

B.Sc. Part - I
PHYSICS- Paper - I
MECHANICS AND PROPERTIES OF MATTER

Maximum Marks-50

Duration -3 hours.

UNIT – I

Vector and its Application: Triple and quadruple products, Reciprocal vectors, Vector and Scalar fields. Vector differentiation, Gradient, Divergence and curl in Cartesian and curvilinear (Spherical and cylindrical), Coordinates with physical significance, Vector integration, Gauss and Stoke Theorem.

UNIT – II

Rigid Body Motion: Rotational motion and moment of inertia, Theorem of perpendicular and parallel axes, calculation of Moment of inertia of ring, planer lamina, Disc, Solid, cylindrical rods having circular and rectangular cross section, Spherical shell, Solid sphere, Hollow cylinder and sphere and Fly wheel. Acceleration of a body rolling down on an inclined plane. Compound Pendulum.

UNIT –III

Gravitational Interaction and Central Field: Inertial and Gravitational mass, Gravitational potential, Potential and field due to a spherical shell and solid sphere, Gravitational self energy, central forces, Angular momentum in central forces, Central motion as one body and two body problem, reduced mass, Principle of space flight and satellite (Geostationary).

UNIT –IV

Elasticity : Elastic constants and their mutual relation, Poisson's ratio, Bending of beam, Torsion of cylinder, Maxwell's Needle, Bending beam, Determination of Y , η and σ .

UNIT –V

Viscosity: Poiseuille's formula for flow of liquid through a capillary tube, Viscous resistance, combination of capillary tubes, effects of temperature and concentration on viscosity.

Surface Tensions: Molecular theory of surface tension, Excess of pressure inside a curved surface, Excess pressure inside a liquid drop and air and soap bubble, Wetting, vapour pressure and surface tension, Effect of temperature on surface tension, Jaeger's method of determination of surface tension.

Book Recommended:-

1. Mechanics : D.S.Mathur.
2. Concept in Physics Vol. I : H.C.Verma.
3. Mechanics : R.K.Shukla and Anchal Srivastava.
4. Elements of Properties of Matter: D.S.Mathur
5. Mechanics : J.C. Upadhyay

B.Sc. Part - I
PHYSICS , Paper - II
Waves and Oscillations

Maximum Marks-50

Duration -3 hours.

UNIT – I

Free Oscillations: The description of SHM, Energy in SHM, Examples of SHM, Basic spring mass system, Simple and compound pendulum, Torsional pendulum, L.C circuit, Vibration of magnet, Oscillation of two masses connected by a spring , Superposition's of two harmonic oscillations, Combination of two perpendicular harmonic oscillations (with frequency ratio 1:1 and 1:2).

UNIT – II

Damped and Forced Oscillations : Damped harmonic motion in mechanical and electrical system and its application to moving coil Ballistic galvanometer, Forced oscillation of mechanical and electrical system, Transient and steady state, Power absorption, Amplitude and velocity resonance, Sharpness of resonance, Mechanical and electrical impedance.

UNIT –III

Normal modes of system having two degrees of freedom with mechanical and electrical oscillations, Forced oscillation of two coupled systems: Theory of filters (qualitative treatment only), Fourier analysis.

UNIT –IV

Wave Motion: Mathematical representation of harmonic waves, Differential form of wave equation, Energy flow in progressive waves, Wave velocities in continuous Systems. Plane and spherical waves, Huygen's principle, Superposition of waves, Interference, Beats and stationary waves, Modes of stationary vibration of air columns and strings, Waves in absorbing and dispersive medium, Phase and group velocity.

UNIT –V

Electromagnetic Waves : . Hertz Experiment, Maxwell's equations and their physical significance, Electromagnetic waves and its propagation in free space.

Ultrasonic Waves : Production of ultrasonic waves, Velocity measurement and applications of ultrasonic waves.

Text Books Recommended:-

1. The Physics of Waves and oscillations: N. K. Bajaj
2. Waves and oscillations: Dongre and C.K. Bhattacharya
3. Waves and oscillations: R.B. Singh

Reference Books Recommended.

