United States Naval Academy
Mechanical Engineering Department

Catalog Description: EM468 Nuclear Energy Conversion **Credit:** 3 (3-0-3)
Designation: Elective, engineering major

Principles of the conversion of nuclear energy into useful power are covered. Various types of nuclear power plants, their design, cycles, load following characteristics, etc., are studied. Advanced nuclear energy systems, including fusion, and direct nuclear energy conversion systems are also studied.

Prerequisites: Reactor Physics I

Corequisites: none

Textbooks: M.M. El-Wakil, *Nuclear Energy Conversion*, American Nuclear Society, 1982.

Course Director: Professor Mark J. Harper

Course Content:

No.	Topic or Subtopic	hrs.
1	Nuclear Reaction Rates	6
2	Reactor Heat Transfers	2
3	Thermodynamics of reactor power systems	4
4	Boiling Water Reactors	4
5	Pressurized Water Reactors	4
6	Gas Cooled Reactors	4
7	Breeder Reactor Systems	4
8	Isotopic Heat Sources	3
9	Direct Energy Conversion systems	3
10	Nonproliferation Issues	3
11	Environmental Effects and Considerations	3
12	Fusion Power Systems	2

Assessment Methods:

		YES	NO
A	Quizzes	X	
B	Homework	X	
C	Exams	X	
D	Laboratory Reports		X
E	Oral Presentations	X	
F	Design Reports/Notebooks	X	
G	Prototypes/Demonstrations		X
H	Projects	X	
I	Other		X

Course Outcomes[1]

1. Determine nuclear reaction rates, taking into account neutron flux distribution due to geometry and materials. (A, B, C)
2. Evaluate reactor heat rates for different fuel geometries, including the calculations of key temperatures. (A, B, C)
3. Apply general thermodynamic concepts to nuclear power plant systems, including Carnot cycle limitations. (A, B, C)
4. Perform detailed thermodynamic analyses on the following nuclear power systems: boiling water reactors, pressurized water reactors, and gas cooled reactors. (A, B, C)
5. Evaluate nuclear isotopic heat sources that are used in direct energy conversion systems such as RTGs. (A, B, C, E, F, H)
6. Understand the basic concepts of future nuclear energy systems, including fusion and other novel systems. (A, B, C, E, F, H)
7. Discuss the factors affecting and concerns related to proliferation of nuclear material, with particular emphasis on dual use technologies common to power plants and nuclear weapons. (A, B, C, E, F, H)
8. Understand and explain the environmental factors and impacts related to the front end, operation, and back end of the nuclear fuel cycle. (A, B, C, H)

[1] Letters in parenthesis refer to the assessment methods listed in the previous section.

	Course Outcomes							
Program Outcomes	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a)	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
(b)								
(c)				**X**	**X**	**X**	**X**	**X**
(d)						**X**	**X**	
(e)				**X**	**X**	**X**	**X**	**X**
(f)							**X**	**X**
(g)						**X**	**X**	**X**
(h)						**X**	**X**	**X**
(i)								
(j)							**X**	**X**
(k)								

Date of Latest Revision: 29 April 2010, Professor Mark J. Harper