241/PHY/MD101-A

Detailed Syllabi of Pool Courses for M. Sc. (Physics)

Semester-I

Multidisciplinary Course

COURSE ID: 241/PHY/MD101

MODERN PHYSICS

Max. Marks: 50
Internal Assessment: 25

Credit: 3
Time: 2 Hours

Note: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist of at least 4 parts covering entire syllabus. The question paper is expected to contain problems to the extent of 20% of total marks. The examinee will be required to attempt 5 questions; selecting one question from each unit and the compulsory.

Course Outcomes:

After successful completion of the course on Modern Physics, a student will be able to:

- *Understand the quantum theory of light and wave-particle duality.*
- *Describe Heisenberg uncertainty principle and linear superposition principle.*
- *Solve the Schrödinger equation for simple systems and interpret wave functions in terms of probabilities and normalization.*
- *Distinguish between different types of radioactive decays.*

Unit-I

Blackbody Radiation, Planck's proposition and quantum theory of light, Photoelectric effect, Compton scattering, Pair Production, De Broglie Waves, Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and the relation between them. Two-Slit experiment with electrons, Probability, Wave amplitude and wave functions, Rutherford Model, Bohr model of atom, Explanation of Hydrogen spectra

Unit-II

Position measurement- gamma-ray microscope thought experiment; Heisenberg uncertainty principle: its application for estimating minimum energy of a confined particle, Energy-time uncertainty principal application to virtual particles and range of interaction. Two slit interference experiment with photons; Wave-particle duality, Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

Ranjit

Unit-III

Solution of Schrodinger equation for one-dimensional problems: One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension-across a step potential & rectangular potential barrier.

Unit-IV

Nuclear Decay: Stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta-decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma-ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.

Lasers: Basic principle of lasers, Spontaneous and Stimulated emissions. population inversion, Einstein's A and B coefficients. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser.

References/Books:

1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
2. Modern Physics, John R. Taylor, Chris D. Zafiratos, M. A. Dubson,2009, PHI Learning
3. Six Ideas that Shaped Physics: Particle Behave like Waves, T. A. Moore, 2003, McGraw Hill
4. Quantum Physics, Berkeley Physics Course, Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
5. Modern Physics, R.A. Serway, C.J. Moses, and C.A. Moyer, 2005, Cengage Learning. Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill

Discipline-Specific Course(s)

(Choose one out of 241/PHY/DS101 & 241/PHY/DS102 Options)

COURSE ID: 241/PHY/DS101

ELECTRONICS

Marks (Theory): 50 **Credits: 3**

Marks (Internal Assessment): 25 **Time: 2 Hours**

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Course Outcomes:

Ranjit