1. The Physics of Vibration and Waves: H. J. Pain (John wiley & sons Ltd)
2. Vibrations and Waves: A. P. French. (CBS Publication & Distributors)

B.Sc. Part - I
PHYSICS , Paper - III
Electricity and Electronics

Maximum Marks-50

Duration -3 hours.

UNIT – I

A.C. Circuits : ‘J’ operator and its application to L.C.R. circuit, Series and parallel resonance, Q of Coil.

A.C. Bridge : Anderson , Weins and Robinson bridges.

UNIT – II

Networks : T and π networks and their equivalence, Thevenin, Norton and Maximum power transfer theorems.

UNIT –III

Semiconductors: Intrinsic and extrinsic semiconductor, Junction diodes and their characteristics, Transistors and their characteristics, Relation between α and β .

Regulated Power Supply : Basic idea of regulation using Zener diode and transistor electronic regulator.

UNIT –IV

Transistor Amplifiers: Transistor as two port network, Hybrid parameters, Transistor biasing , Classification of amplifiers, A,B, AB and C transistor amplifiers, Simple and cascaded amplifiers, R.C. coupled amplifier, Feedback amplifier and their analysis.

UNIT –V

Transistor Oscillators : Bark-Housen’s criterion, Simple oscillator circuits using transistor , Tuned collector, Tuned emitter, Colpit and Hartley oscillators, Crystal controlled oscillator , R-C phase shift and wein’s bridge oscillator.

Book Recommended :-

1. Electronics Fundamental and Application: D. Chattopadhyay and P.C. Rakshit.
2. Principle of Electronics: V.K. Mehta
3. Electricity and Electronics: H.B. Lal
4. Electricity and Electronics: K.K. Tewari
5. A Text Book of Electronics: S.L. Kakani and Bhandari.

B.Sc. Part - II
PHYSICS , Paper - I
Thermal Physics

Maximum Marks-50

Duration -3 hours.

UNIT – I

Kinetic Theory of Gases: Maxwell's distribution of molecular speeds, Degree of freedom, Equipartition of energy, Specific heat of an ideal gas, Mean free path, Transport phenomena, Conduction and viscosity.

Equation of State: Andrew's curves, Vander Wall's equation, Critical constants.

UNIT – II

Thermodynamics and Entropy : Reversible and irreversible process, Carnot's engine and its efficiency, Carnot's theorem, Absolute scale of temperature, Second law of thermodynamics, Entropy and its physical significance, Entropy and disorder, Entropy of simple reversible and irreversible process, Nernst heat theorem.

UNIT –III

Maxwell's Thermodynamic Relations : Maxwell's thermo dynamical equations and their application viz. Claussius-Cleypron latent heat equation, Specific heat equation, Magneto caloric effects and thermodynamic functions.

UNIT –IV

Cryogenics: Principle of refrigeration, cooling by Joule Thomson, Throttling process, Principle of regenerative cooling, Liquefaction of gases, Introduction to Super fluidity, adiabatic demagnetization.

UNIT –V

Conduction of Heat : Fourier equation of heat flow, Conduction of heat through insulated rod, Heat conduction through axially heated cylindrical shell, Conduction through spherical shell heated at Centre.

Thermal Radiation : Kirchhoff's law and its applications, Energy density, Pressure of diffuse radiation, Stefan Boltzmann law, Planck's law, derivation of Wien, Rayleigh-Jean and Stefan-Boltzmann law from Planck's law.

Book Recommended :-

1. Heat and Thermodynamics: K.W. Zeemansky.
2. Thermal Physics: B.K. Agarwal.
3. Heat and Thermodynamics: Brij Lal and N. Subramanyam.
4. Heat and Thermodynamics : Dayal, Verma and Pandey
5. A Treatise on Heat : M.N. Saha and B.N. Srivastava.

B.Sc. Part - II
PHYSICS , Paper - II
Optics

Maximum Marks-50

Duration -3 hours.

UNIT – I Geometrical Optics

1. Cardinal points, location for a thick lens and a system of Co-axial thin lenses, Nodal slide.
2. Aberrations:
 - (a) Chromatic: Achromatism of lenses and prisms.
 - (b) Monochromatic: Spherical, Coma, Astigmatism, Curvature of field and distortion and their elimination, Aplanatism and its applications.
3. Eyepieces, Huygen and Ramsden .

