NUCL 402: Nuclear Reactor Systems Syllabus

1. Introduction:

Nuclear Power Plants Light Water Reactors (LWRs); PWR, BWR

2. Nuclear Reactor Kinetics and Control

Point Kinetics: one delayed neutron group

Fission product poisoning: Xenon and Samarium

Feedback effects: temperature Doppler moderator temperature

moderator void fraction

3. Radiation protection:

Internal and external dose rates Regulatory guidelines

4. Shielding:

Buildup factors Sievert's integral

5. Fuel cycle and waste management

Fuel cycle Spent fuel reprocessing Radioactive waste management

6. Nuclear fuel and thermal design:

Nuclear fuel

Steady heat conduction: temperature distribution

Transient heat conduction: lumped parameter model, fuel response during

LOCA

Reactor fuel design limits: CHF, LOCA

7. Power conversion:

First and second laws of thermodynamics Carnot cycle, Rankine cycle Thermal and frictional irreversible processes Thermodynamic efficiency of LWRs Balance Of Plant (BOP) design

8. Thermodynamic design of reactor components:

Dry containments: PWRs

Pressure suppression pool system: BWRs

PWR pressurizer SBWR vessel

9. Thermal-hydraulics of LWRs:

Pressure drop for one and two phase flows Heat transfer and critical heat flux

10. Nuclear reactor safety:

Power Excursions (Chernobyl)
Loss of Coolant Accidents (TMI)
Emergency Core Cooling System (ECCS)
Advanced Water Reactor Design
Accidents –TMI and Chernobyl

11. Additional Topics

PRA Licensing Decommissioning