Rajkamal Science & Management College, Bahadrabad

B.Sc. Syllabus

SEMESTER-I

Paper I: Mechanics and Properties of Matter

Laws of Motion and Conservatipon laws: Frames of reference, Newton's Laws of motion, Work and energy, uniform circular motion, Conservation of energy and momentum, Conservative and non conservative forces, Motion of rocket, Motion of a particle in a central force field, Kepler's laws of planetary motion, Newton's Law of Gravitation, Gravitational field, potential and potential energy, Gravitational potential and field intensity for spherical shell, Satellite, Basic idea of global positioning system (GPS).

Rotational Motion: Dynamics of a system of particles, Cetre of mass, Angular velocity and momentum, Torque, Conservation of angular momentum, Equation of motion, Moment of inertia , theorem of parallel and perpendicular axis, moment of inertia of rod, rectangular lamina, disc, solid sphere, spherical shell, kinetic energy of rotation, rolling along a slope.

Fluids: Surface Tension and surface energy, Excess pressure across surface: application to spherical drops and bubbles, variation of surface tension with temperature- Jaegar's method, Viscosity: Flow of liquid, equation of continuity, energy of fluid, Bernoulli's theorem, Poiseuille's equation and method to determine coefficient of viscosity, variations of viscosity of a liquid with temperature.

Elasticity: Hooke's law, Stress-strain, Elastic potential energy, Elastic modulus: Young's , Bulk and shear modulus of rigidity, Poisson's ratio, relation between elastic constants, Work done in strecthing and in twisting a wire, Twisting couple on a cylinder, Strain energy in twisted cylinder, Determination of Rigidity modulus by statical and dynamical method (Barton's and Maxwell's needle), Torsional pendulum, Young's modulus by bending of beam, Determination of Y,η,σ and moment of inertia by Searle's method.

Reference Books:

1. Mechanics Berkeley Physics course, vol. 1; Charles Kittel, et. Al.2007

2. Physics-Resnick, Halliday & Walker 9/e, 2010, Wiley

3. Mechanics : J.C. Upadhaya, Ram Prasad and Sons, Agra

4. Mechanics: Mathur and Hemnel; S Chand Publications

5. Mechanics and General Properties of Matter: P.K. Chakraborthy, Books and Allied Pvt. Ltd.

6. Elements of mechanics, Prakash & Aggarwal, Pragati Prakashan, Meerut

Paper II: Electricity and Magnetism

Vector field and Electrostatics: Scalar and Vector field, gradient, divergence, curl, Line, surface and volume integrals of Vector field, Gauss-divergenceand Stoke's theorem, Electrostatic Filed, electric flux, Gauss's theorem of electrostatics, Applications of Gauss theorem- Electric field and potential due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, Electric potential as line integral of electric field, electric dipole, uniformly charged spherical shell and solid sphere. Capacitance of an isolated spherical conductor, Parallel plate, spherical and cylindrical condenser, Energy per unit volume in electrostatic field, Dielectric medium, Polarization, Parallel plate capacitor filled with dielectric.

Magnetostatics: Lorentz forces, Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current, Divergence and curl of magnetic filed, Magnetic vector potential, Ampere's circuital law, Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, Brief introduction of dia-, para-, and ferro-magnetic materials.

Electromagnetic Induction and Alternating current: Field due to Helmhotz coli, solenoid and current loop, Ballistic galvanometer, Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, Mutual inductance of coil system, Energy stored in magnetic field, Alternating currents, Alternating voltage across R-C, L-C, and R-L and LCR circuits, condition of resonance.

Maxwell's equations and Elctromagnetic wave propogation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vaccum and isotropic dielectric medium, transverse nature of EM waves, polarization.

Reference Books:

1. Elecricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House

2. Elecricity and Magnetism, Satyaprakash, Pragati Prakashan, Meerut

SEMESTER- II

Paper I: Waves and Oscillations

Wave Motion: Travelling and standing waves on a string, Normal Modes of string, Group velocity, Phase velocity, Plane waves, Spherical waves, Wave intensity, Differential equation of S.H.M and its solutions, Kinetic and Potential energies, Fourier's theorem and its applications to square waves, sawtooth waves and triangular wave.

Harmonic Oscillations: Simple harmonic oscillations in mechanical and electrical systems,Superposition of two Collinear Harmonic oscillations: Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats), Anharmonic oscillations,Superposition of two Perpendicular Harmonic Oscillations, Lissajous figures.

Damped and Forced Oscillations: Damped Harmonic Oscillator, Power dissipation in damped harmonic oscillator, relaxation time and quality factor, Electrically damped harmonic oscillator (LCR circuit), Forced harmonic oscillations in mechanical and electrical system, Transient and steady state behavior, Resonance, sharpness of resonance, bandwidth, energy dissipation, quality factor of forced oscillator, mechanical and electrical impedance.

