 3
Prerequisites: MAE 3200 or instructor's consent

NU_ENG 8435: Physics of Diagnostic Radiology
Principles and applications of X-ray production and interactions. Images production concepts including X-ray film, intensifying screens, grids, fluoroscopy, image intensification and television monitors. Image quality analysis and assessment.

Credit Hours: 3
Prerequisites: NU_ENG 8409 or equivalent or instructor's consent

NU_ENG 8439: Clinical Physics in Radiotherapy
Principles and applications of radiation producing units, exposure and dose measurements, and calibration. External beam physics parameters and application to fixed field and rotational field treatment planning.

Credit Hours: 3
Prerequisites: NU_ENG 8409 or equivalent or instructor's consent

NU_ENG 8452: Ultrasound and Magnetic Resonance Imaging
The physical principles of MRI and ultrasound including clinical instrumentation, artifacts in images, biological effects and quality control. Images obtained with both techniques will be presented.

Credit Hours: 3
Prerequisites: NU_ENG 4391, NU_ENG 8409, NU_ENG 4306 or equivalent

NU_ENG 8453: Advanced Fusion Theory
Plasma stability theory, charged particle diffusion, slowing down of charged particles, interaction of radiation with matter, direct energy conversion using charged particles, and engineering considerations.

Credit Hours: 3
Prerequisites: NU_ENG 4353 and NU_ENG 4375 or PHYSCS 8450 or instructor's consent

NU_ENG 8461: Neutron Transport Theory
The Boltzmann equation; general properties and solution; numerical methods of solving the transport equation; neutron thermalization and neutron spectra.

Credit Hours: 3
Prerequisites: NU_ENG 8412; MATH 4940, MATH 4300, or instructor's consent

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NU_ENG 8470: Fast Reactor Analysis
Analytical methods for designing fast breeder reactor systems. Graded on a S/U basis only.

Credit Hours: 3
Prerequisites: NU_ENG 8412, NU_ENG 8432, NU_ENG 8451 or instructor's consent

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NU_ENG 8471: Radiation Protection
Theory and applications of radiation protection and health physics. Radiation dosimetry methods and calculations, shielding evaluations, equipment surveys and inspection, environmental monitoring, radiation standards and regulations and administration presented.

Credit Hours: 3
Prerequisites: NU_ENG 4303 and NU_ENG 4328

NU_ENG 9090: Research in Nuclear Science and Engineering
Independent investigation in nuclear engineering to be presented as a thesis. Graded on an S/U basis only.

Credit Hour: 1-99
