Course Title: Nuclear Physics-I
Course Code: 0533-322 [PHY-322]
Credit Hour: 03

(a) Detailed Lecture Plan:

Chapter 1: Basic Properties of Nuclei (Lectures 1–8)

1 Introduction to nuclear physics; nuclear size, radius, density
2 Packing fraction; mass defect
3 Binding energy and binding energy curve
4 Semi-empirical mass formula: derivation and applications
5 Semi-empirical mass formula: derivation and applications
6 Angular momentum; nuclear spin and parity
7 Electric and magnetic moments; nuclear force: origin and characteristics
8 Mid-term I

Chapter 2: Radioactivity (Lectures 9–14)

9 Radioactive decay laws; introduction to radioactivity
10 Half-life, mean life, activity; units of radioactivity
11 Measurement of decay constants; successive disintegration
12 Secular and transient equilibrium; natural radioactive series
13 Artificial radioactivity; production and applications of radioisotopes
14 Assignment or Quiz

Chapter 3: Radioactive Decay (Lectures 15–24)

15 Alpha decay: energy levels; alpha-particle spectra
16 Alpha absorption: range, stopping power, straggling
17 Geiger–Nuttall law; quantum tunneling in alpha decay
18 Beta decay types (β^-, β^+, EC) and beta spectra
19 Conservation laws in beta decay; neutrino hypothesis
20 Fermi theory of beta decay
21 Beta absorption; range–energy relationships
22 Gamma-ray spectra; nuclear energy-level transitions
23 Gamma decay; internal conversion
24 Mean life and lifetime calculations for gamma emission

** Announcement of the Presentation Schedule **

Chapter 4: Nuclear Reactions (Lectures 25–30)

25 Introduction to nuclear reactions; reaction types
26 Conservation of physical quantities in nuclear reactions
27 *Q*-value equation and threshold energies
28 Nuclear cross-section: definition and measurement
29 Compound nucleus hypothesis
30 Mid-term II

Chapter 5: Nuclear Fission and Fusion (Lectures 31–35)

31 Introduction to nuclear fission; liquid drop model
32 Energy release; fragment mass and energy distributions
33 Prompt and delayed neutrons; fission chain reactions
34 Controlled and uncontrolled fission; reactor basics
35 Nuclear fusion processes; thermonuclear reactions in stars

Chapter 6: Detectors and Accelerators (Lectures 36–39)

36 Ionization chamber: construction and operation
37 Geiger–Mueller counter: characteristics and applications
38 Scintillation detectors: NaI(Tl), organic scintillators
39 Accelerators: Van de Graff, cyclotron, synchrotron

(b) Books:

1. Nuclear Physics (2^{nd} Edition) by Irving Kaplan, Addison-Wesley Pub. Co.
2. Concepts of Modern Physics (6^{th} Edition) by Arthur Beiser, McGraw-Hill.
3. Fundamentals of physics (10^{th} Edition) by Jearl Walker, David Halliday, Robert Resnick, Wiley.
4. Elements of Nuclear Physics by Walter E. Meyerhof, McGraw-Hill.
5. Nuclear Physics by S. N. Ghoshal, S Chand.