COURSE #: NERS 442; **CREDITS:** 4/Selective	**COURSE TITLE:** Nuclear Power Reactors
TERMS OFFERED: Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL: Duderstadt and Hamilton, *Nuclear Reactor Analysis*, 1976	**PREREQUISITES:** NERS 441 (E), CEE 325 or ME 230 (A)
INSTRUCTOR(S): John Lee	**COGNIZANT FACULTY:** Lee and Hartman
CoE BULLETIN DESCRIPTION: Analysis of nuclear fission power systems including an introduction to nuclear reactor design, reactivity control, steady-state thermal-hydraulics and reactivity feedback, fuel cycle analysis and fuel management, and environmental impact and plant siting, and transient analysis of nuclear systems. A semester-long design project of the student's choice.	**COURSE TOPICS:** Overview on reactor design approach (2h), flux spectrum calculations and effective cross sections (4h), lattice physics analysis for heterogeneous cores (14h), global reactor analysis (4h); thermal-hydraulic analysis of reactor cores (14h), thermal-hydraulic limits, power capability, and feedback (4h), depletion, fuel -cycle analysis and fuel management (6 h), reactivity and power distribution control (4h).

COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @80 minutes, 1 per week @50 minutes each

COURSE OBJECTIVES For each Course Objective, links to The Program Educational Objectives are shown	1. To teach students neutronic and thermal-hydraulic aspects of nuclear reactor core design analysis. [1-3] 2. To teach students analytical methods and computational tools for nuclear engineering problems. [1-3] 3. To prepare students to make decisions regarding ethical, economic, and environmental aspects of nuclear energy. [3] 4. To provide experience for students to work in teams in a typical reactor design environment. [3] 5. To provide experience for student to practice oral and written communication skills. [3] 6. To expose students to career opportunities in nuclear engineering. [3]
COURSE OUTCOMES For each Course Outcome, links to the Program/ABET Student Outcomes are shown [#,a-k]	1. Characterize key attributes of lattice physics codes for generation of few-group cross sections[1-4,11|ABET a,k,e,c,j] 2. Obtain global flux and power distributions using multi-group diffusion theory codes [1-4,11|ABET a,k,e,c,j] 3. Write and solve steady-state fluid conservation equations single- and two-phase flows for single-channel flow [1-4,11|ABET a,k,e,c,j] 4. Represent coupled nuclear-thermal-hydraulic effects in reactivity and power distribution calculations [1-4,11|ABET a,k,e,c,j] 5. Calculate power peaking factors and represent thermal-hydraulic feedback in power capability determination. [1-4,11|ABET a,k,e,c,j] 6. Calculate fuel isotopics as a function of fuel depletion and fuel cycle length. [1-4,11|ABET a,k,e,c,j] 7. Calculate power coefficient of reactivity and reactivity worth of control elements. [1-4,11|ABET a,k,e,c,j] 8. Analyze ethical, economic, and environmental aspects of nuclear core design, fuel cycle and plant siting. [8,9,11|ABET h,f,j] 9. Synthesize various aspects of design calculations into a consistent design for a selected reactor core[6-11|ABET b,d,g,h,f,i,j]

	10. Complete and report on preliminary and final designs for a selected reactor core. [6-11|ABET b,d,g,h,f,i,j]
ASSESSMENT TOOLS For each assessment tool, links to the Course Outcomes are identified	1. Open-book mid-term examination measures outcomes 1-6 for individual students under a time constraint. 2. Problem sets measure outcomes 1-9 under less time pressure and with student collaborations. 3. Preliminary and final design reports (written and oral) evaluate all outcomes. 4. Class discussions and critiquing design project presentations measure all outcomes. 5. Course evaluation by each student at the end of the course assesses all outcomes. 6. Faculty self-assessment provides self-assessment data on all outcomes.

Revision History: September 1998; March 2002; January 2004; June 2010