

Sanders Nuclear Advisory Technical Course Offering

All courses are given as a 3-credit semester U.S equivalent course. Courses are available to be given as intermediate 1-2 weeks intensive course or as short training courses 1-2 days.

1. Fundamentals of Nuclear Engineering

The course is an ‘introduction’ course focusing on the theory to practical aspects of nuclear science and technology. It is a ramp-up course for non-nuclear engineers who wish to pursue further advancement in nuclear engineering.

Topics include, but not limited to:

- Introduction to the nuclear fuel cycle
- Power Reactors
- Nuclear Physics
- Nuclear reactions and radiation
- Radiation Protection
- Nuclear reactor theory
- Reactor kinetics and control
- Reactor energy removal
- Reactor Accidents and Lessons Learnt.

2. Introduction to Nuclear Criticality Safety

Topics include:

- Review of criticality accidents
- Overview of the physics of criticality
- Factors that affect reactivity
- Experiments and the development of subcritical limits
- Standards and regulations
- Hand calculation techniques
- Engineering and evaluations for criticality safe processes and facilities

3. Nuclear Criticality Safety Engineering

Nuclear engineering for criticality safe processes and facilities. Including, but not limited to:

- In-depth physics of criticality
- Hand calculation techniques
- Monte Carlo applications
- Experimental development of subcritical limits
- Nuclear criticality accidents, anomalies, and case studies
- Nuclear data/benchmarking
- Standards and regulations, etc.
- Practical engineering examples/case studies and the preparation of a nuclear criticality safety evaluation.

4. Monte Carlo Methods in Nuclear Engineering

Theory and application of the Monte Carlo method for neutron transport calculations from introductory concepts to advanced simulations of criticality in fissile materials. Computer applications in nuclear engineering; verification and validation (V&V), nuclear data files, examples of Monte Carlo calculations, case studies and applied problems.

5. Probabilistic Risk Assessment (PRA)

Studies the theory and application for Nuclear Safety using Probabilistic Risk Assessment (PRA) and Integrated Safety Analysis (ISA), used extensively for Nuclear Power Plants and Nuclear Fuel Cycle Facilities.

It covers:

- The history of nuclear power safety and the background of PRA
- The basic concepts of risk and safety analysis to PRA
- Nuclear safety design methodologies and show how PRA is applied
- The fundamental essentials of a full PRA
- The role of PRA in decision making and industry application
- The importance of PRA quality and the role it has in analysing risk

6. Radiation Protection and Shielding

General principles of radiation, radioactivity, and radiation protection including radiation sources, radioactive decay, radiation interactions, radiation detection, radiation shielding, radiation dose calculations, and biological effects.

Course Goals:

- Understand the basic concepts of radiation and radioactivity
- Develop computational skills associated with radiation protection methodology
- Provide a comprehension of methods of radiation detection and the limits of each method
- Provide a knowledge of dose limits
- Provide a basic understanding of biological effects of ionizing radiation

7. Nuclear Power Analysis

- Development of the neutron diffusion equation with application to the design of steady state nuclear reactors.
- Derivation of critical core dimensions for single energy and multi-energy neutron groups.
- Determination of group constants for thermal and fast neutrons.
- Unsteady reactor dynamics and criticality control.
- Introduction to Monte Carlo techniques.

8. Intro and Advanced Reactor Physics

a) Introduction (Part 1)

Provides a thorough introduction to the physics of a nuclear reactor. We discuss the fission chain reaction and nuclear criticality, reactor materials and safety, and use what we learn to simulate a nuclear reactor core.

Provides the basic knowledge of reactor physics.

b) *Advanced (Part 2)*

Neutronics, thermal-hydraulics, and fuel performance analysis of advanced reactors. Reactor plant system and basic operations. Technological roadmap and policy issues. Computational methods for advanced reactor design and analysis.

9. Nuclear Waste Management & Decommissioning.

Course modules include:

- The nuclear fuel cycle and the nuclear waste compartments
- The classification of radioactive waste by the International Atomic Energy Agency, in the U.S., and internationally
- Radioactive waste and spent fuel management techniques/technologies
- Nuclear Law as it relates to International nuclear and Nuclear Liability Conventions
- Regulations and risks associated with radioactive waste transportation
- The challenges and strategies for the siting of interim storage facilities and final disposal sites for radioactive waste and spent fuel
- The global varied approaches in nuclear waste management strategies

Sanders Nuclear Advisory Legal Course Offering

Currently offered as short courses. Either as a full 1-2-week program or as a 1-2-day summary overview.

Topics covered include:

- Nuclear law – what it is and isn't
- International framework – Governing Institutions and Organizations
- Radiological Protection – Standards and Practices
- Nuclear Safety – It's importance and how to meet today's challenges
- Nuclear Accidents – Historical perspective and notification and assistance obligations
- Nuclear regulatory regimes and Environmental Protection
- The Management of Spent Fuel and Radioactive Waste
- Nuclear security: physical protection, illicit trafficking, and terrorism
- Transport of nuclear materials and fuel – It is secure?
- Who Plays and Who Pays? Nuclear liability, compensation, and insurance for nuclear damage.



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