PT–201 CLASSICAL ELECTRODYNAMICS, PLASMA ANDANTENNAE PHYSICS

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 Dipole Radiation

Maxwell's equations in terms of scalar and vector potential, Gauge transformations: Lorentz gauge and Coulomb gauge, Retarded potentials, Radiation from oscillating electric and magnetic dipoles with simple applications.

UNIT - II Radiation from a Point Charge

Lienard - Wiechart potentials, Fields due to point charge in uniform and accelerated motions, Power radiated by a point charge (in non relativistic limit), Radiation reaction: Abraham Lorentz formula, Physical origin of the radiation reaction.

UNIT - III Plasma Physics

Occurrence of Plasma in nature, Definition of plasma, Concept of temperature, Debay shielding, The Plasma Parameter, Criteria for plasma, plasma diagnostics by Langmuir probe and by microwave techniques, Plasma oscillations, adiabatic invariants, Plasma confinement by magnetic mirrors and by pinch effect condition for reflection by mirrors.

UNIT - IV Single Particle Theory & Wave Propagation

Hydro magnetic description of plasma, Hydro magnetic waves, Magneto sonic and Alfven waves, Motion of charged particle in Electric Magnetic E and B fields, Gravitational field, time varying fields, Phase velocity, Group velocity, Cutoff and resonance for electromagnetic wave propagating parallel and perpendicular to the magnetic field.

UNIT - V Antenna Arrays

Two element array, Horizontal pattern in broadcast array, Linear array, Multiplication of patterns, Binomial arrays, Antenna gain, Effective area, Antenna terminal Impedance, Idea of super directive arrays, Radiation from current sheet.

Books Recommended:

1. Classical Electrodynamics by J.D. Jakson
2. Introduction to plasma physics by F.F. Chen
3. E.M. Waves and Radiating systems by Jorden and Ballman
4. Introduction to Classical Electrodynamics by Griffth

PT – 202 NONRELATIVISTIC QUANTUM MECHANICS – I

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 Fundamentals

Correspondence principle, Complementarity, Uncertainty, Schrödinger wave equation, Statistical interpretation, Normalisation, Probability current density, Expectation value, Ehrenfest's theorem, Eigenfunctions and eigenvalues, Energy eigenfunctions, Separation of the time dependent wave equation, Stationary states, Significance of the separation constant E, Boundary and continuity conditions, Boundary conditions for infinite potential energy, Dynamical variables as operators, Hermitian operators and their properties, Orthonormality, Free particle solution, One-dimensional step potential (finite and infinite), Particle in a one-dimensional square potential well (finite and infinite), parity, Schmidt orthogonalization, Schwarz inequality, Momentum eigenfunctions, Linear harmonic oscillator parity, zero point energy, Correspondence with classical theory, The rectangular potential barrier.

Unit - II Three-dimensional Systems

Particle in a three-dimensional box, The Dirac delta-function, Orbital angular momentum, Commutation relations, Eigenfunctions and Eigenvalues of L^2 and L_z. Infinitesimal rotations, Central force problem in three dimensions, Separation of the wave equation, Parity, Series solution, generating functions, recurrence relations and orthogonality of Laguerre polynomials, Bessel equation, Series solution, Generating function, Integral order, Recurrence relations, Integral representation, Orthogonality, Neumann functions, Spherical Bessel and Neumann functions (definition only), Bound states in a three-dimensional square potential well, Solution for $l=0$, Interior and exterior solutions for arbitrary 'l', The hydrogen atom, Reduced mass, Asymptotic behaviour, Hydrogen atom wave functions, Energy levels, Degeneracy Energy eigenvalues of a three-dimensional harmonic oscillator, Energy eigenvalues of (a) plane rigid rotator (b) 3-D rigid rotator, Partial wave expansion of a free particle wave function.

Unit - III Matrix Theory

Postulates of quantum mechanics, Commuting operators and commutator algebra, Virial theorem, Derivation of uncertainty relation through operators Matrix formulation of quantum theory, Linear vector spaces, Vectors and operators, Matrix representation of vectors and operators, Bra and ket notation, Projection operator Change of basis and unitary transformations, Matrix theory of the linear harmonic oscillator (energy representation), Raising and lowering operators, Matrices for a x, p and H, Transformation to coordinate representation, Spin: Pauli spin matrices and their algebra, Matrix formulation of angular momentum, Matrices for J^2 and J_z, Addition of two angular momenta (elementary discussion).

Unit - IV Approximation Methods

The WKB approximation, Classical limit, Approximate solutions, Connection formulae Application to the problem of i) penetration though a potential barrier ii) energy levels in a potential well, Formulation of variational approximation method, Application to helium atom ground state, Linear combination of atomic orbitals, Application to the ground state of .

Unit - V Approximation Methods for Bound States - I

Stationay perturbation theory, Nondegenerate case, Formulation upto second order, Penurbation of a linear harmonic oscillator (i) estimation of correction to second order for perturbation terms depending on x and x^2 (ii) first order correction to energy by x^3 and x^4 type terms, Ground state of Helium atom, Stark effect of a plane rigid rotator.

