COURSE # AND CREDITS: NERS 250 **CREDITS:** 4/Required	**COURSE TITLE:** Fundamentals of Nuclear Engineering and Radiological Sciences
TERMS OFFERED: Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Adv**
TEXTBOOKS/REQUIRED MATERIAL: J. Kenneth Shultis & Richard E. Faw, *Fundamentals of Nuclear Science and Engineering*, Marcel CRC Press, (2nd Ed.) 2008	**PREREQUISITES:** Preceded or accompanied by Math 216 and Phys 240 (A)
INSTRUCTOR(S): David Wehe	**COGNIZANT FACULTY:** David Wehe
CoE BULLETIN DESCRIPTION: Technological, industrial and medical applications of radiation, radioactive materials and fundamental particles. Basic nuclear physics, interactions of radiation with matter. Fission reactors and the fuel cycle.	**COURSE TOPICS:** U.S. and World Energy Flows, Modern physics concepts, Properties of the Nucleus, Nuclear Energetics, Radioactivity, Binary Nuclear Reactions, Radia Dose and Biological Impact, Nuclear Fission, Nuclear Reactors, Nuclear Fue Cycle, Reactor Safety and Accidents, Nuclear Weapons and Nonproliferation, Nuclear Fusion, Other Applications of Nuclear Technology.
COURSE STRUCTURE/SCHEDULE: Lectures: 2 per week @ 80 minutes; Discussion: 1 per week @ 50minutes	

COURSE OBJECTIVES For each Course Objective, links to the Program Educational Objectives are shown	1. To teach students fundamental physics that applies to a broad range of nuclear technologies [1,2] 2. To begin to introduce students to the analytical methods used in nuclear engineering and radiological science [1,2] 3. To introduce students to environmental impacts of nuclear technology, and the physical and biological effects of ionizing radiation [3] 4. To expose students to career opportunities in nuclear engineering and radiological sciences [3] 5. To introduce students to nuclear engineering and radiological sciences and their impact on contemporary societal issues [3] 6. To provide practice in technical communication [3]

COURSE OUTCOMES For each Course Outcome, links to the Program/ABET Student Outcomes are identified [#,a-k]	1. Apply relativistic transformations of length, time, velocity and momentum (Lorentz transformations), expression for relativistic energy. Use these concepts to solve problems [1,2|ABET a,k] 2. Apply $E=mc^2$ to calculate the energy released in nuclear reactions. [1,2|ABET a,k] 3. Understand basic nomenclature of nuclear physics, including how to find information on the Chart of the Nuclides, X(a,b)Y reaction notation, and radioactive decay types. [1,2|ABET a,k] 4. Compute decay constants from half-life and vice versa. Write decay equations, including decay with production, and solve the Bateman equations for simple decay chains. [1,2|ABET a,k] 5. Describe the natural decay chains and environmental radiation. [3|ABET e] 6. Define basic nuclear terminology and describe the breadth of current and potential nuclear applications, including fission power, medical diagnostic systems and cancer treatment, and fusion systems. [1,2,8|ABET a,k,h] 7. Define the concept of cross-section, and define the concept of probability of interaction per unit path length (macroscopic cross section). Compute macroscopic cross-section of mixtures. [1,2|ABET a,k] 8. Define beam intensity and generalize to scalar flux. Compute scalar flux in vacuum and pure absorbers. [1,2|ABET a,k] 9. Describe the fundamentals of sustained neutron chain reactions, fission reactor design, and fission products. Derive the 4- and 6-factor formula from basic balance arguments. Define and describe BWR and PWR and enumerate the basic systems of each reactor type. Describe international reactor types, including GCR and PBMR, CANDU, LMFBR, and RBMK. [1,2|ABET a,k] 10. Understand the guiding principles of reactor safety and the lessons learned from past accidents (e.g., EBR-I, TMI-2, Chernobyl) [8,9,10|ABET h,f,i] 11. Read the ANS and HPS Code of Ethics. [9,10,11|ABET f,i,j] 12. Write about nuclear technology. [7,8,9,11|ABET g,h,f,j]
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 outcomes [1-10, 12] for individual students under a time constraint 2. Problem sets measure outcomes [1-10, 12] under less time pressure and encourages student collaborations 3. In class discussions (lecture and recitation) establishes [6] at a class-wide level 4. Course evaluation by each student at the end of the course provides self-assessment data on all outcomes. 5. Faculty self-assessment provides self-assessment data on all outcomes.

Revision History: March, 2002; May, 2005; August, 2005; March, 2007; July 2010