B. Sc. (Pass)

Sl. No.	Name of the Paper	Paper Code	Credits	Periods/week
		Semester I		
1	Mechanics	PHB-11P	3	3
2	Lab 1	PHB-12L	1	2
		Semester II		
3	Thermal Physics	PHB-21P	3	3
4	Lab II	PHB-22L	1	2
		Semester III		
5	Electricity & Magnetism I	PHB-31P	3	3
6	Optics	PHB-32P	3	3
7	Lab III	PHB-32L	2	4
		Semester IV		
8	Electricity & Magnetism II	PHB-41P	3	3
9	Quantum Mechanics	PHB-42P	3	3
10	Lab IV	PHB-42L	2	4
		Semester V		
12	Electromagnetic Theory	PHB-51P	3	3
13	Atomic & Molecular Physics	PHB-52P	3	3
14	Lab V	PHB-52L	2	4
		Semester VI		
15	Solid State Physics	PHB-61P	4	4

Semester I

Core Course **Mechanics** **PHB-11P**

Unit I: Fundamentals of Dynamics

Newton's Laws of motion, dynamics of a system of particles, centre of mass, conservation of momentum, impulse, variable mass system. Work-energy theorem, potential energy, conservative and non-conservative forces, force as gradient of potential energy. Particle collisions, centre of mass and laboratory frame. Inertial frames and non-inertial frames, uniformly accelerated system,

Unit II: Rotational Dynamics

Angular momentum of a system of particles, torque and conservation of angular momentum, rotation about a fixed axis, moment of inertia tensor: its calculation for regular bodies, kinetic energy of rotation; Physics in rotating coordinate system, Centrifugal and Coriolis forces.

Unit III: Gravitation

Newton's law of gravitation, inertial and gravitational mass, potential energy due to spherical shell and solid sphere, angular momentum conservation Kepler's laws.

Unit IV: Special Theory of Relativity I

Michelson Morley experiment, Lorentz transformations, simultaneity and order of events, Lorentz contraction and time dilation, velocity addition theorem.

Reference Books:

1. An introduction to mechanics : Kleppner & Kolenkow.
2. Feynman Lectures-Volume I,
3. Problems in Physics : Irodov
4. Special Theory of Relativity :Resnick
5. Newtonian Mechanics : A.P.French
6. Mechanics : Berkeley Physics Course.

Semester I

Physics Practical **Lab I** **PHB-12L**

Mechanics & Oscillation

List of Experiments :

1. To study the Motion of Spring and calculate Spring constant by static and dynamic method (4)
2. To determine the value of g using Bar Pendulum. (4)
3. To determine the value of g using Kater's Pendulum. (4)
4. To determine surface tension of a fluid by capillary rise method. (3)
5. To determine the Moment of Inertia of a Flywheel. (4)
6. To determine Coefficient of Viscosity of water by Stoke's law. (3)
7. To determine the Young's Modulus of a Wire by Optical Lever Method.(1)
8. To determine the surface tension of a liquid by Jaeger's method.(2)

Semester II

Core Course **Thermal Physics** **PHB-21P**

Unit I: Kinetic theory of gases

Derivation of Maxwell's law of distribution of velocities and its experimental verification. Mean free path. Transport phenomena, viscosity.

Unit II: Ideal and Real gases

Equation of state for ideal gas, internal energy, specific heat, entropy, deviation from ideal gas, Andrew's experiment, Van der Waal's equation, critical constants and law of corresponding states, Joule-Thompson effect.

Unit III: Thermodynamics

Zeroth, First and Second laws. Reversible and irreversible processes. Carnot's theorem. Clausius inequality. Absolute scale of temperature. Entropy. Thermodynamic Relations and their applications.

Unit IV: Thermodynamic Functions

Maxwell's relations and their applications. Change of phase. Equilibrium between a liquid and its vapour. Clausius–Clapeyron equation. Triple point with examples from physics. Second order phase transitions.

