

B.Sc.-III (Physics)
Semester – V

Physics – PH-502

Paper – X : Nuclear Physics

Max. Marks: 40
Internal Assessment: 10
Time: 3 hours

Note:-

1. Nine Questions will be set in total.
2. Question number 1 will be compulsory and will be based on the conceptual aspects of entire syllabus. This question may have five parts and the answer should be in brief but not in Yes/ No.
3. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit I: Nuclear Structure and Properties of Nuclei

Nuclear composition (p-e and p-n hypotheses), Nuclear properties; Nuclear size, spin, parity, statistics, magnetic dipole moment, quadruple moment (shape concept).

Determination of mass by Bain-Bridge, Bain-Bridge and Jordan mass spectrograph. Determination of charge by Mosley Law. Determination of size of nuclei by Rutherford Back Scattering. mass and binding energy, systematic of nuclear binding energy, nuclear stability

Unit II: Nuclear Radiation decay Processes

Alpha-disintegration and its theory. Energetics of alpha-decay, Origin of continuous beta spectrum (neutrino hypothesis), types of beta-decay and energetics of beta-decay. Nature of gamma rays, Energetics of gamma rays.

Radiation interaction

Interaction of heavy charged particles (Alpha particles); Energy loss of heavy charged particle (idea of Bethe formula, no derivation), Range and straggling of alpha particles. Geiger-Nuttal law. Interaction of light charged particle (Beta-particle), Energy loss of beta-particles (ionization), Range of electrons, absorption of beta-particles. Interaction of Gamma Ray; Passage of Gamma radiations through matter (Photoelectric, Compton and pair production effect) electron-positron annihilation. Absorption of Gamma rays (Mass attenuation coefficient) and its application.

Unit III: Nuclear Accelerators

Linear accelerator, Tandem accelerator, Cyclotron and Betatron accelerators.

Nuclear Radiation Detectors.

Gas filled counters; Ionization chamber, proportional counter, G.M. Counter (detailed study), Scintillation counter and semiconductor detector.

Unit IV:

Nuclear reactions.

Nuclear reactions, Elastic scattering, Inelastic scattering, Nuclear disintegration, Photoneuclear reaction, Radiative capture, Direct reaction, Heavy ion reactions and spallation Reactions. Conservation laws, Q-value and reaction threshold.

Nuclear Reactors.

Nuclear Reactors, General aspects of Reactor Design. Nuclear fission and fusion reactors,(Principle, construction, working and use).

References:

1 Kaplan I, Nuclear Physics, 2nd Ed (1962), Oxford and IBH, New Delhi

Sriram K, Nuclear Measurement Techniques, (1986), AEWP, New Delhi
Tayal D C, Nuclear Physics (1994), HPH, Bom