University of Management and Technology

School of Science

Department of Physics

Course Code: PH 7252
Course Title: INTRODUCTION TO NUCLEAR SCIENCE
Program: MS (PH)/PHD (PHY)

Course Outline (Spring Semester 2024)

Lecture Schedule	Sunday (09:00 a.m. – 12:00 p.m.)	Pre-requisite	Graduate Standing
Course Instructor	Dr. Zaheer Hussain Shah	**Contact**	zaheer.hussain@umt.edu.pk
Course Description	Atomic and nuclear Physics, Radioactive decay, Radioactivity calculations, Nuclear reactions and binding energy, Neutron interactions, Neutron attenuation, Neutron flux, Energy loss in scattering collisions, The fission chain reaction, Nuclear reactor fuel, Components of nuclear power plants and nuclear reactors, Power reactors and nuclear steam supply systems, Nuclear cycles and isotope separation, Fuel reprocessing and radioactive waste disposal, Fick's law, Continuity equation and diffusion equation, Group diffusion method, Thermal Neutron diffusion, Two group calculation of neutron moderation.		
Expected Outcomes	The purpose of this course is ➢ to provide graduate education for students interested in developing new nuclear technologies for the benefit of society and the environment and in advancing the intellectual frontiers of the field. ➢ to develop new tools for exploring, modeling and controlling complex nuclear and radiation processes which are laying in the application of nuclear technologies in medicine and industry. ➢ to introduce the fission technology which is entering a new era in which upgraded existing plants, new-generation reactors, and new fuel cycle technologies and strategies will contribute to meet the rapidly growing global demand for safe and cost-competitive low-carbon electricity supplies. ➢ to provide the knowledge about the nuclear power plant systems and application of nuclear energy. ➢ to describe most of the reactors currently in production or under development.		
Text Book	Introduction to Nuclear Engineering, Latest Edition by Jhon R. Lamarsh and Anthony J. Bratta, Prentice Hall, Inc. Upper Saddle River, New Jersey, USA.		
Reference Book	Nuclear Energy: An Introduction to the Concepts, Systems, and Applications of Nuclear Processes, 6th Edition by Raymond L. Murray, Elsevier Inc. USA, 2009.		
Assignments	Problems will be assigned at regular intervals as an assignment.	**Quizzes**	All quizzes will be announced well before time. No make-ups will be offered for missed quizzes.
Mid Term Examination	A 90-minutes exam will cover all the material covered during the first half of the semester.	**Final Examination**	A 150-minutes exam will cover all the material covered during the semester.
Attendance Policy	Students missing more than 20% of the lectures will receive an "SA" grade in the course and will not be allowed to take final exam.		
Grading Policy	Assignment + Quizzes + Term Project and Presentation: 25% Mid Term Examination: 25% Final Examination: 50%		

Department of Physics
PH 7252 Introduction to Nuclear Science

Lecture Plan (Spring 2024)

Week	TOPICS	CH	SECTIONS
1	Introduction to Nuclear Energy , Nuclear Reactors and Power Plants	1	---
2	Atomic and Nuclear Physics, Energy and Matter Equivalence,	2	2.1-2.5
3	Nuclear Stability, Radioactive Decay and Radioactivity Calculations	2	2.6-2.9
4	Nuclear Reactions and Nuclear Models	2	2.10-2.14
5	Neutron Interactions and Neutron Attenuation	3	3.1-3.3
6	Neutron Flux and Neutron Cross-Section Data	3	3.4-3.5
7	Energy Loss in Scattering Collisions and Fission	3	3.6-3.7
8	γ-Ray Interactions with Matter and Charged Particles	3	3.8-3.9
9	The Fission Chain reaction and Nuclear Reactor Fuel	4	4.1-4.2
10	Non-Nuclear Components of Nuclear Power Plants and Components of Nuclear Reactors	4	4.3-4.4
11	Power Reactors and Nuclear Steam Supply Systems	4	4.5
12	Nuclear Cycles and Isotope Separation	4	4.6-4.7
13	Fuel Reprocessing and Radioactive Waste Disposal	4	4.8-4.9
14	Fick' Law, The Equation of Continuity and The Diffusion Equation	5	5.1-5.5
15	The Diffusion Length and Thermal Neutron Diffusion	5	5.6-5.10