MANGALORE UNIVERSITY

Department of Physics

MSc Physics

PHS 508: NUCLEAR PHYSICS II

(52 Hrs.)

Course outcome

CO1 On completion of the course, the candidates will be able to describe various factors involved in energy generation in the nuclear reactors.

CO2 Able to explain nuclear fusion and the difficulties in achievingcontrolled thermonuclear Fusion.

CO3 would get sufficient background knowledge to pursue their career in research in the field reactor physics and particle physics.

Unit I Nuclear spectroscopy

Experimental determination of beta interaction. The shape of beta spectra. The rest mass of neutrino - neutrino recoil experiment. Inverse beta decay. Double beta decay.

Gamma ray spectroscopy - life time measurements. gamma-gamma, beta-gamma correlation studies - decay schemes - angular distribution of gamma rays from oriented nuclei, polarization of gamma rays [13 hrs]

Unit II Heavy ion physics

Special features of heavy ion Physics - remote heavy ion electromagnetic interaction - Coulomb excitation - close encounters - grazing interactions - particle transfer - direct and head on collision - compound nucleus and quasi molecule formations. [13 hrs]

Unit III Review of deuteron problem and nuclear forces

Deuteron as mixture of S and D states - admixture in the deuteron wave function - magnetic and electric quadrupole moment of deuteron from S and D mixture. Ground state wave function of deuteron. Expression for Pd.

Review of nuclear forces - charge, Symmetry, spin-dependence, tensor character, exchange character. Pseudoscalar meson theory. General survey of non-central forces. Two body potential, three body and many body potentials [13 hrs]

Unit IV Scattering [13 hrs]

Free n-p and p-p scattering - n-p scattering formalism - partial wave analysis - theory of S wave neutron scattering by free protons - scattering length - spin dependence of n-p scattering. Effective range theory of n-p scattering - significance of sign of scattering length - coherent and incoherent scattering. Coherent scattering from hydrogen molecules and sign of scattering lengths. Cross sections for ortho and para hydrogen - comparison with experiment. The optical theorem. Low energy scattering of protons by protons. Mott's modification of Rutherford formula. Experimental results. Effective range theory for p-p scattering. Analysis of n-p and p-p scattering at low energy. High energy n-p and p-p scattering and experimental results. Photo disintegration of deuteron - dipole approximation cross-section for photo disintegration - photoelectric disintegration cross section and angular distribution studies. [13 hrs]

Text Books:

1. Roy R R and Nigam B P, 'Nuclear Physics – Theory and Experiment' (Wiley Eastern Ltd., 1993)
2. Emilio Segre, 'Nuclei and Particles', II Edn. (Benjamin, 1977)
3. Ghoshal S N, 'Atomic and Nuclear Physics', Vol. II (S Chand & Company, 1994)
4. Singru R M, 'Experimental Nuclear Physics' (Wiley Eastern, 1972)
5. Curtis L F, 'Introduction to Neutron Physics'
6. Wong, `Introduction to Nuclear Physics' (Prentice Hall, 1997)
7. Ponearu D N and Greiner W (ed) 'Experimental Techniques in Nuclear Physics' (Walter de Gruyter Berlin, 1997)
8. Glaston S, 'Introduction to Thermonuclear Reactions'

Reference Books:

1. Kenneth S Krane, 'Introductory Nuclear Physics' (John Wiley, 1986)
2. Enge H, 'Introduction to Nuclear Physics' (Addison Wesley, 1988)
3. Paul E B, 'Nuclear and Particle Physics' (North Holland, 1969)
4. Evans R D, 'Atomic Nucleus' (Tata McGraw Hill, 1972)
5. Kapoor S S and Ramamoorthy V S, 'Radiation Detectors' (Wiley Eastern, 1986)
6. Burcham W E, 'Nuclear Physics', II Edn. (Longman, 1963)
7. Siegbahn Kai, Alpha, Beta & Gamma Spectroscopy', Vol. I, II (North Holland, 1979)
8. Marmier D and Sheldon E, 'Nuclear Physics', Vol. I, II (Academic Press, 1969)