Reference Books:

1. A Text book of heat: M. N Saha and B.N Srivastava
2. Heat and Thermodynamics: Zemansky, Richard Dittman .
3. Thermal Physics : Garg, Bansal and Ghosh .
4. Thermodynamics, Kinetic Theory and Statistical Thermodynamics: Sears &Salinger.

Semester II

Physics Practical **Lab II** **PHB-22L**

Electronics (Analog) & Thermal Physics

List of Experiments :

1. To study V-I characteristics of PN junction diode. (4)
2. To study the V-I characteristics of a Zener diode and its use as voltage regulator. (4)
3. To study the characteristics of a Bipolar Junction Transistor in CE configuration. (4)
4. To study growth and decay of charge on a condenser in RC circuit. (4)
5. To study Half wave and Full wave rectifier and find their ripple factor for various filters.(4)
6. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee's disc method. (2)
7. To determine Stefan's constant (2)
8. To determine the frequency of the mains with Melde's experiment.(3)

Semester III

Core Course **Electricity & Magnetism I** **PHB-31P**

Unit I: Vector Calculus

Scalars and vectors, dot and cross products. Gradient of a scalar field, divergence and curl of vector field. Line, surface and volume integrals involving vector fields. Gauss' , Green's and Stokes' theorems.

Unit II: Electrostatics

Coulomb's law, Calculation of electric field for simple distributions of charges. Electrostatic potential, Gauss' law and its applications. Capacitors, electrostatic field energy. Method of images. Poisson and Laplace's equations.

Unit III: Magneto-statics

Magnetic induction B. Lorentz force, Biot-Savart law. Ampere's law. Fields due to a straight wire and a circular current loop. Magnetic dipole. Circular current and solenoid.

Unit IV: Faraday's law

Electromagnetic induction: Integral and differential forms. Induced electric field and emf. Mutual and self-inductance. Transformers. Magnetic field energy.

Reference Books:

1. Introduction to Electrodynamics : D.J. Griffiths
2. Electricity and Magnetism : A.S. Mahajan and A.A. Rangwala
3. Electricity and Magnetism : Berkeley Physics Course ed. E.M. Purcell
4. Physics (Vol. 2) : Halliday and Resnick
5. Feynman Lectures in Physics (Vol II)

Semester III

Core Course **Optics** **PHB-32P**

Unit I: Interference :

Coherent sources, Young's Double slit experiment, Division of wave front. Fresnel's bi-prism. Division of amplitude. Interference in thin films. Newton's rings. Michelson's interferometer.

Unit II: Diffraction :

Fraunhofer diffraction at single, double and N slits. Fresnel diffraction at a straight edge and circular aperture. Cornu-spiral. Half-period zones. Zone plate. Diffraction grating.

Unit III: Polarization :

Plane, circular and elliptical polarization of light. Double refraction. Nicol prisms. Wave plates. Optical activity.

Unit IV: Miscellaneous Topics :

Fermat's principle of geometrical optics. Huygen's principle. Resolving power of optical instruments and diffraction grating. Principle of lasers and holography.

Reference Books:

1. Optics : A. K. Ghatak
2. Fundamentals of Optics : Jenkins and White
3. Principles of Optics : Max Born and Emil Wolf
4. Optics : Eugene Hecht

Semester III

Physics Practical **Lab III** **PHB-32L**

Optics

List of Experiments :

1. Focal length of two lenses by Nodal Slide method and verification of Newton's formula. (1)
2. To determine wavelength of Na source using plane diffraction grating (2)
3. Determination of refractive Index and dispersive power of a prism using spectrometer. (2)
4. Determination of wavelength of LASER using plane transmission diffraction grating. (2)
5. Determination of wavelength of sodium light by Newton's Rings method. (4)
6. Determination of specific rotation of sugar solution by Laurent's Half-Shade Polarimeter(4)

7. Verification of Hartman's dispersion formula. (1)
8. To determine wavelength of spectral lines of Hg source using plane diffraction grating. (2)
9. To determine dispersive power and resolving power of a plane diffraction grating.(1)
10. To determine the wavelength of Sodium light by using Fresnel’s Biprsm (1)

Semester IV

Core Course **Electricity & Magnetism II** **PHB-41P**

Unit I: Current and circuits

Current density, steady and non-steady currents and continuity equation, rise and decay of currents in LR and CR circuits, Complex impedance and reactance, frequency response. Series and parallel circuits, resonance, Q factor, Power dissipation and power factor.