UNIT – II

Physical/ Wave optics

- Interference :** 1. Production of coherent light sources, Fresnel's Bi-prism, Lloyd's mirror, Newton's rings, Michelson interferometer, Fabry-Perot interferometer/Etalon, Interference filter.
2. Coherence: Temporal and Spatial.

UNIT –III

- Diffraction:** 1. **Fresnel's Diffraction :** Fresnel's Half period zones, Explanation of Rectilinear propagation of light, Zone plate, Diffraction at a straight edge, Circular aperture and opaque disc and narrow wire.
2. **Fraun Hoffer's Diffraction:** Fraun Hoffer's Diffraction patterns due to a single slit , double slit and N slits ,Plane transmission grating.

UNIT –IV

1. **Concave Grating:** Theory and its various mountings.
2. **Resolution:** Rayleigh criterion of limit of resolution and resolving power of grating, Prism, Telescope and Microscope.

UNIT –V

Polarization : Linearly polarized light, its production and detection, Polariscopes, Brewster's law, Law of Malus, Double refraction, Nicol prism, Huygen's theory of double refraction in uni-axial crystals, Retardation plates, Circulatory and elliptically polarized light, their production and detection , Optical rotation, Polarimeters, Bi-quartz and Half shade.

Book Recommended :-

1. Physical Optics: B. K. Mathur and T. P. Pandya.
2. A textbook of Optics: N. Subrahmanyam, Brijlal and M. N. Avadhanulu.
3. Geometrical and Physical Optics: Longhurst.
4. Introduction to Modern Optics: G. R. Fowels.
5. Optics: P. K. Srivastav.
6. Optics: Jenkins & White
7. Optics: Born and Wolf

B.Sc. Part - II
PHYSICS , Paper - III
Modern Physics

Maximum Marks-50

Duration -3 hours.

UNIT – I

Relativity: Concept of space, Time and mass, inertial frame of reference, Galilean invariance, Michelson-Morley experiment, Postulates of special theory of relativity, Lorentz transformation equations, Length contraction, Time dilation, velocity addition theorem, variation of mass with velocity, Mass energy equivalence, Energy momentum relationship.

UNIT – II

Matter Waves : de-Broglie's concept of matter waves, de-Broglie wave length, Wave velocity and Group velocity for de-Broglie waves, Experimental study of matter waves, Heisenberg's uncertainty principle with illustration , Wave mechanical model of atom .

Atomic Physics : Sommerfeld's relativistic atom model (qualitative description only), Vector atom model, Coupling Schemes, Pauli's exclusion principle, Normal Zeeman effect, Stern gerlach experiment, Raman effect.

UNIT –III

X-rays and Crystal Lattice: Continuous and characteristic X-rays spectrum, Mosley's law, Compton scattering, Crystal lattice, Unit cell, Bravais lattice, Miller indices, Element of symmetry, Structure of Diamond, KCl and NaCl crystals .

UNIT –IV

Radioactivity: Half life period, Mean life, Law of successive disintegration, Radioactive equilibrium, Radioactive dating.

Particle Accelerator: Cyclotron, Basic concept of higher energy accelerators.

UNIT –V

Nuclear Physics : General properties of nucleus, Nuclear binding energy, Nuclear forces, Elementary idea about liquid drop and shell model of the nuclear structure, nuclear Fission & Fusion, Thermonuclear reaction and stellar energy.

Cosmic Rays : Origin, Primary and Secondary cosmic rays, Cosmic ray showers.

Book Recommended :-

1. The Concept of Modern Physics: Arthus Beiser
2. Elementary Modern Physics: A.P. Arya.
3. Introduction to Special Relativity: Robert Resnick.
4. Modern Physics: J. Bernstein, P.M. Fishbane, Stephen Gasiorowicz.
5. Solid State Physics: N.W. Ashcroft and N.D. Mermin
6. Modern Physics: R. Murugesan.
7. Modern Physics: K.S. Krane.

B.Sc. Part - III
PHYSICS , Paper - I
Mathematical and Classical Physics

Maximum Marks-55

Duration -3 hours.

UNIT – I

Relativity: Four vector and tensor, Relativistic dynamics of point particle, Proper time , velocity, Energy and momentum.

