PT – 301 QUANTUM MECHANICS - II

Max. Marks: 85 Pass Marks : 29

Unit - I Approximation methods for bound states - II
Formulation of first order time independent perturbation theory for degenerate levels, Application to first order Stark effect of a hydrogen like atom, Fine structure splitting of atomic energy levels, Zeeman effect with and without electron spin.

Unit- II Approximation methods for time dependent problems
Time dependent perturbation theory, first order transition probability, constant perturbation, harmonic perturbation, Fermi Golden Rules, Atom in a radiation field, Einstein's A and B coefficients, Plane electromagnetic waves, Electric dipole transitions, selection rules.

Unit - III Identical Particles
Indistinguishability, Exchange degeneracy, Symmetric and antisymmetric wlave functions for many particle systems, Spin and statistics, Computation of interaction energy for two-particle systems, Exchange interaction, Application to ground state of a helium-like atom, Structure of wave function lor excited states of a helium-like atom, Pauli exclusion principle (qualitative), Collisions of identical particles Allowed states of 2-particle systems.

Unit - IV Scattering theory
Scattering cross section, Laboratory and center-of-mass coordinate systems, Transformation of variables from one system to another, Asymptotic behaviour, Scattering by spherically symmetric potentials, Partial waves and phase shifts, Partial wave expansion of differential cross section, Total cross section, Ramsauer – Townsend effect Scattering by a perfectly rigid sphere, Scattering *by* a square potential well, Green's functions in scattering theory, Born approximation, Application to scattering by (i) a square potential well (ii) Yukawa potential, Hypergeometric functions, Scattering in a Coulomb field (separation in parabolic coordinates), Rutherford formula.

Unit - V Elements of relativistic quantum mechanics
Klein - Gordon equation, Free particle solutions, Dirac equation for a free particle, Free particle solution, Negative energy, Hole theory, Reduction of Dirac equation into covariant form, Gamma matrices and their algebra, Existence of spin, Electromagnetic potentials in Dirac equation, Existence of magnetic moment.

Books Recommended:

1. Quantum Mechanics: L.I. Schiff
2. Quanrum Mechanics: J.L. Powell and Crasmann
3. Introduction to Quantum Mechanics: Pauling and Wilson
4. Quantum Mechanics and Field Theon: B. K Agrawal
5. Quantum Mechanics: A.K Ghatak and S. Loknathan
6. The Principles of Quantum Mechanics: Dirac.
7. Practical Quantum Mechanics: Flugge.

PT – 302 ATOMIC & MOLECULAR PHYSICS AND NUCLEAR INSTRUMENTATION (2)

Max. Marks: 85 Pass Marks : 29

Note: This paper has been divided into FIVE units. The paper will be set as per existing examination norms covering uniformly all the units and providing to the examinee sufficient choice in each unit.

Unit – I Atomic Physics

Quantum states of one electron atom, atomic orbitals, Hydrogen spectrum, spectra of alkali elements, spin orbit interaction and fine structure of alkali spectra, normal and anomalous Zeeman effect, Pschenback effect, Startk effect, two electron system, equivalent and non equivalent electrons, Pauli's exclusion principle, interaction energy, L-S and J-J coupling, Hyperfine structure, line broadening mechanisms.

Unit – II Rotational Spectra

Type of molecules: Linear, non-linear, symmetric top, asymmetric top, spherical top; rotational spectra of diatomic molecules as a rigid rotator, energy level diagram and spectra, rotational spectra of non rigid rotator, energy level diagram and spectra, intensity of rotational lines, applications of rotational spectra and pure rotational Raman spectra.

Unit – III Vibrational and Vibrational-rotational Spectra

Vibrational energy of diatomic molecules, diatomic molecule as a simple oscillator, its energy level diagram and spectrum, Morse potential energy curve, molecules as vibrating rotator, vibration spectrum of diatomic molecules, PQR branches, infrared spectrometry, vibrational Raman spectroscopy, structure determination from Raman and IR spectroscopy.

Unit – IV Fluorescence Spectroscopy

Vibronic interaction, Herzberg Teller theory, fluorescence spectroscopy, Kasha's rule, Quantum yield, non radiative transition, Jablonski diagram, time resolved fluorescence and determination of excited state life time.

Unit – V Nuclear Instrumentation

Ionization of matter by charge particles, interaction of electromagnetic radiation with matter, stopping power and range, photo electric effect, Compton effect and pair production, radiation detection, gas filled counters, solid state counters, scintillation counter, photomultiplier tube, Cerenkov detector, nuclear emulsions, Betatron, electron synchrotron and proton synchrotron.

BOOKS RECOMMENDED

1. Introducttion to Atomic Physics: H.E.White
2. Fundamentals of Molecular spectroscopy: C.N.Banwell and E.M.McCash
3. Spectra of diatomic molecules: Herzberg
4. Spectroscopy Vol.I&II: Walker and Straughen
5. Nuclear Physics: Kaplan

PT – 303 CONDENSED MATTER PHYSICS – II

Max. Marks: 85 Pass Marks : 29

Note: This paper has been divided into FIVE units. The paper will be set as per existing examination norms covering uniformly all the units and providing to the examinee sufficient choice in each unit.

Unit – I Point Defects and Alloys

Lattice vacancies, Interstials and their thermodynamical calculations, Features of point defects, Color centres, Formation of alloys, Order-disorder transformation, Elementary theory of order

Unit – II Dielectric and Ferroelectric

Static polarization: various types of polarization, Local fields, Clausius-Mossotti relation, Time dependent polarization and dielectric relation, Lyddane-Sachs-Teller relation, Ferroelectric crystals, Classification of ferroelectric crystals, polarization catastrophe, First and second order phase transitions, Idea of antiferroelectricity, Piezo-electricity and ferroelectricity

Unit – III Magnetic Properties of Solids

Quantum theory of paramagnetism and ferromagnetism, exchange integral and Heissenberg interaction, Magnon and magnon dispersion relation, Antiferromagnetic and ferrimagnetic orders, Anisotropy energy, Bloch Walls, Idea of ferrites

Unit – IV Superconductivity – I

ConcePT of superconducting state, Thermodynamical properties of superconductors, London's equation and penetration depths, Magnetic properties and critical magnetic fields, Meissner effect, Flux quantization, Microwave and infrared properties, Coherence length

Unit – V Superconductivity – II

Two fluid model for superconducting state, Ginzburg-Landau theory, Basic featurs of Pipard's non local theory, elements of BCS theory of superconductivity, Isotpe effect, Single particle tunneling, DC and AC Josephson effects, Josephson tunneling, a Qualitative description of high Tc superconductivity in ceramic oxides.

BOOKS RECOMMENDED

1. Introduction to solid state physics: Kittel
2. Solid state Physics: Ashcroff and Marmin
3. Solid State Physics: Epifanov
4. Superconductivity: Parks
5. Intermediate quantum theory of crystalline solids: Animalu
6. Solid state Physics: Zimam