United States Naval Academy
Mechanical Engineering Department

Catalog Description: EM362 Reactor Physics I **Credit:** 3 (3-0-3)
Designation: Elective, major

An introductory course in radiation physics and nuclear reactors. Course covers topics in atomic models, different types of radiation and their interaction with matter, radioactivity, fission process, neutron diffusion, and reactor criticality concepts for bare and reflected homogeneous systems.

Prerequisites: SP212- General Physics II or SP222, Electricity and Magnetism I

Corequisites: **None**

Textbooks: John .R.LaMarsh and Anthony J. Baratta, Introduction to Nuclear Engineering, 3rd Edition, Prentice Hall

Course Director: Professor Martin E. Nelson

Course Content:

No.	Topic or Subtopic	hrs.
1	Nuclear Physics	5
2	Radioactivity	2
3	Nuclear reactions	2
4	Neutron interactions with matter	6
5	Nuclear fission	5
6	Gamma ray and charged particle interactions with matter	4
7	Neutron transport in non-multiplying media	5
8	Reactor criticality in infinite medium	1
9	Neutron diffusion theory	3
10	Reactor criticality in finite medium	3
11	Reflected reactors	1

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.	describe radioactivity decay processes and perform basic calculations related to simple decay, production/decay, and secular decay.
2.	describe nuclear reactions and relativity theory and apply the fundamental conservation equations to balance reactions, calculate Q-values, and particle kinetic energies.
3.	describe the basic characteristics of the fission process such as threshold energy requirements, radiation released, and energy release. .
4.	describe basic neutron interactions with matter including moderation, collision density, and cross section characteristics..
5.	calculate reactor power, fuel consumption rate, and fission product activity.
6.	describe basic gamma and charge particle interactions with matter and calculate their uncollided attenuation with shielding,
7.	describe basic neutron transport in a vacuum or a diffusing medium from a neutron source and calculate the resulting flux and current.
8.	describe the neutron life cycle and calculate the factors in the six factor formula.
9.	calculate the critical mass of a bare or reflected reactor.
10.	identify the basic materials and isotopes that would be required to make a nuclear reactor.

[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)	(9)	(10)
(a)	X	X	X	X	X	X	X	X	X	X
(b)										
(c)				X	X	X		X	X	X
(d)										
(e)	X	X	X	X	X	X	X	X	X	X
(f)										
(g)										X
(h)					X					
(i)					X					
(j)		X	X		X	X			X	X
(k)				X	X	X		X		

Date of Latest Revision: 28 APR 2010, Professor Martin E. Nelson