NE405/505
Reactor Systems (3 CH)

Instructors
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Office Hours: To be arranged

Prereq: NE401 & NE402

Course Objectives
• General - Learn how to apply knowledge in engineering sciences to design and understanding complex systems.
• Focused - Gain an understanding of nuclear power plant engineering utilizing specific analytical skills acquired in other courses.

Texts (Copies will be provided)
• The Westinghouse PWR NPP, Westinghouse
• BWR/6 General Description of a BWR, GE
• NE405/505 Class Notes

References
• Updated Final Safety Analysis Reports (UFSAR): Brunswick BWR and McGuire PWR Chapter 4 - Core Design and Chapter 15 - Safety Analysis
• Thermal Analysis of PWRs, Tong and Weisman
• T-H of a BWR, Lahey and Moody
• Principles of Design Improvements for LWRs, Tong

Grading Basis
Grading: Plus and minus will be used.

Grade Makeup:
• Examinations
  Hourly (2)  40%
  Final  30%
• Group Computer Projects (2)  10%
• Group Term Paper  10%
• Homework  10%

Students taking NE505 will have an extra assignment (computer project or term paper) assigned to justify receiving graduate credit.

Homework:
• Due prior to class when assignment due (normally one week from when assigned).
• EOL students should send homework as an attachment to following: homework_eol@ncsu.edu
• No late submittals accepted without prior approval.
• To be eventually worked alone but can be discussed prior to this time.
Accommodation
If you have a certified disability that requires accommodation, please advise me so I can take appropriate measures.

Dead Week:
Class assignments, such as homework, term paper or computer project report, could be due during dead week. There will be no examinations during dead week.

Grading Guidelines for NE405/505 Computer Simulation Projects:

1. Did the introductory section clearly state the objectives of the project? (5%)

2. Was the report from an English language viewpoint well written? (15%)

3. Did the report use consistent formatting and writing style throughout, i.e. not cut and paste of individual contributions without further editing? (5%)

4. Were all the computer cases that needed to be executed completed? (15%)

5. Were figures and tables used effectively to present the results such that results that are described are supported by figures and tables and those not described omitted? (10%)

6. Were the physics of each event clearly and properly described in the report? (50%)
NE 405/505
Reactor Systems
3 (3-0) Prerequisite: NE 401 & NE 402

A. Introduction
   1. Design Process
   2. System Overviews of Light Water Reactors
   3. Industry Subdivisions & Participants

B. Nuclear Steam Supply Systems Design
   1. Reactor Coolant Systems
   2. Auxiliary Systems
   3. Reactor Control Systems

C. Nuclear Power Plant Accidents
   1. Objectives
   2. Fuel Failure Modes & Radiation Release Paths
   3. Engineering Safeguards System
      a. Reactor Protection System
      b. Secondary System Protection
      c. Containment Protection
      d. Power Protection System
   4. Accident Analysis
      a. Accident Classification
      b. Safety Analysis Predictions
      c. Review of Real Events

D. Containment
   1. Building
   2. Pressure Suppression
   3. Atmospheric Cleanup

E. Core Design of Light Water Reactors
   1. Fuel
      a. Materials Selection
      b. Mechanical Description
      c. Thermal-Hydraulics Design
      d. Nuclear Design
   2. Reactivity Control
      a. Requirements
      b. Control Approaches

F. Advanced Nuclear Power Plant Designs
   1. Advanced Light Water Reactors
   2. Fast Spectrum Metal Cooled Reactors
   3. High Temperature Gas Cooled Reactors

Lectures
1. Design Process
   ½
2. System Overviews of Light Water Reactors
   ½
3. Industry Subdivisions & Participants

1. Reactor Coolant Systems
   3
2. Auxiliary Systems
   1
3. Reactor Control Systems
   2

1. Objectives
   ¼
2. Fuel Failure Modes & Radiation Release Paths
   ¼
3. Engineering Safeguards System
   a. Reactor Protection System
   b. Secondary System Protection
   c. Containment Protection
   d. Power Protection System
   ¼
4. Accident Analysis
   a. Accident Classification
   b. Safety Analysis Predictions
   c. Review of Real Events
   2

1. Building
   1
2. Pressure Suppression
   ½
3. Atmospheric Cleanup
   ½

1. Fuel
   a. Materials Selection
   ½
   b. Mechanical Description
   1.5
   c. Thermal-Hydraulics Design
   2
   d. Nuclear Design
   2
2. Reactivity Control
   a. Requirements
   1
   b. Control Approaches
   1

1. Advanced Light Water Reactors
   1
2. Fast Spectrum Metal Cooled Reactors
   ½
3. High Temperature Gas Cooled Reactors
   ½