Nuclear Engineering

Chair and Professor: Pope
Professors: Brey, Imel
Research Professor: Schultz
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Program Description

Doctor of Philosophy in Nuclear Science and Engineering, Ph.D. (http://coursecat.isu.edu/graduate/scienceengineering/nuclearengineering/daphilosophynuclearscience/)

Master of Science in Nuclear Science and Engineering, M.S. (http://coursecat.isu.edu/graduate/scienceengineering/nuclearengineering/msnuclearscience/)

Master of Science in Health Physics (http://coursecat.isu.edu/graduate/scienceengineering/nuclearengineering/mhealthphysics/)

Nuclear Engineering and Health Physics Certificate Program in Applied Nuclear Energy (http://coursecat.isu.edu/graduate/scienceengineering/nuclearengineering/certappliednuclearenergy/)

Doctor of Philosophy in Nuclear Science and Engineering

This program combines the atomic nuclear aspects of engineering and science. Research areas range from the more traditional nuclear engineering disciplines (reactor physics, thermal hydraulics, and reactor design) to cross-discipline topics in the fields of health physics, radiation detection and measurement, nuclear fuels, materials development, nuclear fuel cycle systems studies, and radioactive waste management.

Goals

- Enhance knowledge of graduates in the physics and engineering of nuclear reactors, the nuclear fuel cycle, and other aspects of the study of nuclear engineering. At Idaho State University, while our emphasis is on advanced reactors and the science and technology of nuclear fuel recycling, we allow the flexibility to build programs on other aspects, which can include systems studies and simulations including policy aspects, radiation shielding and detection, medical applications of radiation, and the economics and safety of all of these applications.
- Increase the ability of graduates to synthesize and apply these advanced concepts to develop realistic nuclear engineering designs and to solve identified problems, designing strategies for implementing them safely, ethically, and effectively.
- Enhance the ability of graduates to effectively communicate these concepts both in oral and written formats.

Master of Science in Health Physics

The Nuclear Engineering Program additionally offers the master's option in Health Physics. Health Physics, an applied science, is concerned with the protection of humans and their environment from the possible harmful effects of radiation while providing for its beneficial uses. It is a multi-disciplined profession that incorporates aspects of both the physical and biological sciences. The master's program in Health Physics is accredited by the Applied and Natural Sciences Accreditation Commission of ABET, http://www.abet.org. The Idaho State University Health Physics programmatic educational objectives have been developed via close collaboration of faculty and the Idaho State University Health Physics Program Advisory Board.

The educational objectives of the ISU Health Physics program are to produce health physicists with:

1. broad, fundamental technical knowledge;
2. written and verbal communication skills;
3. professional judgment and capability to think critically;
4. practical experience in solving applied health physics problems;
5. the ability to work independently; and
6. a professional ethic of magnitude sufficient for them to work productively and successfully in a variety of health physics settings.

The graduate program has two additional educational objectives, which are to equip graduates with:

1. An ability to conduct research; and
2. Professional tools and experience above that expected for the baccalaureate program.

Students may enter the master's program in health physics from several undergraduate majors including health physics, physics, chemistry, biology, and other science or engineering majors. Additional course work to correct deficiencies may be necessary.
Certificate Program in Applied Nuclear Energy

This program provides bachelor's degree graduates who do not have recent experience or education in the nuclear energy field with historical insights, information on basic concepts, regulatory requirements, and economic and environmental considerations. The Certificate is granted upon completion of fourteen (14) credit hours of classwork, consisting of nine credit hours of required courses, a three-credit elective course, and participation in two semesters of a one-credit graduate seminar. Up to six credits of appropriate graduate course work taken at another university may be applied toward the certificate program subject to approval by the student's certificate committee. With appropriate pre-planning, some of these credits could be applied to a master's degree.

Courses

**NE 5519 Energy Systems and Nuclear Power: 3 semester hours.**
Fundamentals of conventional and renewable energy systems. Energy sources, distribution, use and environmental effects. Nuclear power plant "balance of plant" design. Specific, evaluated graduate-level activities and/or performances are identified in the course syllabus. PREREQ: ME 3307 and MATH 3360 or instructor permission.

**NE 5521 Mathematical Methods in Nuclear Engineering: 3 semester hours.**
First and second order ordinary differential equations (ODEs), generalization to systems of ODEs, Laplace transforms, series solutions to second order ODEs, special functions and Sturm-Liouville systems; partial differential equations by separation of variables. Examples will emphasize practical problems of interest to nuclear engineers. PHYS 6602 may be substituted for this course. PREREQ: MATH 3360.

**NE 5543 Thermal Fluids Laboratory: 1 semester hour.**
Measurement of thermal and fluid properties, experiments on fluid flow and heat transfer systems. Equivalent to ME 5543. PREREQ: ME 3341 and NE 5576 or NE 4476.

**NE 5545 Reactor Physics: 3 semester hours.**
Neutron balance equations in reacting systems, diffusion and diffusion-perturbation theory, introductory reactor kinetics, the multi-group energy approach, neutron slowing down and thermalization, introductory concepts in reactor systems. PREREQ: NE 3302 or NSEN 6685, and NE 5521 or equivalent.

**NE 5546 Nuclear Fuel Cycle Systems: 3 semester hours.**
Uranium mining, milling, conversion; enrichment technology including cascade analysis; fuel fabrication, criticality safety in the nuclear fuel cycle, introduction to ORIGEN and Monte-Carlo methods and codes, reactor fuel management, waste management (LLW, HLW, TRU waste). PREREQ: NE 3302 or NSEN 6684 or equivalent.

**NE 5548 Design Control and Use of Radiation Systems: 3 semester hours.**
Generation detection and measurement systems design for control and use of neutrons and gamma rays in industrial and medical applications. Radiation protection, regulations, environmental and economic considerations. COREQ: ENGR 5545.

**NE 5551 Nuclear Seminar: 1 semester hour.**
Current topics in nuclear science and engineering. Specific, evaluated graduate-level activities and/or performances are identified in the course syllabus. PREREQ: Graduate student status in NSEN or HPHY program.

**NE 5558 Monte Carlo Methods and Applications: 3 semester hours.**
Basics of the application of stochastic methods to calculate the transport of neutrons, photons, and other sub-atomic particles. Includes introduction to the MCNP code, and sample application problems in both nuclear reactor design and in applications such as radiation beams used for cancer therapy.