THIRD YEAR T.D.C., SCIENCE

(Effective from session 2016-17)

PHYSICS

Paper Code	Paper & Title	Hrs/week	Max. Marks
3161	I: Quantum Mechanics, Atomic and Molecular Physics	2	50
3162	II: Electrodynamics, Electromagnetic Waves and Relativity	2	50
3163	III: Solid State, Nuclear and Particle Physics	2	50
3164	IV: Practical	4	75

Note:

1. Each theory question paper in the annual examination shall have three sections:
   Section A shall contain one compulsory question of 5 marks having 10 parts. Two parts shall be set from each unit. The candidate is required to answer each part in one or few words**. (Total: 5 Marks)**

   Section B shall contain five compulsory questions of 5 marks each with internal choice. One question with internal choice will be set from each unit. The answer may be given in approximately 250 words**. (Total 25 Marks)**

   Section C shall contain four descriptive questions covering all units and candidates have to answer any two questions of ten marks each. The answer may be given in approximately 500 words. There can be two parts in a question from this section**. (Total 20 Marks)**

Paper-I: 3161, Quantum mechanics and Atomic & Molecular Physics

Unit-I

Introductory Schrodinger theory :

Rise and fall of Plank-Bohr quantum theory Duality of radiation and matter, de Broglie's hypothesis, justification for the relation , experimental confirmation

Phase and group velocities of a wave ; formation of a wave packet, illustrations. Uncertainty principle relating to position and momentum, relating to energy and time, application complimentarity principle, photon interpretation of two slit interference, Einstein-de-Brroglie relations as a link between particle and wave properties, general

equation of wave propogation, propogation of matter waves, time dependent and time independent schrodinger equations, physical meaning of ψ, conditions to be satisfied by schrodinger equation as an operator equation. Postulatery approach to wave mechanics, operators, observable and measurements.

Operators, eigen values and eigen functions; linear operators, product of two operators, commuting and non commuting operators, simulataneous eigen functions, orthogonal functions.Hermition operators, their eigen values, Hermition adjoint operators, expectation values of an operator.

Unit – II

Simple one dimensional problem ; particle in a box with rigid walls. Concept of a potential well. Wave functions and energies for the ground and excited states ; quantization of energy qualitative discussion of the solutions for a shallow potential well.

Application of Operator methods ; Simple harmonic oscillator, step-up and step-down operators, eigen functions and eigen values of the ground state and excited state, zero point energy probability density and its variations with degree of excitation ; orthogonality of wave functions.

Other one dimensional problems ; step potential, penetration through rectangular barrier. Transmission coefficients, barriers of special shapes, quantum mechanical tunneling, particle in of three dimensional cubical box, degeneracy.

UNIT-III

Angular momentum and spin

Central force ; orbital angular momentum, operators for its cartesian components, commutation relations, mutual as well as with L^2 , operators L^+ and L^-, their interpretation as step operators eigen values of L_2 , half integral values for quantum numbers. Angular momentum operators in spherical polar coordinates ; evaluation of their eigen functions explicitly in terms of the coordinates, their degeneracy.
Schrodinger equation for hydrogen atom in spherical polar coordinates ; separations into radial and angular variation, qualitative discussion of spherical harmonics.
Angular momentum and magnetic moment of electron due to orbital motion Bhor mageton.

Unit – IV

Mono valent and divalent atoms

Back ground from quantum theory : The four quantum numbers ; spectral terms arising from L-S coupling, s,p,d,f, notation, selection rules. Half life of excited states, width of a spectral line.

Spectra of mono and divalent atoms : Doublet fine structures of hydrogen lines ; screening constant for monovalent atoms, series limits, doublet structure for alkali spectrum. Spectra of helium and alkaline earth atoms, singlet and triplet series.
Effect of magnetic field on energy levels : Gyromagnetic ratios for orbital and spin motions ; vector model, Lande g factor, strong and week field effects, illustrative cases of H, Na, Ca and Hg.
X-ray spectra : The continuous x-ray spectrum, Duane and Hunt limit. Characteristic x-rays : Mosley's law, doublet fine structure, H-like character of x-ray states, x-ray absorption spectra, absorption edges.

Unit – V

Sharing of electrons : formation of molecular orbitals, H_2^+ ions H_2^- molecule, electronic levels, singlet and triplet characters. Rotational energy levels, internuclear distance.
Vibrational energy levels, force constants, anharmonicity dissociation energy, isotope effects on rotational and vibrational energies. Raman effect (brief study).
Spectra of diatomic molecules : Pure rotation spectra ; selection rules, vibration-rotation spectra, selection rules, vibration-rotation spectra ; selection rules, P, Q and R branches.
Electronic band systems, sequences and progressions
Frank-Candon principle. (Statement only, no derivation)

Recent developments in Physics including discussion of Nobel prizes in Physics (no questions to be set in the theory examination).

Text books:

1. Quantum mechanics : S.P. Singh, M.K. Bagde and Kamal Singh (S.Chand and Co
2. Quantum Mechanics by G.R. Chatwal and Anand SK, Himalaya Publishing Co.

Reference books

1. Quantum Mechanics Alistair I M Rac. ELBS (Low Drice edition)
2. Quantum mechanics , S. N. Biswas, Books and Allied, Calcutta (P) Ltd.
3. Atomic and Nuclear Physics ; A.B. Gupta, mew central book agency pvt. Ltd.
4. Introduction to Modern Physics, H S Mans and G K Mehta