Core theory course (Disciplinary)

CPH-601: STATISTICAL MECHANICS AND NUCLEAR PHYSICS

UNIT-I

Some concept in statistical mechanics and Quantum statistics :

Ergodic Hypothesis, Density distribution in phase space, The Liouville Theorem, Princple of conservation of density in phase space and prnciple of conservation of extension in phase space, Condition for statistical equilibrium, Density matrix, Liouville Theorem in quantum statistical mechanics, Condition for statistical equilibrium (in quan statistics), Ensembles in quantum mechanics.

UNIT-II

Ideal Bose and Fermi system and Transport phenomena ;

Photon gas, Einstein derivation of Planck's law, Bose-Einstein condensation, Fermi energy, An alternate derivation of Fermi energy, Mean energy of fermions at absolute zero, Fermi gas in metals, Fermi energy as a function of temperature, White dwarfts, Compressibility of a Fermi gas, Mean collision time, Thermionic emission, Photoelectric effect, Molecular collisions, Einstein relation for mobility, Distribution function, Boltzmann transport equation, Boltzmann H-theorem in Q.M. , Maxwell-Boltzmann distribution from Boltzmann equation.

Basic reference :

Fundamentals of statistical mechanics by B. B. Laud, 1998, New age international (P) LTD, (For III&IV)

Publishers, New Delhi.

Other reference:

1. Statistical Mechanics by S.K. Sinha, Tata McGraw Hills.
2. Statistical Mechanics and Properties of Matter by E.S. Raja Gopal,Mc Millan Company of India Limited.

UNIT – III

.Two-bodv problem in nuclear physics :

Introduction , The ground state of the Deuteron, Excited states of the Deuteron, Neutron-Proton scatteringat low energy, Scattering length , Spin-dependence of Neutron-Proton scattering, Singlet n-p system, Effective range theory in n-p scattering, Significance of the sign of the scattering length, Tensor force and the Deutron problem, Proton-Proton scattering at low energy, Analysis of n-p and p-p scattering, Interpretation of p-p and n-n scattering. .

Nuclear Reactions:

Nuclear reactions and cross section, Resonance: Breit-Wigner dispersion formula for $l = 0$, The compound nucleus, The continuum theory of cross section σ_c, Statistical theory of Nuclear reactions.

Basic referenc : Nuclear Physics by Roy arid Nigam : Pub : New age Internation Ltd. New Delhi

UNIT – IV

Elementrv Particles:

Classification of elementary particles, type of interaction, Baryon number, lepton number, parity, charge conjugation and time reversal, CPT theorem, charge independence nuclear forces, Isospinm consequences of Isospin, G-Parity, Strange particles, associated prediction, Gell-mann Nishijima scheme, Neutral K- meson, strangenees, oscillations (?) hypercharge, CP-violation in K- decay, Ispin and SU(2) and SU(3) ,Baryon and meson multiplates, Gell-mann Okubo mass formula. Quark model falvour and colour.

Basic refernce:

Introduction to high energy physics by D. H. Perkins 3r edition Cambridge Uni. Press Elementry particles by I. H. Hughes, Cambridge Uni. Press •

Other references:

1. Nuclear Physics by I Kaplan, Narosa Pub.
2. Introduction to Nuclear Physics by H.A.Enge, Addition-Wesley