University of Management and Technology

School of Science (SSC)

Department of Physics

Course Code: PH-417
Course Title: NUCLEAR PHYSICS
Program: BS (PH)

Course Outline (Spring Semester 2023)

Lecture Schedule	Monday (11:00 am – 12:15 pm) Wednesday (11:00 am – 12:15 pm)	**Pre-requisite**	Undergraduate Standing
Course Instructor	Dr. Zaheer Hussain Shah	**Contact**	zaheer.hussain@umt.edu.pk
Course Description	History, Introductory Terminology, Nuclear Properties, Nuclear Radius, Mass and Abundance of Nuclides, Nuclear Binding Energy, Nuclear Angular Momentum, Nuclear Electromagnetic Moments, Nuclear excited states, Radioactive Decay Law, Production of Radioactivity, Growth of daughter activities Types of Decay, Natural Radioactivity, Radioactive dating, Units for measuring Radiations, Why Alpha Decay occurs, Basic Alpha Decay Processes, Why Nuclear Fission, Characteristics of Fission, Energy in Fission, Controlled Fission Reaction, Fission reactor, Fusion, Fusion Reactor ,Accelerator , Electrostatic accelerator, Cyclotron , Synchrotron		
Expected Outcomes	Upon successful completion of this course, the student will be able to: *(Knowledge based)* ➢ demonstrate a knowledge of fundamental aspects of the structure of the nucleus, radioactive decay, nuclear reactions and the interaction of radiation and matter ➢ discuss nuclear physics connection with other physics disciplines – solid state, elementary particle physics, radiochemistry, astronomy etc. ➢ discuss nuclear physics applications in medical diagnostics and therapy, geology, archaeology ➢ describe experimental techniques used (or developed) for nuclear physics purposes (logic circuits, gamma cameras, semiconductor detectors) and discuss their influence on development of new technologies ➢ explore an application of nuclear physics and communicate their understanding to a group of their peers in a short presentation		
Text Book (TB)	Introductory Nuclear Physics, Kenneth S. Krane. Oregon State University USA. Rev. ed. Copyright © 1988, by John Wiley & Sons, Inc.		
Assignments	i). Problems will be assigned at regular intervals as an assignment. ii). Projects on different topics may also be assigned to the students. Marks will be deducted for late submission.	**Quizzes**	All quizzes will be announced well before time. No make-ups will be offered for missed quizzes.
Mid Term Examination	A 60-minutes exam will cover all the material covered during the first 14-16 lectures.	**Final Examination**	A 120-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 willnot be allowed to take final exam.		
Grading Policy	Assignment + Quizzes + Term Project + Presentations: 30% Mid Term Examination: 30% Final Examination: 40%		

Department of Physics

PH-417 Nuclear Physics

Lecture Plan (Spring 2023)

Week	Lecture #	TOPICS	CH	Sections
1	1	History, Introductory Terminology, Nuclear Properties	01	1 – 4
	2	Nuclear Radius	03	1
2	1	Mass and Abundance of Nuclides	03	2
	2	Nuclear Binding Energy	03	3
3	1	Nuclear Angular Momentum, Nuclear Electromagnetic Moments, Nuclear excited states	03	4– 6
	2	Radioactive Decay Law, Quantum Theory	06	1 – 2
4	1	Production of Radioactivity, Growth of daughter activities	06	3 – 4
	2	Types of Decay, Natural Radioactivity	06	5 – 6
5	1	Radioactive dating, Units for measuring Radiations	06	7 – 8
	2	Why Alpha Decay occurs, Basic Alpha Decay Processes	08	1 – 2
6	1	Alpha Decay systematic, Theory of Alpha emission	08	3 – 4
	2	Angular Momentum and Alpha decay spectroscopy	08	5 – 6
7	1	Energy release in beta decay, Fermi Theory	09	1 – 2
	2	Experimental Test of Fermi Theory	09	3
8	1	Angular Momentum and Parity selection rules	09	4
	2	Comparative Half-lives and Forbidden Decays	09	5
9	1	Energetic of gamma decay, Electromagnetic Radiations	10	1 – 2
	2	Angular Momentum and selection rules	10	3
10	1	Angular Distribution and Polarization measurements	10	5
	2	Internal Conversion, Life time for gamma emission	10	6 - 7
11	1	Types of reactions and conservation laws	11	1
	2	Energetic of Nuclear reactions, Isospins	11	2 - 3
12	1	Reaction Cross-section, Columbic and Nuclear Scattering	11	4 – 7
	2	Compound Nuclear and Direct Reactions	11	10 – 11
13	1	Why Nuclear Fission, Characteristics of Fission	13	5 - 7
	2	Energy in Fission, Controlled Fission Reaction	13	3 – 5
14	1	Fission Reactors, Fission Explosives	13	6 – 9
	2	Basic Fusion Process, Characteristics of Fusion	14	1 – 2
15	1	Controlled Fusion Reaction, Thermonuclear Weapons	14	4 – 5
	2	Revision		