Ultrasonics and Accoustics: Intensity and loudness of sound-Decibels-Intensity levels- musical notes-musical scale, Generation of Ultrasonic waves and their detection and its applications, Piezoelectric effect, Quartz crystal, Accoustics of buildings: Reverberation and time of reverberation- Absorption coefficient-Sabine's formula- measurement of reverberation time- Accoustic aspects of halls and auditora.

Reference Books:

1. Wave and oscillations; J.C. Upadhyaya, Himalaya Publishing

2. Wave and oscillations; N. Subramanyam and Brijlal

3. Wave and oscillations, Satya Prakash, Pragati Prakashan, Meerut

Paper II: Optics

Geometrical Optics and Instruments: Fermat's Principle and laws of refection and refraction using Fermat's principle, coaxial system, Cardinal points of an optical system, combinations of thin lenses, Ramsdon's and Huygen's eyepieces, telescope, spectrometer, chromatic and spherical aberrations, various methods to minimize the chromatic aberration (achromatism) and to reduce the spherical aberration.

Interference: Electromagnetic nature of light, Definition and Properties of wavefront, Huygen's Principle, Interfernce: Division of amplitude and division of wavefront, Young's Double Slit experiment, Fresnel's Biprism, Interfernce in Thin Films: parallel and wedge-shapedfilms, Fringes of equal inclination and equal thickness, Newton's Rings, measurement of wavelength and refractive index, Michelson's Interferometer: measurement of wavelength and diffraction of two wavelengths.

Diffraction: Fraunhofer diffraction: Single slit, Double slit, Multiple slits and diffraction from transmission grating, Fresnel Diffraction: Half–period zones, Zone plate, Fresnel Diffraction pattern of a straight edge, a slit and a wire using half period zone analysis.

Polarization: Transverse nature of light waves, Plane pplarized light and production by reflection and refraction, Brewster's and Malus Laws, Double refraction, Nicol prism, superposition of two plane polarized light, Circular and elliptical polarization, Quarter wave and half wave plane.

Reference Books:

1. Principles of Optics, B.K. Mathur,1995, Gopal Printing

2. Optics, S.P. Singh and J.P. Agarwal, Pragati Prakshan, Meerut

3. Optics, Satya Prakash, Pragati Prakashan Meerut.

SEMESTER-III

Paper I: Heat and Thermodynamics

Laws of Thermodynamics: Thermodynamic system and variables, Zeroth Law of thermodynamics and thermal equilibrium, First law and internal energy, conversion of heat into work, Indicator diagram, Thermodynamic Processes, Workdone during Isothermal and Adiabatic Processes, Joule-Thomson expansion of real gas.

Second Laws of Thermodynamics: Inadequacy of first law, Reversible & irreversible processes, Principle of Heat engine and refrigerator, Second law of thermodynamics, Carnot's cycle & theorem, Entropy changes in Reversible & irreversible processes, Entropy-temperature diagrams, Third law of Thermodynamics, Unattainability of absolute zero

Thermodynamic Potentials: Enthalpy, Gibbs free energy, Helmholtz and Internal Energy functions, Thermodynamic relation & applications: Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for (C_p-C_v), C_p/C_v, second law in terms of entropy.

Theory of Radiation and Kinetic Theory of Gases: Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wein's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Weins displacement law from Planck's law, Derivation of Maxwell's law of distriution of velocities and its experimental verificatioin, Mean free path, Law of equipartition of energy and its applications to specific heat of gases; monoatomic and diatomic gases.

Reference Books:

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, TataMcGraw- Hill

2. Heat and Thermodynamics, Pragati Prakashan, Meerut

3. Heat and Thermodynamics, Brijlal and Shubramaniam

Paper II: Solid State Physics and Statistical Mechanics

Crystal: Lattice, basis and crystal structure, translation, primitive lattice, two and three dimensional lattice types, point group symmetry and miler indices, sc, fcc anf bcc structure: coordination number, packing fraction, NaCl, CsCl, and ZnS strucutres.

Reciprocal lattice: X-ray diffraction, Bragg's law, Laue and Powder method of X-ray diffraction, Reciprocal lattice, Reciprocal of fcc and bcc lattice, Briloun Zone.

Statistical Mechanics: Probability and thermodynamical probability, postulate statistical mechanics, microstate and macrostate, Equilibrium and fluctuations constraints, ensembles and average properties, Phase space, μ-space and gamma-space, division of phase space into cells, Microcanonical, canonical and grand canonical ensembles, Entropy and probability, interpretation of second law of thermodynamics, Boltzmann canonical distribution law.