Books Recommended:

1. Quantum Mechanics: L.I. Schiff.
2. Quantum Mechanics: J.T. Powell and Crasemann
3. Quantum Mech. & Field Theory By " Agrawal.
4. Quantum Mechanics A. K. Ghatak & S.Loknathan
5. Intro. to quantum mechanics by *Pauling & Wilson*

PT – 203 CONDENSED MATTER PHYSICS - I

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 Crystal Structure

A review of concepts of space and crystal lattice, Primitive vectors and cells; Symmetry elements, Miller indices for planes and axes, Space groups and point groups, Bragg's law, Construction of reciprocal lattice, reciprocal lattice vectors, Brillion zones, Reciprocal lattice of SC, BCC and FCC, Structure and atomic factors

Unit – II Lattice Dynamics and Thermal Properties

Vibrations of one dimensional monoatomic and diatomic lattices, Quantization of lattice vibrations, Phonon momentum, Qualitative description of phonons in three dimensional lattice, phonon density of states, Einstein and Debye models of lattice specific heat, Anharmonic effects in crystals: thermal expansion of solids, Equation of states of solids, Phonon-phonon interaction and thermal conductivity

Unit – III Electronic Energy Bands

A brief review of properties of free electron gas, Hall effect and quantised Hall effect, The periodic potentials, Bloch theorem and Born-von Kramer boundary conditions, General remarks about Bloch theorem, Fermi surface, Electron density of states, Kroning-Penny model, Equation for electron wave in a periodic potential: solution of central equation, approximate solution near zone boundary, Construction of Fermi surfaces, The tight binding approximation for bond structure, Effective mass in solids

Unit – IV Elements of Semiconductor Physics

Examples of semiconductors, Typical band structure of a semiconductor, Number of carriers in thermal equilibrium, Intrinsic (non-degenerate) semiconductors, Extrinsic semiconductors, Effect of doping, Impurity levels, Population of impurity levels, Fields and carrier densities in equilibrium, p-n junctions, Elementary picture of rectification by p-n junction.

Unit – V Optical Properties of Solids

Optical reflectance, Kramers-Kroning relations, Electronic intra and inter band transitions; Direct and indirect transitions, Absorption of light in metals and semiconductors, Idea of excitons, Elements of Raman effects in solids, Energy loss by fast moving particle in solids

BOOKS RECOMMENDED

1. Introduction to solid state physics: Kittel
2. Solid State Physics: Ashcroff and Mermin
3. An introduction to x-ray crystallography: woolfson
4. Solid state Physics: Azaroff
5. Intermediate quantum theory of crystalline solids: Aniamalu
6. Solid state Physics: Epifanov

PT – 204 DIGITAL ELECTRONICS, NUMERICAL ANALYSIS AND COMPUTER PROGRAMMING

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 Binary Logic, Digital Switching Circuits, Counters

Binary number systems and other codes, Binary arithmetic, Boolean theorem, synthesis of Boolean functions, Karnaugh diagram, Logic Gates, combinational logic: half and full adders, demultiplexers, Multiplexers, D/A and A/D converters.

Clock generator, sequential logic: RS flip flop, D flip flop, T flip flop, JK flip flop, Master-Slave flip flop, Shift register, Ripple counter, Decade counter, up-down counter, divide by n counters, Synchronous counters, Applications of counters, Dynamic MOS circuit, two phases of MOS, Idea of MOS shift register and MOSROM

Unit – II Numerical Solutions, Least Square Fits and Error Analysis

Numerical solutions of Transcedental equations: Iterative method, Bisection method, False Position and Newton Raphson method, Numerical solutions of simultaneous linear equations: Gauss Elimination and Gauss Seidel method, Least Square fits: Linear and polynomial regression, Error analysis: Basic concepts of errors and their types with special reference to numerical methods

Unit – III Interpolation, Numerical Integration and Solution of Differential Equations

Forward, Backward and Central differences and their symbolic relation with shift operator, Newton 's forward and backward interpolation, Gauss central difference interpolation formula, Trapezoidal formula and Simpson 1/3 rule, Solution of Differential equation: Picard's method, Eulers method, and Runga-Kutta methods (second and Fourth order)

Unit – IV Computer Programming

Introduction to modern digital computers, Organization to a digital computer, Computer instruction and programs, Motivation of high level languages, Basic elements of any programming language, Arithmetic expressions, operators, Standard arithmetic functions, Input and output statements, various types of control statements, loops, nesting of loops, concept of main program, subprograms, declarations statements

Unit – V Programming in 'C'

Introduction to programming in C; constants, variables, operators, header files; Statements: Input/output, control, looping, general examples based on units II and III.

BOOKS RECOMMENDED

1. Digital principals and applications: Malvino & Leach
2. Electronic Devices and Circuits: Millman and Halkius
3. Numerical Analysis: Rajaram
4. Computer programming by S.S. Sastri
5. Programming in C: Balaguruswami
6. Numerical Computational methods by Patil and Verma