Degree Program: Nuclear Engineering and Radiological Sciences **Date:** May, 2005
Prepared by: Terry Kammash

COURSE #: NERS 472 NON-ACTIVE COURSE	**COURSE TITLE:** Fusion Reactor Technology
TERMS OFFERED: Winter	**For each prerequisite below, "E" denotes Enforced and "A" denotes Advised.**
TEXTBOOKS/REQUIRED MATERIAL:	**PREREQUISITES:** NERS 471 (A)
INSTRUCTOR(S):	**COGNIZANT FACULTY: Kammash**
CoE BULLETIN DESCRIPTION: Study of technological topics relevant to the engineering feasibility of fusion reactors as power sources. Energy and particle balances in fusion reactors, neutronics and tritium breeding, various approaches to plasma heating, heat removal and environmental aspects.	**COURSE TOPICS:** Basic processes and balances in fusion reactions, fuel cycles and burn-up fractions, Neutronics, tritium breeding and blanket-design, Plasma heating by neutral beams, Plasma heating by adiabatic compression, Reactor fueling, pellet fueling, pellet ablation, Dynamics and control of fusion reactors, feedback control and thermal instabilities, Systems analysis of fusion reactors, feedback control and thermal instabilities, Heat removal from reactors, MHD flow, pumping power, stress considerations in coolant ducts, Interface between confinement physics and heat removal aspects
COURSE STRUCTURE/SCHEDULE Lecture: 2 per week @ 80 minutes	

COURSE OBJECTIVES	Links shown in brackets are to departmental educational outcomes: 1. To teach students fusion and radiation processes in fusion reactors including various fuel cycles and corresponding burn-up fractions.[1,2] 2. To teach students the elements of fusion reactors blanket design including neutronics, tritium breeding and radioactivity generated.[2] 3. To teach students various methods employed in heating plasma to thermonuclear temperatures with emphasis on neutral beam heating and adiabatic compression as applied to tokamaks.[2] 4. To teach students various approaches to reactor fueling with emphasis in pellet-fueling.[2] 5. To teach students the current approaches to the control of fusion reactors including feedback control.[1,2] 6. To teach students the methods of removal from fusion reactors and its impact on operations and efficiency of the power plant.[2] 7. To teach students systems analysis of a fusion power plant and the important components that reflect on its efficiency. [2]
COURSE OUTCOMES For each course outcome, links to the Program Outcomes are identified.	Links shown in brackets are to course objectives: 1. Demonstrate a working knowledge of the underlying principles of an operating fusion reactor.[2] 2. Demonstrate understanding of the neutronics and radioactivity associated with fusion reactors.[3,4] 3. Demonstrate knowledge of the approaches employed in heating the plasma to ignition.[1] 4. Demonstrate knowledge of the plasma dynamics and control in a fusion reactor.[1,2,3] 5. Demonstrate knowledge of reactor startup and fueling[2,3] 6. Demonstrate understanding of the means by which heat is removed and ultimately converted to electric power.[3,4] 7. Demonstrate knowledge of systems analysis of a fusion power plant and the relationship between the various components that make up the plant.[5]
ASSESSMENT TOOLS For each assessment tool, links to the course outcomes are identified.	9. Exams given during the semester and at its end, measure all outcomes under time constraint. 10. Problem sets measure all outcomes under less time pressure and with collaboration between students with assistance from instructor. 11. Course evaluation by each student at the end of the course assess all outcomes.

Revision History: September, 1998