

ER301 Fundamentals of Nuclear Engineering

**United States Naval Academy
Mechanical Engineering Department
ER301 Fundamentals of Nuclear Engineering**

Catalog Description: ER301 Fundamentals of Nuclear Engineering **Credit:** 3 (3-0-3)

An introductory course in the basics of nuclear engineering and radiological sciences.

Subject areas include the basics in radiation physics, nuclear core physics, nuclear plant design, the fuel cycle and radiological health physics.

Prerequisites: SP211 (or equivalent)

Corequisites: SP212 (or equivalent)

Textbooks: Fundamentals of Nuclear Science and Engineering, Second Edition, Shultis and Faw

Supplemental Material:

(1) NAVSEA Applied Engineering Principles Manual, Chapter 3.

(2) Nuclear Engineering Handbook, Edited by K.D. Kok, CRC Press.

(3) Introduction to Nuclear Engineering, Third Edition, Lamarsh and Baratta.

Course Director: Professor Mark M. Murray

Course Content:

No.	Topic or Subtopic	hrs.
1.	Basic Nuclear/Radiological Applications	4
2.	Types of Radiation and Sources	3
3.	Radioactivity and Decay	2
4.	Radiation Interaction with Matter	4
5.	Radiation Detection	3
6.	Nuclear Fission and Mass Defect	2
7.	Micro/Macro Cross Sections	2
8.	Core Physical Design (Fuel/Moderator/Poisons)	3
9.	Neutron Life Cycle	2
10.	Reactor Physics	3
11.	PWR and BWR Plant Design	4
12.	Thermo/Hydraulic Considerations	1
13.	Reactor Safety and Containment	2
14.	Biological Effects of Radiation	2
15.	Exposure and Dose	2
16.	Minimization of Exposure	1
17.	Fuel Cycle Front End (Mining/Enrichment)	2
18.	Fuel Cycle Back End (Reprocessing/Spent Fuel Disposal)	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 Outcomes¹ :

1. Students will demonstrate an understanding of the basic types of radiation including the sources of radiation, radioactive decay, interaction with matter and detection. (A,B,C)
2. Students will demonstrate the ability to solve radiation problems involving radioactive decay and shielding. (A,B,C)
3. Students will demonstrate an understanding of mechanism of power production in a nuclear reactor including fission, neutron life cycle, criticality, moderation, temperature coefficient of reactivity and control. (A,B,C)
4. Students will demonstrate the ability to solve reactor physics problems involving mass defect, fission reaction rates and the six factor formula. (A,B,C)
5. Students will demonstrate an understanding of the basic design of nuclear power plants including PWR's, BWR's and other reactors, and the thermal, hydraulic, safety and containment issues associated with each. (A,B,C)
6. Students will demonstrate the ability to solve basic thermodynamic, fluid dynamic and heat transfer problems associated with nuclear power plants. (A,B,C)
7. Students will demonstrate an understanding of the basics of radiological health physics including biological effects of radiation, dose and exposure, and the concept of dose minimization. (A,B,C)
8. Students will demonstrate the ability to solve radiological health physics problems involving dose rate and minimization of exposure.(A,B,C)
9. Students will demonstrate an understanding of the nuclear fuel cycle including mining, enrichment, reprocessing and spent fuel disposal. (A,B,C)

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

Program Outcomes	Course Outcomes								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(a)	X	X	X	X	X	X	X	X	X
(b)									
(c)									
(d)									
(e)		X		X		X		X	
(f)									
(g)									
(h)							X		X
(i)									
(j)					X		X		X
(k)									

Date of Latest Revision: 20 APR 2017