COURSE #: NERS 421 **CREDITS:** 3/Elective	**COURSE TITLE:** Nuclear Engineering Materials
TERMS OFFERED: Fall	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advise**
TEXTBOOKS/REQUIRED MATERIAL: Course Pack	**PREREQUISITES:** NERS 312, MSE 220 or MSE 250 (A)
INSTRUCTOR(S): Michael Atzmon	**COGNIZANT FACULTY:** Michael Atzmon
CoE BULLETIN DESCRIPTION: An introduction to materials used in nuclear systems and radiation effects in materials (metals, ceramics, semiconductors, organics) due to neutrons, charged particles, electrons and photons.	**COURSE TOPICS:** Background on thermodynamics, crystal structure, defects, diffusion, phase transformations and mechanical behavior, neutron-nuclear interactions, displacement theory, cross-sections, displac rates, spikes, defects, diffusion and radiation enhanced diffusion, radiation induced segregation, void swelling, hardeni embrittlement, creep and growth, fuels

COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 80 minutes

COURSE OBJECTIV For each Course Objective, links to the Program Educational Objectives are shown	1. Teach students the fundamentals of crystal structure, phase diragrams, diffusion and mechanical properties of solids [1,2] 2. Teach students the fundamentals of materials behavior under irradiation [1,2] 3. Teach students methods of calculating displacement rates in irradiated solids [1,2,] 4. Make students familiar with approaches to materials selection for fuels and waste forms [1,2] 5. To provide links for students between the disciplines of materials science and nuclear engineering [1,2,3] 6. To provide experience for students to practice written communication skills [3]
COURSE OUTCOME For each Course Outcome, links to the Program/ABET Student Outcomes are Shown [#,a-k]	1. Calculate differential angular and energy-transfer scattering cross sections for simple potentials [1,2|ABET a,k] 2. Derive expressions for the number of displacements resulting from an energetic particle [1,2|ABET a,k] 3. Derive expressions for the displacement rate in a solid for given irradiation parameters [1,2|ABET a,k] 4. Derive expressions for defect concentrations in irradiated solids [1,2|ABET a,k] 5. Describe and express quantitatively defect migration under irradiation and the process leading to segregation and swelling [1,2|ABET a,k] 6. Explain the changes in mechanical behavior resulting from radiation-induced defects [1,2|ABET a,k] 7. Describe the selection criteria for nuclear fuel materials [1,2|ABET a,k] 8. Perform simple geometric calculations in crystal lattices [1,2|ABET a,k] 9. Calculate diffusion coefficients and solve simple diffusion problems [1,2|ABET a,k] 10. Perform simple phase diagram calculations [1,2|ABET a,k] 11. Perform stress/strain calculations [1,2|ABET a,k] 12. Perform cladding corrosions calculations [1,2|ABET a,k]
ASSESSMENT TOOI For each assessment tool, links to the Course Outcomes are identified	1. Exams given during the semester and at its end, measure all outcomes under time constraint. 2. Weekly/biweekly assigned problem sets measure all outcomes under less time pressure and with collaboration between students with assistance from instructor. 3. Course evaluations by each student at the end of the course assess all outcomes. 4. Faculty self-assessment provides self-assessment data on all outcomes.

Revision History: September, 1998; March, 2002; December, 2004; August, 2005; October 2005; May 2011