UNIT – II

Tensors : Coordinate transformation, scalar, Vector, contravariant, Co-variant, Mixed, Symmetric, Skew-symmetric, Epsilon, Metric, Pseudo and associated tensors, Addition , Substraction, multiplication and contraction of tensors, Rank of tensor, Christoffel's symbol, Co-variant derivative of a vector and a tensor.

UNIT –III

Partial Differential Equation:. Laplace equation and its solution, Bessel, Hermite, Legendre and Laguerre differential equations and their solutions. Generating functions, Recurrence relations, Orthogonality condition, Rodrigue's formula.

UNIT –IV

Generalized Coordinates, D'Alemberts principle and Lagrange's equation of motion, Hamilton's variational Principle, Hamilton's equation of motion.

UNIT –V

Canonical Transformation, Hamilton-Jacobi equation, Action and angle variables, Poisson Brackets, Jacobi Identity.

Book Recommended:-

1. Mathematical Methods for Physicists: Arfken and Weber
2. Mathematics for Physicists and Engineers: Pipes.
3. Mathematical Method for Physics: Ghatak
4. Mathematical Methods for Physics: Wyle
5. Mathematical Methods for Physical Sciences: Boas.
6. Mathematical Physics: P.K. Chattopadhyay
7. Classical Mechanics: H. Goldstein.
8. Mechanics: L.D. Landau and E.M. Lifshitz.
9. Introduction to Classical Mechanics: R.G. Takwale and Puranik.
10. Classical Mechanics of Particles and Rigid Bodies: K. C. Gupta.
11. Introduction to Classical Mechanics: N.C. Rana and P. Joag.

B.Sc. Part - III
PHYSICS , Paper - II
Atomic and Molecular Physics

Maximum Marks-55

Duration -3 hours.

UNIT – I

Quantum mechanics of hydrogen atom (Full solutions of the equation is not given here). Angular momentum associated with l/m , concepts of nodal surfaces-shape of functions for $l=0,1,2$.

Electron Spin : Concept of an electron as a magnet, Relation between spin angular momentum and magnetic moment, Interaction between orbital and spin magnetic moment, Spin-orbit interaction and causes of double structure (Vector model treatment in detail and Perturbation treatment can be indicated).

UNIT – II

Many Electron Atoms : Bohr-Stoner Schemes of electronic shells, Helium atom and the inter-electron repulsion term, Introduction of vector coupling and concept of electron configurations, Optical spectra of alkali atoms and concept of penetrating orbits, Rydberg atoms and their properties (Qualitative picture).

UNIT –III

Introduction to LASERS: Einstein's coefficients and phenomenological treatment of radiation, Properties of spontaneous and stimulated emissions, Coherence in stimulated emission, Population inversion and laser radiation , Ammonia maser, Ruby and He-Ne lasers, Laser applications (Qualitative treatment).

UNIT –IV

Manny Electron Atoms: Alkaline Earth atoms and their energy levels, LS and JJ Coupling (Vector model treatment), Derivation of electronic states from a given electron configuration, Ground states of atoms.

Di-atomic Molecular Structure: Formation of di-atomic molecule from two atoms, Forces of attraction and repulsion , Dispersion forces, Vander wall's forces, Covalent bonds and general variation of energy as a function of internuclear separation, Approximation of a molecule near equilibrium in terms of a harmonic oscillator, Rigid rotator, Spectra of an oscillator and a rotator, Modification due to an harmonicity and non-rigidity.

UNIT –V

Electronic energy and qualitative description of electronic transition in a diatomic molecule, Frank-Condon factor and intensity distribution, Rotational Structure of electronic transitions, Determination of molecular constants, Dissociation of a molecule, Forces between molecules.

Book Recommended :-

1. Introduction to Atomic Spectra: H.E. White.
2. Molecular spectroscopy vol, I: Hertzberg
3. Atomic, Molecular physics and Lasers: D.K. Rai and S.N. Thakur.
4. Molecular spectroscopy: G. M. Barrow
5. Physics of Atoms and Molecules : B.H. Bransden, C.J. Jochain.
6. Fundamental of Molecular spectroscopy: Colin N Banwell
7. Lasers Theory and Applications: K. Thyagarajan, A.K.Ghatak.
8. Principles of LASERS :- Svelto

B.Sc. Part - III
PHYSICS, Paper - III
Statistical and Quantum Mechanics

Maximum Marks-55

Duration -3 hours.

