ENU4103 - Reactor Analysis and Computat.1 - Statics (3 cr), Required Course, Spring, 2006

Description: Study of neutron reactions, fission chain and criticality and neutron transport/diffusion for nuclear reactors. Analytical and numerical diffusion theory calculations for reactor design and analysis. Cell calculations for heterogeneous cores.

Prerequisites: ENU 4001 and ENU 4605.

Course Objectives: To become familiar with analytical, numerical, and computational aspects of nuclear reactor physics, understanding the applications and limitations of neutron diffusion theory, applications of neutron transport theory, and the principles and concepts of reactor physics, and time independent behavior of the neutron and gamma population in a nuclear reactor.

Program Educational Objectives / Professional Components Supported by Course:

1. Graduates will have successful careers in Nuclear Engineering and related disciplines.
2. Graduates will pursue continuing education or advanced degrees.
4. Graduates will use the knowledge and skills obtained in their undergraduate education to practice high ethical professional standards in Nuclear Engineering and related disciplines

Program Outcomes Supported by Course:

Outcome a: an ability to apply knowledge of mathematics, science and engineering for problem solving in engineering.

Outcome e: an ability to identify, formulate and solve engineering problems.

Outcome k: an ability to use the techniques, skills and modern engineering tools, including modern computational skills and tools, necessary for nuclear and radiological engineering practice.

Outcome l: an ability to apply advanced mathematics, science, atomic and nuclear physics and engineering to nuclear and radiological systems and processes.

Outcome n: an ability to work professionally in on or more of the areas of: nuclear power reactors, nuclear instrumentation and measurement, radiation protection and shielding and radiation sources and applications

Text: *Nuclear Reactor Analysis* by J. J. Duderstadt, L. J. Hamilton, Wiley & Sons
ISBN number: 0-471-22363-8 *(Referred to as "D&H")*

References: (Optional) (i) *Introduction to Nuclear Engineering*, 2nd Ed, J.R. Lamarsh, Addison-Wesley, 1983; (ii) *Nuclear Reactor Engineering*, 4th Ed, Glasstone and Sesonke, Chapman and Hall, Inc, 1994; (iii) *Nuclear Reactor Theory*, Bell and Glasstone, Van Nostrand-Reinhold Co, New York, 1970.

Grading: Homework (25%), Projects/Presentations In-Class (5%), 2-Exams (40%), Final Exam (30%)

ENU4103 - Reactor Analysis and Computat.1 - Statics, Course Outline, Spring 2005

You should have a solid foundation for this course based on your experiences in ENU 4001 and ENU 4605, the mandatory prerequisites. In ENU 4103, you will learn the fundamentals of reactor physics, and gain a unique perspective on the derivation of the neutron transport equation, and understand some approximations to this equation, including neutron diffusion. We will solve many application problems that incorporate elements of nuclear physics, radiation interactions, criticality eigenvalues, diffusion theory, and transport theory. For this course, we will use the classic text by Duderstadt and Hamilton, *Nuclear Reactor Analysis, or "D&H"*. I will also supplement this text with notes and handouts relevant to the subject matter. Three Blocks will cover:

a. **Block I**. D&H Chapters 1-4 (cross sections, scattering, neutron transport theory, solutions)

b. **Block II**. D&H Chapter 5 (neutron transport equation and diffusion equation applications, numerical approximations)

c. **Block III**. D&H Chapter 7, selections from Chapters 8-9, Chapter 10 (multigroup theory, multigroup diffusion, group constants, cell homogenization, numerical solutions)

Prepared by: Glenn E. Sjoden
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