Jordan University of Science and Technology

Faculty of Engineering

Nuclear Engineering Department

NE471 Radiation Interactions & Shielding Design
First Semester 2019-2020

Course Catalog
3 Credit Hours. Basic principles of radiation interactions and transport, especially as related to the design of radiation shields. Radiation sources, nuclear reactions, radiation transport, photon interactions, dosimetry, buildup factors and fast neutron shielding.

Text Book	
Title	Radiation Shielding
Author(s)	J. Kenneth Shultis & Richard E. Faw
Edition	1st Edition
Short Name	Ref #1
Other Information	

Course References

Short name	Book name	Author(s)	Edition	Other Information
Ref #2	Introduction to Nuclear Engineering	John R. Lamarsh, Anthony J. Baratta	3rd Edition	

Instructor	
Name	**Dr. Salaheddin Malkawi**
Office Location	E2L2
Office Hours	Sun : 11:30 - 13:30 Mon : 08:00 - 09:00 Tue : 09:30 - 10:30 Tue : 12:00 - 14:00 Thu : 09:30 - 10:30 Thu : 11:30 - 12:30
Email	salahm@just.edu.jo

Class Schedule & Room
Section 1: Lecture Time: Sun, Tue, Thu : 08:30 - 09:30 Room: E2113

Prerequisites		
Line Number	**Course Name**	**Prerequisite Type**
2003110	NE311 Ionizing Radiation & Measurement	Prerequisite / Study

Tentative List of Topics Covered		
Weeks	**Topic**	**References**
Week 1	Characterization of Radiation Fields and Sources	**Ch 2** From **Ref #1**
Weeks 2, 3	Review of Interaction of Radiation with Matter	**Ch 3** From **Ref #1**
Weeks 3, 4	Radiation Sources Encountered in Shield Design	**Ch 4** From **Ref #1**
Weeks 5, 6	Response functions	**Ch 5** From **Ref #1**
Weeks 7, 8, 9	Methods for Radiation Dose Calculations	**Ch 6** From **Ref #1**
Weeks 10, 11, 12	Special techniques for photons	**Ch 7** From **Ref #1**
Weeks 12, 13, 14	Special Techniques for Neutrons	**Ch 8** From **Ref #1**
Weeks 15, 16	Special techniques for charged particles	**Ch 9** From **Ref #1**

Mapping of Course Outcomes to Program Student Outcomes	Course Outcome Weight (Out of 100%)	Assessment method
Characterizing radiation fields in space in terms of fluence and flow and realizing spatial variation of the joint distribution of particle energy and direction with ability to analyze the major reactions energy transfer for common radiation sources encountered in shield design [11]	16%	
Linking between the physical description of radiation field (fluence or flux) and various measures of radiation sensor response (dose) by deriving response functions using specific methods starting from cross-section data and connecting radiation fluence/flux with effective dose for human (phantom) body at varied situations and verifying the conservative choices [11]	18%	
Calculating uncollided radiation and response for several distributed sources and shielding configurations with demonstrating ability of applying the superposition technique and the point kernel in terms of dose calculations [11, 12, 14]	18%	

Designing a proper shielding for photon sources at varied geometries by deriving the proper relations for response functions starting from differential elements and using buildup factor tabulated data, attenuation factors, linear deposition coefficients, skyshine and albedo methods [11, 12, 14]	18%	
Apply a complete a treatment of neutron shielding design using neutron cross sections and quantifying the neutron moderation and energy transfer to matter, applying simplified techniques for fast neutron shielding design [11, 12, 14]	18%	
Evaluate the spatial distribution of absorbed dose arising from charged particle sources in different geometries [11, 12, 14]	12%	

Relationship to Program Student Outcomes (Out of 100%)						
1	2	3	4	5	6	7
56	22		22			

Evaluation	
Assessment Tool	**Weight**
Midterm Exam Theory	10%
Midterm Exam Practical	15%
Final Exam	40%
Performance, Reports, Quizzes, Class Participation and Homeworks	35%

Policy	
Quizzes	Quizzes will be given at the end of selected classes to measure the understanding of the basic principles.

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