MANGALORE UNIVERSITY

Department of Physics

MSc Physics

PHS 505: NUCLEAR PHYSICS I

(52 Hrs.)

Course outcome

CO1 Able to explain the structure and properties of the nucleus.

CO2 Discuss the advantage and shortcomings of various nuclear models.

CO3 Explain different kinds of nuclear reactions and the approaches made to obtain the cross Sections.

CO4 Attain sufficient knowledge to pursue research in nuclear reactions.

Unit I Interaction of particulate radiations and radiation dosimetry: Interaction of heavy charged particles with matter - stopping power, Bethe-Bloch formula, energy loss characteristics, Bragg curves, practical range of charged particles, scaling laws.

Interaction of neutrons - Elastic scattering, inelastic scattering, capture reactions, cross sections, neutron attenuation.

Radiation dosimeters – Thermoluminescent dosimeters, Solid State Nuclear Track Detectors, Bubble detectors. **[13 hrs]**

Unit II Nuclear detectors : Scintillation detectors – organic and inorganic scintillators, basic scintillation process, photomultiplier tube, NaI(Tl) gamma ray scintillation spectrometer, calibration of the spectrometer, spectrum details.

Semiconductor detectors - physics of semiconductor detectors, diffused junction, surface barrier, ion-implanted, Si(Li) and Ge(Li) detectors. HPGe gamma ray spectrometer, calibration of the spectrometer, spectrum details.

[13 hrs]

Unit III Nuclear electronics

Preamplifier circuits, charge sensitive pre-amplifiers, pulse shaping, pulse stretching. Linear amplifiers, linear pulse amplifier. Pulse discriminators, single channel analysers, coincidence and anticoincidence circuits. Flash ADCs, Wilkinson type ADCs, multichannel analysers. Basic principles of measurement techniques- collimation, geometry, shielding.

[13 hrs]

Unit IV Particle accelerators and Applications

Classification and principles of operation of DC, Linear and Cyclic accelerators, Synchrotron Radiation Sources, Storage rings. Accelerator Driven Sub-critical Systems, Measurements of percentage depth dose and profiles of photons and electron beams from accelerators - Relative dosimetry. Particle energy, flux, fluence, range, exposure and absorption. Accelerator shielding - Safety aspects of accelerators, Accelerators in medical and industrial applications.

[13 hrs]

Text Books:

1. Emilio Segre, 'Nuclei and Particles', II Edn. (Benjamin, 1977)
2. Ghoshal S N, 'Atomic and Nuclear Physics', Vol. II (S Chand & Company, New Delhi, 1994)
3. Kenneth S Krane, 'Introductory Nuclear Physics' (John Wiley, 1986)
4. Knoll G F, 'Radiation Detection and Measurement', II Edn. (John Wiley, 1989)
5. Evans R D, 'Atomic Nucleus' (Tata McGraw Hill, 1972)
6. Delaney, 'Electronics for Physicists'
7. Wallemar Scharf `Particle Accelerators and their uses' (Harwood Acasemic Publishers, 1986)

Reference Books:

1. Enge H, 'Introduction to Nuclear Physics' (Addison Wesley, 1988)
2. Paul E B, 'Nuclear and Particle Physics' (North Holland, 1969)
3. Singru R M, 'Experimental Nuclear Physics' (Wiley Eastern, 1972)
4. Kapoor S S and Ramamoorthy V S, 'Radiation Detectors' (Wiley Eastern, 1986)
5. Burcham W E, 'Nuclear Physics', II Edn. (Longman, 1963)

6. Marmier D and Sheldon E, ‘Nuclear Physics’, Vol. I, II (Academic Press, 1969)