GRADUATE CERTIFICATE IN NUCLEAR NONPROLIFERATION

OFFERED BY:
Department of Mining and Nuclear Engineering.

PARENT DEPARTMENT AND DEGREE:
Department of Mining and Nuclear Engineering, Nuclear Engineering, MS

INTENDED AUDIENCE:  _Main Campus Students _Distance Students _X_ Both

PROGRAM DESCRIPTION:
The nuclear engineering program offers a graduate certificate program to professionals and students who desire to undergo formal instruction in nuclear nonproliferation. The topics in comprising the certificate program are selected from courses available to graduate students in the nuclear engineering program at Missouri University of Science and Technology. All courses are available both in traditional on-campus delivery and online format. The certificate program deployment strategy allows all enrollees to pace their study in manner consistent with the individual's plans.

PURPOSE:
The graduate certificate in nuclear nonproliferation is designed to provide graduate level studies to professionals and students who are on nuclear security career path or intend to have a career in nuclear security. The United States of America, through various executive departments like Department of Energy (DOE), Department of State (DOS) and Department of Defense (DoD), is fully vested in nuclear security. For example, DOE's National Nuclear Security Administration (NNSA), DoD’s Defense Threat Reduction Agency (DTRA), and DOS’s Threat Reduction Programs are staffed by personnel who require continuous knowledge certification. These agencies also require continued staffing by hiring people who are knowledgeable in nuclear nonproliferation. By putting together specific courses relevant to the NNSA and other organizations vested in nuclear security, it facilitates training and human capital development in this career path through the certificate program.

ADMISSION:
The Graduate Certificate in Nuclear Nonproliferation is open to all persons holding a B.S., M.S., or Ph.D. degree in Engineering, Science, and/or Mathematics as well as related B.A. or M.A. degrees, or are currently accepted into a graduate degree program at Missouri S&T. Once admitted to the program, the student must take the four designated courses (provided in the curriculum section). In order to receive a Graduate Certificate, the student must have an average cumulative grade point of 3.0 or better in the certificate courses. Students who do not have English as first language may be required to provide evidence of English language proficiency. Once admitted to the program, a student will be given three years to complete the program.

Students admitted to the Graduate Certificate in Nuclear Nonproliferation Program will have non-degree graduate status, however, they will earn graduate credit for the course they complete. If the student completes the four-course sequence with a grade of B or better in each of the courses taken, they, upon application, will be admitted to the M.S. degree program in Nuclear Engineering. The certificate credits taken by the students admitted to the M.S. degree program will count towards their master's degrees.
Students who do not have all of the prerequisite courses necessary to begin the courses in the Graduate Certificate in Nuclear Nonproliferation Program will be allowed to take "bridge" courses at either the graduate or undergraduate level to prepare for the formal certificate courses.

**CONTRIBUTING FACULTY:**
Ayodeji Alajo
Carlos Castano Giraldo
Hyoung Koo Lee
Xin Liu
Joshua Schlegel
Shoaib Usman

**CURRICULUM:**
The certificate program requires 4 courses equivalent to 12 credit hours. There are 8 course available to the certificate program, 1 of which is required for the completion of the graduate certificate in nuclear nonproliferation. Program enrollees may select any 3 of the remaining 7 courses towards the completion of the graduate certificate. Enrollees may take 1 or 2 classes each semester so that the certificate program may be completed within 1 to 2 years.

**Required Course:**
- NUC ENG 5509 – Nuclear Nonproliferation

**Elective Courses:**
- NUC ENG 5207 – Nuclear Fuel Cycle
- NUC ENG 5281 – Probabilistic Risk Assessment I
- NUC ENG 5312 – Nuclear Radiation Measurements and Spectroscopy
- NUC ENG 5347 – Radiological Engineering
- NUC ENG 5577 – Nuclear Forensics
- NUC ENG 5507 – Nuclear Policy
- NUC ENG 6331 – Radiation Shielding

**COURSE DESCRIPTIONS:**
Note: All courses are available for delivery both online and on campus.

**NUC ENG 5207 Nuclear Fuel Cycle (LEC 3.0)**
Nuclear fuel reserves and resources; milling, conversion, and enrichment; fuel fabrication; in-and-out-of-core fuel management; transportation, storage, and disposal of nuclear fuel; low level and high-level waste management; economics of the nuclear fuel cycle.

**NUC ENG 5281 Probabilistic Risk Assessment I (LEC 3.0)**
A study of the techniques for qualitative and quantitative assessment of reliability, safety and risk associated with complex systems such as those encountered in the nuclear power industry. Emphasis is placed on fault tree analysis.

**NUC ENG 5312 Nuclear Radiation Measurements and Spectroscopy (LAB 1.0and LEC 2.0)**
Contemporary radiation detection theory and experiments with high resolution gamma-ray spectroscopy, solid state detectors, neutron detection and conventional gas filled detectors. Neutron activation analysis of unknown material, statistical aspects of nuclear measurements.
NUC ENG 5347 Radiological Engineering (LEC 3.0)

NUC ENG 5507 Nuclear Policy (LEC 3.0)
This course introduces nuclear security and safeguards policy. It explores the following topics: history of domestic and international nuclear policy, evolution of U.S. nuclear weapons policy, factors influencing policy, the IAEA, nuclear deterrence policy, nuclear safeguards policy, policy in non-proliferation issues, comprehensive safeguards agreement, additional Protocol, 123 agreement, nuclear deterrence theory, and nuclear policy-driven international relations.

NUC ENG 5509 Nuclear Nonproliferation (LEC 3.0)
This course will introduce IAEA mission specific to nonproliferation. The class will provide discussion of essential elements of a nuclear weapon, followed by a brief historical over of nonproliferation treaties in place to deter proliferation. Methods of fissile material production will be discussed followed by a survey of tool and techniques available and employed by IAEA to monitoring and account for Special Nuclear Material (SNM) to ensure treaty compliance.

NUC ENG 5577 Nuclear Forensics (LEC 3.0)
Learn concepts and terminology associated with nuclear forensics and radiochemistry through study of nuclear forensic case studies. Learn about the applications of some of the techniques of nuclear forensics via laboratory demonstrations. Become acquainted with cosmochemistry, isotope production in a neutron field, solvent extraction principles, and fuel reprocessing. Students will research and prepare a demonstration related to nuclear forensics and share the experience with the rest of the class (PPT Presentation, plus video of the laboratory, or simulation results).

NUC ENG 6331 Radiation Shielding (LEC 3.0)

If you have any questions about this form, please contact the Office of Graduate Studies, 573-341-4141.