ENME 430
FUNDAMENTALS OF NUCLEAR REACTOR ENGINEERING

Professor: R. C. Sanders

Office: 0151 Martin Hall

Email: rsanders@umd.edu

Phone: 443-804-6485

Office Hours: TuTh 12:00pm – 1:30pm

Classroom: EGR 2107

Schedule: TuTh 2:00pm – 3:15pm

Text: Introduction to Nuclear Engineering 3rd Edition,
John R. Lamarsh and Anthony J. Baratta
Prentice Hall 2001

Additional Materials: Lecture notes and handouts

Course Description: ENME 430 presents the principles of nuclear reactor engineering as applied to reactor cores. This includes topics in basic nuclear physics, neutron interactions, nuclear fission, neutron diffusion and moderation, continuity, criticality of steady state systems, time dependent reactor behavior, and heat generation and removal from reactor cores.

Course Objectives: The major objective of ENME 430 is to have the student understand the fundamental concepts of reactor engineering as applied to steady state and time dependent reactor systems. A student who successfully completes ENME 430 is able to demonstrate the ability to:

1. Understand the basics of the structure of an atom and nucleus, radioactivity, nuclear reactions, neutron cross sections, nuclear fission.
2. Understand how neutrons interact with matter.
3. Understand the fundamentals of neutron diffusion and moderation, including neutron flux, continuity, the diffusion equation and its solutions, thermal neutron diffusion, and multigroup diffusion.
4. Understand the fundamentals of nuclear reactor theory (steady state and time dependent), including the one-group reactor equation and its solutions, one-group critical equation, thermal and reflected reactors, homogeneous and heterogeneous systems.
5. Understand the basics of heat generation and removal from reactor cores

Grading Policy

Hour Exams (2):	100 each
Final Exam:	200
Homework:	100
TOTAL:	500

The student's final grade will be determined based on all course work (total of 500 possible points). The final grade is determined only after all course work is completed (i.e. after the final exam).

Examinations

There will be two one-hour exams and a final. Each hour exam will concentrate on the subject matter covered since the previous exam. However, keep in mind that engineering material builds on itself as a course progresses – you are expected to have mastery of all previous material. The final exam will be cumulative and cover all course material.

Homework

In order for the student to better understand the material presented in class, homework will be assigned. Problem sets will be collected at the beginning of the class on the due date. The problem sets will be worth 10 point each. Solutions to all problems will be posted on Blackboard. Students can work together, however copying homework is a violation of the Student Code of Academic Integrity – any occurrences will be referred to and dealt with by the Student Honor Board. Also, to be fair to all students, late homework will not be accepted under any circumstances.

Topic Outline

1 – Fundamental Concepts (Lamarsh and Baratta – Chapters 1, 2)
1.1 Atomic and nucleus structure
1.2 Mass and energy
1.3 Excited states, nuclear stability, radioactive decay
1.4 Atom and molecular density

2 – Radiation Interactions (Lamarsh and Baratta – Chapter 3)
2.1 Neutron interactions
2.2 Neutron cross sections
2.3 Neutron attenuation
2.4 Neutron flux
2.5 Neutron scattering
2.6 Fission

3 – Neutron Diffusion and Moderation (Lamarsh and Baratta – Chapter 5)
3.1 Fick's Law
3.2 Continuity equation
3.3 Diffusion equation
3.4 Solutions of diffusion equation
3.5 One group diffusion
3.6 Thermal neutron diffusion
3.7 Multigroup diffusion

4 – Nuclear Reactor Theory (Lamarsh and Baratta – Chapter 6)
4.1 One group reactor equation
4.2 Slab reactor
4.3 Spherical, cylindrical reactor geometries
4.4 Thermal reactors
4.5 Reflected reactors
4.6 Multigroup calculations
4.7 Heterogeneous reactors

5 – Time Dependent Reactor Behavior (Lamarsh and Baratta – Chapter 7)
5.1 Reactor Kinetics
5.2 Control Rods
5.3 Temperature Effects
5.4 Fission Product Poisoning

6 – Nuclear Reactor Heat Generation and Removal (Lamarsh and Baratta – Chapter 8)
6.1 Heat production in fuel rods
6.2 Conduction and temperature distribution
6.3 Heat transfer to coolants