NUCE 430: DESIGN PRINCIPLES OF REACTOR SYSTEMS  
Fall 2011

M W F 03:35P - 04:25P  262 Willard Bldg

INSTRUCTOR:  
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COURSE OBJECTIVES: The objectives of this course are to provide students in Nuclear Engineering with sufficient background in nuclear power cycles; nuclear reactor heat generation and removal; thermal/hydraulic calculations for different reactor designs; different accident classifications and reactor operating limits.

TEXTBOOKS:

REFERENCES:
  1) M. Avramova, NUCE 430 Class Materials, PSU 2011
  2) J. R. Lamarsh and A. J. Baratta, “Introduction to Nuclear Engineering”
  3) J. Duderstadt and L. Hamilton, “Nuclear Reactor Analysis” – Chapter 12

WEBSITE: Homework problems/solutions and other course materials will be posted on ANGEL

PREREQUISITES: M E 410; NUC E301 or NUC E401

POLICIES:
  o Homework is due one week from the day assigned. Late submittals within 24 hours will receive an automatic 20% grade reduction. Submittals will not be accepted more than 24 hours after the due date. Homework should be typed and submitted by 11:59 pm on the due day via ANGEL. Additional notes on the homework format and requirements are following.
  o Attendance is mandatory. 0.5 points will be subtracted from the student’s final grade per each class missed. If there is a valid reason to miss the class a brief explanation should be e-mailed beforehand.
  o NucE Seminar (NucE 590): 0.25 extra points will be earned per each seminar attended. In order to get extra credit, students need to submit the preformatted memo to the Teaching Assistant at the end of the seminar session. No late memo is accepted.
  o Exams: There will be three in-class exams. During the exams, the students will be allowed to use one double-sided hand-written page (letter format) with notes, equations, etc.
  o Course Project: A course project will be assigned. The best projects will be presented to the class.
  o Quizzes: There will be several 10-minutes “surprise” quizzes given during the semester.
EVALUATION METHODS:
The grading distributions are as follows:

- Course Project and Course Quiz: 25% (2/3 on the Project report and 1/3 on the Quiz);
- Exams: 10% each;
- Homework: 30% of the average;
- Quizzes: 15% of the average.

Grading scale:
- A 93 - 100
- A- 90 - 92
- B+ 87 - 89
- B 83 - 86
- B- 80 - 82
- C+ 76 - 79
- C 69 - 75 – Needed to graduate
- D 57 - 68
- F 0 - 56

A grade higher than 100% might be given for an excellent job (greater than what is required) or when an innovative treatment of the problem is presented.

HOMEWORK FORMAT:
Homework should be prepared in the following format:

**Introduction:** Brief statement of the problem with the purpose and background of the calculation.

**Assumptions:** List and justification of the assumptions used in the calculations.

**Analysis Approach:** Identification of the analytical approach, computer codes, speared sheet, or other methods used for the calculations.

**Calculations and Results:** Presentation of the performed calculations. If calculations were used to develop code input, this should be shown including units and references. Please, high-light or box the final results. The calculations could be performed in either British or SI units, but a unit balance must be included.

**Discussion of the Results:** This is the most important section!!! Do the results make sense? If so, why; if not why not. The students should show that they understand what they are doing.

**Conclusions:** Brief summary of the performed work.

DESIGN PROJECT:
The course project will include closed channel analyses of the coolant and heat structures behavior during anticipated LWR transients using the COBRA-IV subchannel code. It will be a continuation of the last homework assignment, where the coolant and heat structures behavior at steady state conditions will be evaluated. Because of the limited time available for the students to get familiar with the code,
the input decks will be provided. The students will use the code as a computational tool for illustration and understanding of the thermal-hydraulic phenomena within LWR cores.

**LIST OF TOPICS:**
Principal Characteristics of Power Reactors
Thermal Design Principles and Application
Reactor Energy Distribution
Transport Equations for Single-Phase Flow
Transport Equations for Two-Phase Flow
Thermodynamics of Nuclear Energy Conversion Systems: Nonflow; Steady and Nonsteady Flow
Thermal Analysis of Fuel Elements
Single-Phase Fluid Mechanics
Single-Phase Heat Transfer
Two-Phase Flow Dynamics
Pool Boiling and Flow Boiling
Single Heated Channel

**ACADEMIC INTEGRITY:** The University and the College of Engineering consider academic dishonesty, including cheating and plagiarism, to be a serious offense. The University Policy 49-20 describes the general University policy on academic dishonesty. For Engineering, the academic integrity website is at [http://www engr psu edu CurrentStudents acadinteg asp](http://www.engr.psu.edu/CurrentStudents/acadinteg.asp).