COURSE #: NERS 441 **CREDITS:** 3/Required	**COURSE TITLE:** Nuclear Reactor Theory I
TERMS OFFERED: Fall	**For each prerequisite below, "E" denotes Enforced and "A" denotes Adv**
TEXTBOOKS/REQUIRED MATERIAL: Duderstadt and Hamilton, *Nuclear Reactor Analysis*, 1976	**PREREQUISITES:** NERS 312, Math 454 (A)
INSTRUCTOR(S): Michael Hartman	**COGNIZANT FACULTY:** Michael Hartman
CoE BULLETIN DESCRIPTION: An introduction to materials used in nuclear systems and radiation effects in materials (metals, ceramics, semiconduct organics) due to neutrons, charged particles, electrons and p	**COURSE TOPICS:** Neutron cross sections, reaction rates, flux and current (12 h), diffusion **t**heory (8 h), numerical solution of the diffusio equation (4 h), **c**riticality and eigenvalue problems (6), multigroup diffusion (4 h), point kinetics (10 h), neutron slowing theory (8)

COURSE STRUCTURE/SCHEDULE (Lectures: 2 per week @ 80 minutes; 1 per week @ 50 minutes)

COURSE OBJECTIVES For each Course Objective, links to the Program Educational Objectives are shown	1. To teach students the fundamental behaviors of neutron populations in matter[1,2] 2. To teach students analytical and computational methods for the solution of neutron transport and diffusion problems [1,2] 3. To teach students the essential elements of reactor kinetics behavior [1,2] 4. To prepare students for nuclear reactor core design [1,2]
COURSE OUTCOMES For each Course Outcome, links to the Program/ABET Student Outcomes are shown [#,a-k]	1. Demonstrate a fundamental understanding of microscopic and macroscopic cross-sections, and of the features of neutron cross sections. [1|ABET a] 2. Demonstrate a solid understanding of fundamental transport concepts such as neutron density, neutron scalar flux, neutron energy density. [1,3|ABET a,e] 3. Analytically solve problems in neutron transport and diffusion in both non-multiplying and multiplying media. [1,3|ABET a,e] 4. Utilize a diffusion theory based code to solve neutron transport problems. [1,3,4|ABET a,e,c] 5. Utilize a Monte-Carlo based code to solve neutron transport problems [1,3,4|ABET a,e,c] 6. Describe and qualitatively predict reactor transients using point kinetics. [1,3|ABET a,e] 7. Describe the slowing down of neutrons, and the influence of cross section resonance. [1,3,4|ABET a,e,c]
ASSESSMENT TOOLS For each assessment tool, links to the Course Outcomes are identified	1. A combination of during-term test(s) and/or final examination will be used to measure all outcomes for individual students under a time constraint. 2. Problem sets measure all outcomes under less time pressure and with student collaborations. 3. Course evaluation by each student at the end of the course assesses all outcomes. 4. Faculty self-assessment provides self-assessment data on all outcomes.

Revision History: September 1998; January 2004: October 2006; July 2010