DEPARTMENT OF NUCLEAR ENGINEERING

Nuclear Engineering

Nuclear engineering deals with the application and utilization of nuclear processes and radiations. The use of nuclear energy for the production of electrical power is a mature industry. Nuclear engineers work on all aspects of the nuclear fuel cycle and for many different types of employers such as government and private labs, regulatory agencies, reactor vendors, utilities and architect engineers. In addition, nuclear energy for space applications is a rapidly expanding field. Radionuclide technology in industry and medicine requires a large number of well-trained radiological health engineers. To supply qualified engineers, the Department of Nuclear Engineering offers curricula leading to the Bachelor of Science degree in Nuclear Engineering and is accredited by the Engineering Accreditation Commission of ABET, www.abet.org.

The missions of the Department of Nuclear Engineering are:

• to produce high-quality graduates from the undergraduate through the doctoral levels to help meet the technical manpower needs of our state, region, nation, and the international community;
• to conduct research, including collaboration with research in related fields, to advance the state of knowledge in these disciplines in support of the needs of society; and
• to perform service in these disciplines for many constituencies including our College and University, industry, government and national laboratories, professional organizations, and the public.

In fulfilling these missions, the objective of the undergraduate program is to prepare students for success in their professional endeavors following the baccalaureate degree. These endeavors may include direct employment in the private or public sectors, graduate studies in engineering or science, professional studies in medicine, business, law or public administration, service in the military, or entrepreneurial activities. To achieve this purpose, four principal educational objectives are identified. Graduates of our Bachelor of Science program in Nuclear Engineering:

1. will work on the challenges of maintenance, improvement, innovation, education, and research in nuclear power and industrial utilization of nuclear radiation and radionuclides. In this work, they will fulfill independent assignments, engage in collaborations, and manage the work of others with effective communications characterizing all phases of their responsibilities;
2. will conduct their professional activities with full recognition of the choices and challenges implicit to their work, to its ethical dimensions, and to their implications for matters beyond their immediate tasks;
3. will take the local, global, historical, social, economic, and political settings into account in both their domestic and international endeavors; and
4. will recognize and utilize both the accumulated body of results from prior work and the continuing evolution of science and technology as essential resources for the effective conduct of their work.

The nuclear engineering baccalaureate degree programs stress engineering science fundamentals and mathematics. However, considerable numbers of elective hours are available in the curriculum to permit students to broaden their educations as desired.

Most of the facilities used in the MS and PhD programs are also used in the undergraduate degree programs. These facilities make the Department of Nuclear Engineering one of the best equipped in the United States. Texas A&M is now the only University in the United States with two nuclear reactors on its campus.

Before commencing course work in the major, students must be admitted to the major or have the approval of the department.

Faculty

Adams, Marvin L, Professor
Nuclear Engineering
PHD, University of Michigan, 1986

Akabani, Gamal, Associate Professor
Nuclear Engineering
PHD, Texas A&M University, 1990

Chirayath, Sunil, Research Associate Professor
Nuclear Engineering
PHD, University of Madras, India, 2005

Ford, John R, Associate Professor
Nuclear Engineering
PHD, University of Tennessee, 1992

Kee, Ernie J L, Associate Professor of the Practice
Nuclear Engineering
BS, University of Idaho, 1978

Kimber, Mark L, Assistant Professor
Nuclear Engineering
PHD, Purdue University, 2008

Kirkland, Karen V, Associate Professor
Nuclear Engineering
PHD, The University of Tokyo, 1999

Marianno, Craig M, Assistant Professor
Nuclear Engineering
PHD, Oregon State University, 2000

McClaren, Ryan G, Associate Professor
Nuclear Engineering
PHD, University of Michigan, 2007

McDeavitt, Sean M, Associate Professor
Nuclear Engineering
PHD, Purdue University, 1992

Morel, Jim E, Professor
Nuclear Engineering
PHD, The University of New Mexico, 1979

Nguyen, Thien, Research Assistant Professor
Nuclear Engineering
PHD, Ritsumeikan University, 2010

Ostrovskaya, Natela G, Senior Lecturer
Nuclear Engineering
PHD, Texas A&M University, 2005
Peddicord, Kenneth L, Professor
Nuclear Engineering
PHD, University of Illinois at Urbana-Champaign, 1972

Poston, John W, Professor
Nuclear Engineering
PHD, Georgia Institute of Technology, 1971

Ragusa, Jean C, Professor
Nuclear Engineering
PHD, Institut National Polytechnique de Grenoble, France, 2002

Shao, Lin, Professor
Nuclear Engineering
PHD, University of Houston, 2001

Tsvetkov, Pavel V, Associate Professor
Nuclear Engineering
PHD, Texas A&M University, 2002

Vaghetto, Rodolfo, Research Assistant Professor
Nuclear Engineering
PHD, Texas A&M University, 2013

Majors

- Bachelor of Science in Nuclear Engineering (http://catalog.tamu.edu/undergraduate/engineering/nuclear/bs)

Minors

- Nuclear Engineering Minor (http://catalog.tamu.edu/undergraduate/engineering/nuclear/minor)
- Radiological Health Engineering Minor (http://catalog.tamu.edu/undergraduate/engineering/nuclear/radiological-health-minor)

Courses

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 301; MATH 308 or registration therein.

NUEN 303 Nuclear 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.
Prerequisites: NUEN 309/SENG 309; ECEN 215.

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 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 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 466; 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.
Prerequisite: PHYS 208 or equivalent; senior classification in nuclear, mechanical, or aerospace engineering, physics, or approval of instructor.
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 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 433 Nuclear Power Plant Systems – Pressurized Water Reactor
Credits 3. 3 Lecture Hours.
Principal elements of pressurized water reactor nuclear power systems; overview of reactor physics, thermodynamics, and heat transfer; focus on systems with both function and interfaces stressed throughout; includes basic reactor physics, reactor heat generation, reactor plant systems; support systems, and reactor safety.
Prerequisites: NUEN 431 and junior or senior classification in the college of engineering; non-NUEN majors.

NUEN 434 Nuclear Power Plant Systems – Boiling Water Reactor
Credits 3. 3 Lecture Hours.
Principal elements of boiling water reactor nuclear power systems; overview of reactor physics, thermodynamics, and heat transfer; focus on systems with both function and interfaces stressed throughout; includes basic reactor physics, reactor heat generation, reactor plant systems, support systems, and reactor safety.
Prerequisites: NUEN 431 and junior or senior classification in the college of engineering; non-NUEN majors.

NUEN 435 Nuclear Power Plant Operations
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Overview of mass, momentum and energy conservation as it relates to nuclear power plants; includes coupled neutronic/thermal models to study plant operations semi-quantitatively achieving an integrated plant understanding.
Prerequisites: NUEN 431, and NUEN 432 or NUEN 433; 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: 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.