United States Naval Academy
Mechanical Engineering Department
ER463 Radiation Engineering

Catalog Description: ER463 Radiation Engineering **Credit:** 3 (2-2-3)
An introductory course in basic radiation detection and measurement systems. Subject areas include radiation statistics, data analysis, gas-filled detectors, scintillation detectors, semi-conductor detectors, gamma and charged particle spectroscopy, signal processing and electronics, neutron detection techniques, activation analysis, neutron generators, and radiation detection applications.

Prerequisites: ER301(Fundamentals of Nuclear Engineering)
Corequisites: None

Textbooks: *Radiation Detection and Measurement*, 4th edition, Knoll, 2010.

Supplemental Material:
(1) Principles and Applications of Liquid Scintillation Counting, National Diagnostics
(2) CRC Handbook of Fast Neutron Generators, Volume II, Edited by J. Csikai, CRC Press.

Course Director: CDR Brad Baker

Course Content:
No. Topic or Subtopic hrs.
1. Radiation Statistics 4
2. Data Analysis 4
3. Gas Filled Detectors 4
4. Scintillation Detectors 4
5. Semi-Conductor Detectors 4
6. Charged Particle Detection 4
7. Gamma Spectroscopy 4
8. Signal Processing and Electronics 4
9. Neutron Detection Techniques 4
10. Activation Analysis 4
11. Liquid Scintillation 2
12. Neutron Generators 4
13. Experimental Design 4
14. Radiation Detection Applications 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. Students will demonstrate an understanding and solve problems associated with radiation detection systems including gas filled detectors, scintillation detectors, semi-conductor detectors and charged particle detectors. (A,B,C,D)
2. Students will demonstrate an understanding and solve problems associated with neutron detection and activation analysis. (A,B,C,D)
3. Students will demonstrate an understanding and solve problems associated with signal processing for gamma and charge particle spectroscopy. (A,B,C)
4. Students will demonstrate an understanding and solve problems associated with applications of radiation detection systems. (A,B,C)
5. Students will demonstrate the ability to use statistical methods to solve radiation engineering problems. (A,B,C,D)
6. Students will demonstrate the ability to collect data and analysis experimental results. (D,E)
7. Students will demonstrate the ability to clearly present laboratory results and design projects in written and oral reports.(D,E,F,H)
8. Students will demonstrate the ability to contribute to laboratory and design teams. (D,E,F,H)

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

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

Week	Date	Topic	Chapter
1	9-Jan	*Radiation Sources and Interactions* Mon: Lecture (Tue is Mon schedule) (L1) Fri: Lecture (L2) Lab: **Lab Walkthrough**	1,2
2	16-Jan	*Radiation Interactions* Mon: Holiday Fri: Lecture (L3) Lab: ***Lab#1: Using sources and detectors***	2,3
3	23-Jan	*Radiation Counting Statistics* Mon: Lecture (L4) Fri: Lecture (L5) Lab: ***Lab#2: Statistics and Background***	3
4	30-Jan	*Gas Filled Detectors* Mon: Lecture (L6) Fri: Lecture (L7) Lab: **Lab#3: Gas Filled Detectors and Gas Amp Curve (Full)**	5,6,7
5	6-Feb	Scintillation Detectors Mon: Lecture (L8) Fri: **Exam #1** Lab: **No Lab**, Lecture	8
6	13-Feb (6 weeks)	*Shielding* Mon: Lecture (L9) Fri: Lecture (L9) Lab: ***Lab#4: Shielding Calculations*** **(Full)**	-
7	20-Feb	*Gamma Spectroscopy* Mon: Holiday Fri: Lecture (L10) Lab: ***No Lab, Lecture***	10
8	27-Feb	*Semi-Conductor Detectors* Mon: Lecture (L11) Fri: Lecture (L12) Lab: **Lab#5: High Purity Germanium Detectors**	11
9	6-Mar	*Neutron Detection and Techniques* Mon: Lecture (L13) Fri: **Exam #2** Lab: ***Lab#6: Neutron proportional counters***	14, 15
Spring Break			
10	20-Mar	*Liquid Scintillation and Project Introduction* Mon: Lecture (L14) Fri: Literature Review Session (Ni 108) Lab: ***Lab#7: Liquid Scintillation Lab***	8
11	27-Mar	*Neutron Generators* Mon: Lecture (L16) Fri: Lecture (L16) Lab: ***Lab#9: Neutron Generator Lab***	-
12	3-Apr (12 weeks)	*Activation Analysis* Mon: Lecture (L15) Fri: No class (Project Time) Lab: ***Lab#8: Copper Activation Analysis (Full)***	-
13	10-Apr	*Signal Processing and Electronics* Mon: Lecture (L17) Fri: Lecture (L18) Lab: ***Project Time***	16, 17, 18
14	17-Apr	Radiation Detection Applications Mon: Lecture (L19) Fri: Lecture (L20) Lab: ***Lab#10: AmBe Activation Lab***	-
15	24-Apr	*Project Presentations* Mon: Project time Fri: Project time Lab: Student project presentations (Capstone Day Wed 4/26/17)	-
16	1-May	*Review* Mon: Last day of class Lab: Review	-