Department of Physics,
School of Science,
University of Management and Technology
Course Outline (Fall Semester 2024)

Lecture Schedule	Monday (09:30 am – 10:45 am) Thursday (09:30 am – 10:45 am)	**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 have a solid understanding of the fundamental principles of nuclear physics and its applications. They would be ready for further study in related fields or careers in areas such as nuclear energy, medical physics, or materials science.		
Text Book (TB)	Introductory Nuclear Physics, Kenneth S. Krane. Oregon State University USA. Rev. ed. (Latest Edition) by John Wiley & Sons, Inc.		
Reference Book (RB)	Kaplan, “Nuclear Physics”, Addison-Wesley Publishing Company, Inc, Latest Edition, USA		
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.		
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 thematerial 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%		

Learning Outcomes:

Course Learning Outcomes (CLOs)

Here are some possible learning outcomes for an undergraduate course in nuclear physics. Upon successful completion of the course, the student should be able to:

CLO	CLO Statement	PLO	Learning Domain and level
1	**Apply** knowledge and understanding of the basic principles of nuclear physics, including nuclear structure, properties of nuclei, nuclear reactions, and radiation detection.	1	C1
2	**Analyze** solve basic problems in nuclear physics using mathematical and computational techniques, including nuclear decay, radioactivity, and nuclear fission and fusion.	2	C2
3	**Investigate** the applications of nuclear physics in areas such as energy production, medical imaging, and materials science.	3	C3
4	Learn and explain the theory and background behind different analytical techniques	4	C4

1. CLO – PLO MAPPING:

CLOs	Program Learning Outcomes (PLOs)											
	Scientific Knowledge	Problem Analysis	Conduct investigations of complex problems	Design / Development of Solutions	Science and Society	Environment and Sustainability	Ethics	Communication	Individual and Team Work	Lifelong Learning	Future Employability	Competency
	1	2	3	4	5	6	7	8	9	10	11	12
1	**C1**											
2		**C2**										
3			**C3**									
4										**C4**		

Lecture Plan (Fall 2024)

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		

Mapping of CLOs to Direct Assessments

CLOs▼	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Assignment 1/Quiz 5	Assignment 2/Quiz 6	Assignment 3/Quiz 7	Midterm Exam	Final Exam
1	✓							✓	✓
2		✓	✓		✓	✓		✓	✓
3				✓			✓	✓	✓

Faculty Signature ……. **Date……**

Chairman/Director signature……. **Date……**

Dean's signature…… **Date…….**