Kinetic theory of gases: Kinetic theory of gases, Maxwell's distribution laws of speed and velocities, average, rms and most probable speeds, degree of freedom, Brownian motion, mean free path, law of equipartition of energy.

Reference Books:

1. Introduction of Solid State Physics, C. Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.

2. Elementary of Solid State Physics, J.P.Srivastava, 2nd Ed., 2006, Prentice- Hall of India.

3. Solid State Physics, R.L. Singhal

4. Solid State Physics, S.O. Pillai

5. Elementary of Solid State Physics,1/e M. Ali Omar,1999, Pearson India

SEMESTER-IV

Paper I: Elements of Modern Physics

Fundamental quantum concepts: Planck's quantum theory, Photo-electric effect, Compton effect, De Broglie wavelength and matter waves, Davisson-Germer experiment, Two slit interference experiment with photons, Wave-particle duality, Matter waves and wave amplitude.

Atomic Models and Spectra: Rutherford and Bohr atomic models, Problems with Rutherford model-instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; energy levels and fine structure of Hydrogen loke atoms spectra, Optical spectra, L-S. j-j coupling, selection rules, fine structure of sodium d line, Zeeman effect, X-ray spectra and Moseley's law.

Nuclear Physics: Size and structure of atomic nucleus and its relation with atomic weight, Nature of nuclear forces, binding energy, semi-empirical mass formula, Radioactivity, α, β and γ- radiation, stability of nucleus; Mean life & half-life, mass defect, Fission- nature of fragments and emmision of neutrons, Nuclear fusion, Nuclear reactor and thermonuclear reactions.

Special Theory of Relativity: Constancy of speed of light, Postulate of special theory of relativity, Lorentz transformations, length contraction, time dilation, addition of velocities, relativistic mass, mass energy relation, relativistic momentum and energy, relativistic Doppler Effect.

Reference Books:

1. Fundamental of Modern Physics, Agarwal and agarwal, Pragati Prakashan, Meerut

2. Concept of Modern physics, Arthur Beiser, 2009, McGraw-Hill

3. Quantum Physics, Berkley Physics course Vol. 4 E.H. Wichman, 2008, McGraw-Hill

Paper –II: Basic Electrical and Electronic circuits

Basic Electrical current and Circuits: electric current, AC/DC electricity, electric density, Equation of continuity, Lorentz-Drude Theory, Ohm's law, Current and Power, Kirchoff's laws and applications, Main electric circuit elements and their combinations, Basic electric devices; resistor, inductor and capacitor, colour coding of resistors, Ammeter, Voltmeter, Galvanometer, AC/DC generators, Mulltimeter, Transformer

Network Analysis and Network Theorems: current source, voltage source, Source equivalence, four terminal networks, open circuit and short circuit impedance, T and π representation, image parameters, iterative parameters, Network theorems: Superposition, Reciprocity, Thevenin's, Norton's and Maximum power transfer theorems

Semoconductor devices: Types of semiconductors: intrinsic and n-type, p-type semiconductors, temperature dependence, energy band and Fermi level in intrinsic semiconductor, concentration of Hole and Electrons, P-N Junction diode, depletion region, forward, reverse biased junction doide, Zener diode, Tunnel diode, Photo diode, LED, Point contact diode & Varactor diode

Rectifier and filters: Diode as circuit element, power supply, Load line concept, Half wave, Full Wave and Bridge rectifier, Shunt capacitor filter, series inductor filter, L-section, π-section and T-section filters, Zener diode as voltage regulator.

Reference Books:

1. Basic Electronics, Agarwal and agarwal, Pragati Prakashan, Meerut

2. Elecricity & Magnetism, Satya Prakash, Pragati Prakashan, Meerut

3. Hand Book of Electronics, Gupta Kumar, Pragati Prakashan, Meerut

SEMESTER-V

Paper- I : Electronics and Solid State Device

Solid State Device: Transistors, N-P-N and P-N-P Transistors characteristics(CB,CE, and CC Configurations), Current gain α and β parameters, Relation between α and β, Load Line analysis of Transistors, DC Load line and Q- point, Active, Cutoff, and Saturation regions, Voltage Divider Bias Circuit for CE Amplifier, Field effect Transistors- JFET,MOSFET, UJT, SCR and their characteristics and applications.

Transistor Amplifier: Classification of Amplifiers, transistor biasing, h-parameters, RC coupled amplifier, single stage and double stage, Impedance and Transformer coupled amplifier, Power amplifiers.

Feed back Amplifiers: principle of feed back amplifiers, advantages and disadvantages of negative feed back amplifiers, Types of feed back amplifers: Voltage series and shunt feed back amplifiers, Current series and shunt feed back amplifiers, Amplifiers (Voltage and Current)

Operational Amplifier: Characteristics of an Ideal Op-Amp, Open –loop & Closed-loop Gain, CMRR concept of Virtual ground, Application of Op-Amps; Inverting and Non- inverting Amplifiers, Adder, Subtractor, Differentiator, Intergator.