Statistical Mechanics

UNIT – I

Phase space, Specification of the state of system, Density of state and its general behavior, Liouville's theorem and its consequences, Elements of classical and quantum statistics. Maxwell, Boltzmann, Bose-Einstein and Fermi-Dirac distribution function and their comparison, Partition function.

UNIT – II

Ensemble, viz, Micro-canonical, canonical and Grand and Grand canonical and their application.

Quantum Mechanics

UNIT –III

Foundation of wave mechanics, Particle nature of photons and wave nature of particles, Principle of complementarity, Principle of superposition, Motion of wave packets.

UNIT –IV

Schrodinger wave equation, Physical interpretation of wave function, Expectation values of dynamical variables, Ehrenfest theorem, orthogonal properties of wave function.

UNIT –V

One dimensional motion in step potential, Rectangular barrier, square well potentials, Harmonic oscillator (one dimensional), Rigid rotator, Hydrogen atom (in spherical polar co-ordinates).

Book Recommended :-

1. Fundamentals of Statistical and Thermal Physics: Frederick Reif.
2. Statistical Mechanics (2nd Edition): R.K. Pathria.
3. Equilibrium Statistical Physics: Michael Plischke and Birger Bergersen.
4. Statistical Mechanics: (Wiley): Kerson Huang.
5. Statistical Mechanics: S.K. Sinha
6. Statistical Mechanics: B.K. Agarwal
7. Quantum Physics: S. Gasiorowicz.
8. Quantum Mechanics: B. H. Bransden and C. J. Joachain.
9. Quantum Physics of Atoms, Molecules, Nuclei and Solids: R. M. Eisberg and R. Resnick.
10. Quantum Mechanics: V. Devanathan.
11. Quantum Mechanics: C. S. Chaddha.
12. Quantum Mechanics: Ghatak
13. Quantum Mechanics: J.J. Sakurai

B.Sc. Part - III
PHYSICS , Paper - IV
Semiconductor Devices and Electronics

Maximum Marks-55

Duration -3 hours.

UNIT – I

Physics of Semiconductor Devices : The p-n junction and its band structure, Quantitative theory of junction diodes, currents, V-I relation and characteristics, Temperature dependence of p-n characteristics, Junction capacitance, Diode switching times, Tunnel diodes, Photo voltaic effect Metal semiconductor junctions, Photo diodes and light emitting diodes.

Switching Devices : SCR, its characteristics and applications in triggering and phase control, UJT, its characteristics and applications.

UNIT – II

Field Effect Transistor: Basic structure of the JFET, Principle of operation, characteristic curves and parameters, MOSFET: Depletion mode and enhancement mode, Dual gate MOSFET, Application of FET as an amplifier.

UNIT –III

Logic Circuits: Number systems, Inter conversion of number system, Codes (Natural BCD, Excess 3 and grey codes). Basic logic gates, Invertors/NOT, AND,OR, NAND, X-OR and X-NOR gates, Boolean algebra , NAND and NOR gates as basic building blocks in logic circuits, RTL, DTL, and TTL logic families.

UNIT –IV

Modulation: Amplitude modulation (Linear and Square modulation law), Analysis and spectrum of AM, Production of AM wave, Plate modulation, Grid bias modulation, Carrier suppressed and S.S.B. amplitude modulator.

Frequency Modulation: Analysis, wave shape and frequency spectrum of FM wave, Production of FM wave by reactance tube and semi conductor devices.

UNIT –V

Detection-

Amplitude Detection: Detection of amplitude modulated wave, Diode, triode and semi-conductor detectors.

Frequency Detection: Detection of FM wave by discriminator and its limitations, Ratio detector.

Book Recommended :-

1. Electronics Fundamental and Application: Chattopadhyay and Rakshit.
2. Principle of Digital Electronics: Malvino and Leach.
3. A Text Book of Electronics: Kakani and Bhandari.
4. Electronic Devices: T.L. Floyd.
5. Integrated Electronics: Millman and Halkias.