Jordan University of Science and Technology

Faculty of Engineering

Nuclear Engineering Department

NE472 Modelling & Simulation Of Nuclear Reactors - JNQF Level: 7
Second Semester 2024-2025

Course Catalog
3 Credit Hours. Modeling of nuclear reactor neutronics and nuclear reactor thermal hydraulics. Simulation for the different physics of nuclear reactors by numerically solving initial value problems, boundary value problems and partial differential equations. Analysis of radiation transport problems by Monte Carlo method, use of MCNP code to determine several parameters of a nuclear reactor.
Teaching Method: On Campus

Text Book	
Title	Class Notes
Author(s)	Instructor
Edition	2nd Edition
Short Name	Ref #1
Other Information	

Course References

Short name	Book name	Author(s)	Edition	Other Information
Ref #2	Nuclear Reactor Analysis	James J. Duderstadt, Louis J. Hamilton	1st Edition	
Ref #3	Finite Difference Methods for Ordinary and Partial Differential Equations	Randall J. LeVeque	1st Edition	
Ref #4	Finite Volume Methods for Hyperbolic Problems	Randall J. LeVeque	1st Edition	
Ref #5	Monte Carlo Principles and Neutron Transport Problems	Jerome Spanier, Ely M. Gelbard	3rd Edition	

Instructor

Name	**Dr. RABIE ABU SALEEM**
Office Location	N1 L-2
Office Hours	
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Class Schedule & Room
Section 1: Lecture Time: Sun, Tue, Thu : 12:00 - 13:00 Room: E2113

Prerequisites

Line Number	Course Name	Prerequisite Type
2004410	NE441 Nuclear Reactors Analysis	Prerequisite / Study
2004710	NE471 Radiation Interactions & Shielding Design	Prerequisite / Study

Tentative List of Topics Covered

Weeks	Topic	References
Week 1	Basics of Modeling and Models of Nuclear Reactors.	From **Ref #1**
Week 3	Basics of Numerical Discretization and Numerical Solutions of Initial Value Problems.	
Weeks 4, 5	Numerical Solutions of Boundary Value Problems.	
Weeks 6, 7, 8, 9, 10	Numerical Solution of Partial Differential Equations.	
Weeks 11, 12	Introduction to Monte-Carlo methods.	
Weeks 13, 14, 15, 16	Introduction to MCNP5.	

Mapping of Course Outcomes to Program Outcomes and NQF Outcomes	Course Outcome Weight (Out of 100%)	Assessment method
Derive mathematical models for different physical phenomena and to demonstrate a good understanding of the different mathematical models used in a nuclear reactor [1SO1] [1L7K1]	9%	
Derive numerical approximations for derivatives, determine their order of accuracy and use them to write programming codes that solve initial and boundary value problems [1SO1] [1L7S1]	24%	

Implement, through coding, different numerical schemes to solve Hyperbolic, Parabolic and Elliptic partial differential equations, and perform different analysis methods on those numerical schemes like the modified equation analysis and the Von-Neumann stability analysis [1SO2] [1L7S3]	36%	
Demonstrate a good understanding of the basic concepts of Monte Carlo methods and perform simple Monte Carlo calculations [1SO1] [1L7S1]	13%	
Create input scripts for MCNP5 and analyze output files to calculate the flux distribution, and K_eff parameters [1SO2] [1L7S3]	18%	

Relationship to Program Student Outcomes (Out of 100%)						
SO1	SO2	SO3	SO4	SO5	SO6	SO7
46	54					

Relationship to NQF Outcomes (Out of 100%)		
L7K1	L7S1	L7S3
9	37	54

Evaluation	
Assessment Tool	**Weight**
First Exam	20%
Second Exam	20%
Projects	20%
Final Exam	40%

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