SEMESTER - II

Paper - III : Applied Nuclear Science

Max. Marks: 55
Time: 3 Hrs.

Note: Nine questions will be set and students will attempt 5 questions. Question No. 1 will be compulsory consisting of 4 parts based on the conceptual aspects of the whole syllabus. The answers should not be in yes/no. In addition to Question No. 1 there will be four Units in the question-paper each containing two questions belonging to four Units in the syllabus. Students will select one question from each unit.

UNIT - I

Qualitative description of various modes of energy loss of a charged particles in matter, Classical stopping power equation for electronic energy-loss (no derivation) with significance of various terms involved, Behaviour of electronic energy-loss curve as a function of ion velocity, Concept of energy and range straggling;

Interaction of gamma radiation with matter outlining the features of Photoelectric, Compton and Pair production processes, Linear and mass attenuation coefficients of gamma rays in matter, Positron annihilation in matter.

UNIT - II

Basic principle and mechanism of GM Counter, The Geiger discharge, Development of pulse and quenching, dead time, Geiger plateau, counting efficiency.
Scintillation detectors: The absorption process, Scintillation process, Pulse formation, Mechanism of scintillations detectors, Energy resolution of scintillation detectors.
Silicon Surface barrier detector: Basic principle, construction, working and applications
Li drifted Ge and Si detectors: Basic consideration, Basic principle, construction, working and applications. Energy resolution, Fano factor, Sensitivity and efficiency
HPGe detector: Basic principle, construction and working.

UNIT - III

Neutron sources: α-beryllium source, Radium-beryllium source, plutonium-beryllium source, Americium-beryllium source, Photo neutron source, Reactors - as neutron source, Nuclear reactions - as neutron source.
Classification of neutrons on the basis of energy, Prompt and delayed neutrons, Neutron moderators and their properties, Dynamics of elastic scattering of neutrons, Angular distribution of neutrons, Average logarithmic decrement in energy of neutrons, Slowing down power of moderator, Moderating ratio, Diffusion of neutron and Fermi age equation.

UNIT - IV

Fissile and Fertile materials, Characteristics and production of fissile materials, Classification of nuclear reactors, Neutron economy and multiplication factor, calculation of critical size of reactor, Concept of control of reactor, Properties of reactor shield, Fast breeder reactor, Concept of breeding, Doubling time, Reactor materials and basic principle, Basic concept of fusion reactor.
Desired characteristic of neutron detectors, BF_3 counter.

References

1. Elements of Nuclear Physics - LF Curtis.
2. Elements of Nuclear Physics - W.E. Burcham
3. Elements of Nuclear Physics by W.E. Meyerhof.
4. Nuclear Radiation Detectors - S.S. Kapoor and V.S. Ramamurthy.
5. Technique for Nuclear and Particle Physics experiment - W.R. Leo.
6. Experimental Nuclear Physics - R.M. Singru