THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Introduction to Nuclear Power Engineering

NUCLREN 4701

Credit Hours:
3.00 - 3.00

Course Levels:
Undergraduate (1000-5000 level)

Course Components:
Lecture

Course Description:
For advanced undergraduates in nuclear engineering focusing on the physics and engineering of nuclear reactors and nuclear power plants.

Prerequisites and Co-requisites:
Prereq: 4505 (505) or MechEng 4505 (505); or permission of instructor.

Course Goals / Objectives:
- Introduce the fundamental physical concepts relevant to the operation of nuclear reactors and nuclear power plants.
- Introduce the fission reactor systems in current use.
- Introduce the concepts involved with the design and operation of fission reactors (e.g. neutronics, fluid mechanics, and heat transfer).

Course Topics:

- Fission; Q-Values; Nuclear binding energy; Nuclear shell structure; Fissile vs. Fissionable isotopes Fertile isotopes and breeding; Neutron multiplication factor;
- Macroscopic cross-section; Mean Free Path calculational details; Neutron-nuclear reactions; Formation of compound nucleus and cross-section resonances; Neutron flux, thermal utilization; eta; Infinite medium multiplication factor
- Non-leakage probability; Neutron Diffusion Eqn; Derivation of Neutron Diffusion Equation; Derivation of Non-leakage Probability; Derivation of Extrapolation Distance;
- Criticality Condition; Derivation of criticality condition and flux shape for 1-D slab reactor;
- Right circular cylindrical core criticality condition and flux shape; Critical size for PWR;
- Optimum height to diameter for cylindrical reactor; Heat flux
- Definition of Hot Channel; Nuclear hot channel factor for cylindrical core; Power flattening
- Criticality and Flux Shape for Reflected Slab Reactor; Reflector Savings
- Thermal hydraulic analysis for PWR; Linear power density for PWR; PWR core area
- Six Factor Formula and Two Group Diffusion Theory
- Resonance Escape Probability and Neutron Thermalization; Figures of Merit for Moderators
- Heterogeneous Effects in Reactor Cores
- Doppler Reactivity Feedback; Moderator Reactivity Feedback
- Commercial Nuclear Reactors, TMI
- Point Reactor Kinetic Equations and Analysis of Step Reactivity Insertion
- Overpower Factor and Design Margin
- PWR Plant Operating Characteristics, PWR Simulation
- Fission Product Poisoning

Designation:

Elective