



Nuclear Reactor Systems

NUCLREN 4536

Credit Hours:

3.00

Course Levels:

Undergraduate (1000-5000 level)

Course Components:

Lecture

Course Description:

Introductory course covering concepts of nuclear power reactor systems, thermal and mechanical design aspects and economics of nuclear power plants.

Prerequisites and Co-requisites:

Prereq: 4505 (505) or MechEng 4505 (505); or permission of instructor.

Course Goals / Objectives:

- To become aware of the basic designs of nuclear power reactor systems
 - To understand the fundamental principles of reactor design with an emphasis on reactor thermal design
 - To understand the thermodynamics of operating nuclear power plants (BWRs and PWRs)
 - To understand the shut-down power generation
 - Be able to analyze a simple Brayton power cycle
 - Be able to perform a simplified transient analysis for a nuclear power plant following a postulated LOCA
 - Be able to calculate the steady-state temperature profile in a fuel pin
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Course Topics:

- Reactor types and their major design features (PWRs, BWRs, LMFBRs, Gas-cooled Reactors)
 - Reactor design principles (Reactor core design, Fuel design, Thermal design, Material considerations, Control and safety, and Economics)
 - Thermal design principles (Power peaking factors, Pool boiling curve, Critical heat flux)
 - Reactor heat generation (Heat generation profile in idealized reactors, Power peaking factors, Heat generation in fuel, moderator, and structure, Reactor shutdown heat generation)
 - Single-phase flow analysis (General balance equation, Control volume analysis)
 - Introduction to two-phase flow
 - Review of first and second laws of thermodynamics
 - Thermodynamic analysis of nuclear power plants (Rankine cycle, Co-generation with feedwater heaters, moisture separator, Brayton cycle)
 - Transient first law analysis (BWR Blowdown, Containment pressure response during a LOCA, PWR pressurizer response to load change)
 - Thermal analysis of fuel elements
 - Lessons learnt from the TMI accident
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Designation:

Required

Elective