Reference Books:

1. Text Book of Electronic devices and Circuits, R S Sedha, S Chand

2. Hand Book of Electronics, Gupta Kumar, Pragati Prakashan, Meerut

3. Solid State Electronics, Agarwal and agarwal, Pragati Prakashan, Meerut

Paper II: Mathematical Physics

Vectors: Product of two vectors, Triple product of vectors, simple application of vectors, Differentiation & partial differentiation, scalar and vector fields, Gradient of scalar field, line, surface and volume integrals of vector field, Divergence and curl and their applications, Gauss divergence and Stoke's theorems.

Tensor: n-dimensional space, identical and summation conventions, dummy and ral indices, Kronecker delta symbol, Covariant and contravariant tensor, Rank of tensor and Tensors of higher rank, Invariant tensor, Addition, subtraction, product and contraction of tensors, Summation, convention, Symmetric and Antisymmetric tensor, fundamental tensors, raising and lowering of indices, associated tensors

Matrices: Algebric oeration of matrices: Addition, multiplication, properties of matrix multiplication, sub-matics, partitioning of marics, special types of matrices, Hermition and skew hermition matrices, determinant of matrices, unitary matrices

Laplace and Fourier Transform: Definition of Laplace transform, condition of existence of Laplace transform, properties of Laplace transform, Laplace transform of derivatives f(t) and derivatives of order n, Laplace transform of integral of f(t), Laplace transform of multiplication by t, Laplace transform of division by t, Initial and final value theorems, Fourier integral and its forms, Fourier theorem and its application to square wave, saw tooth wave and triangular wave

Reference Books:

1. Mathematical Physics, Satya Prakash, Pragati Prakashan, Meerut

2. Mathematical Physics, B S Rajput

3. Mathematical Physics, Dass and Verma, S Chand & Company

SEMESTER-VI

Paper I: Quantum Mechanics

Time dependent Schrodinger equation: Concept of wave function, Time dependent Schrodinger equation and dynamical evolution of quantum state: Properties of Wave Function, Interpretation of wave function, Probability and Probability current densities, Conditions for Physical acceptability of Wave Functions, Normalization, Linearity and Superposition Principles, Eigenvalues and Eigenfunctions, Position, momentum & Energy operators and commutation relations; Expectation values of position and momentum and energy.

Time independent Schrodinger equation: Hamiltonian, stationay states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to the spread of Gaussian wave packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wave function.

Application of Schrodinger wave equation in one dimension: particle in one dimension box, quantization of momentum and energy, continuity of wave function, boundary condition and emergence of discrete energy levels; Potential step and Potential barrier, Tunneling effect, one dimensional harmonic oscillator; energy level and eigen function.

Quantum theory of hydrogen-like atoms: Time independent Schrodinger equation in spherical polar coordinates, separation of the variables for the second order partial differntial equation; Radial wave functions; magnetic and orbital quantum numbers, spherical harmonics, radial wave functions, energy levels, significance of quantum numbers n, l, and m

Reference Books:

1. A Text book of Quantum Mechanics, P.M. Mathews & K. Venkatesan, 2nd Ed., 2010, McGraw Hill

2. Quantum Mechanics, E. Merzbacher, 2004, John Wiley and Sons

3. Quantum Mechanics, Satya Prakash, Pragati Prakashan, Meerut

Paper-II: Digital and optoelectronics

Number Systems, Codes and Boolean Algebra: Binary, Decimal, Octal and Hexa decimal number systems & inter conversion, BCD, Gray, 8421, excess-3 codes, Laws of Boolean algebra, De Morgan's theorems.

Digital Circuits: Difference between Analog and digital circuits, Logic gates (AND, OR, NOT, AND, NAND, XOR & XNOR) with circuits, NAND and NOR Gates as Universal Gates, Half adder and full adders

IC Technology: Basic idea of IC Technology, IC 555 Pin diagram and its application, Monolythic IC components (Integrated, Diffused, Thin Film), MOS Capacitors, Inductors, Thin Film technology.

Optoelectronics and Laser: Optical Fiber, Graded index, step index fibers, refractive index, propagation of optical beams in fibers, fibers mode characteristics and cut off conditions, losses in fibers, Principle of Laser, Ruby laser, He Ne laser, Solid state laser.

Reference Books:

1. Digital Electronics, Malvino, TMH Publication

2. Text Book of Electronics, D C Tayal, Kedar Nath Nath Ram Publications

3. Digital electronics, Principle and practice, Kapoor and Maheshwari, Mackmillan Publ.