Unit II: Electrostatic fields in matter

Dielectrics, polarization and the electric displacement vector D. Susceptibility, permittivity, dielectric constant. Energy in dielectric systems, forces on Dielectrics, Clausius-Mossotti equation, Polar molecules. The Langevin formula.

Unit III: Magnetic fields in matter

Magnetization. Dia, para and ferromagnetism. The field of a magnetized object. Bound currents. Ampere's law in magnetized medium. Magnetic field intensity vector H. Magnetic susceptibility and permeability. Ferromagnetism. Energy loss in Hysteresis and the B-H curve.

Unit IV: Boundary value problems

Poisson's equation, Laplace's equation, boundary conditions, uniqueness theorem. Method of images, Different image problems; Techniques for solving boundary value problems in magnetostatics.

Reference Books:

1. Introduction to Electrodynamics : D.J. Griffiths
2. Electricity and Magnetism : A.S. Mahajan and A.A. Rangwala
3. Electricity and Magnetism : Berkeley Physics Course ed. E.M. Purcell
4. Physics (Vol. 2) : Halliday and Resnick

Semester IV

Core Course **Quantum Mechanics** **PHB-42P**

Unit 1: Review of the old quantum theory

De Broglie hypothesis and the wave-particle duality. Davisson Germer experiment. Wave function and Born's interpretation. Fourier Transform. Particles and Wave packets. Phase and Group velocity. Uncertainty Principle. Application of uncertainty Principle

Unit II: The Schrodinger equation

Schrodinger Equation. Conservation of Probability. Probability current density. Expectation values. Ehrenfest theorem. Time independent Schrodinger equation. Stationary States. Eigen function and eigenvalues.

Unit III: One dimensional problems

Particle in potential well - infinite square well and finite square wells. Potential barrier problems - step potential and rectangular potential. The harmonic oscillator problem.

Unit IV: The three-dimensional problem

Spherically symmetric potential. Angular momentum operator and its eigenvalues. Commutation Relations. Spin of the electron. Hydrogen atom and the degeneracy of energy levels.

Reference

1. . Concepts in Modern Physics: Beiser
2. Quantum Mechanics: Zettili
3. Quantum Mechanics: Griffiths
4. A text book on Quantum Mechanics : M.C.Jain

Semester IV

Physics Practical **Lab IV** **PHB-42L**

Electricity & Magnetism

List of Experiments:

1. Determination of E.C.E. of copper using a Copper Voltameter and checking the accuracy of ammeter. (2)
2. Determination of Self Inductance of a coil using Anderson's Bridge. (3)
3. Determination Self Inductance of a coil by Owen's Bridge. (2)
4. Study of LCR circuit and determination of impedence. (3)
5. Determination of magnetic field by Helmholtz coil. (2)
6. To draw the B-H curve for the iron and to determine the energy loss due to hysterisis.(2)
7. To determine the temperature coefficient of resistance by Platinum Resistance Thermometer (PRT). (2)
8. Conversion of a moving coil galvanometer into an ammeter and voltmeter.(3)
9. To determine the dielectric constants for solids.(1)
10. Study of the Wien bridge oscillator and determine the frequency of the oscillator. (2)

Semester V

Core Course **Electromagnetic Theory** **PHB-51P**

Unit I: Electrodynamics

Electromagnetic Units, Displacement current, Continuity Equation, Maxwell's Equations in vacuum and in media, Boundary conditions, Poynting Theorem.

Unit II: Multipole expansion and Radiation

Multipole Expansion of potentials. Radiation, Electric dipole field and radiation, Magnetic dipole radiation, Radiation from an arbitrary source.

Unit III: Electromagnetic waves

Electromagnetic waves in vacuum and non-conducting medium, Propagation in linear media, reflection and refraction at a plane interface, Brewster's angle, total internal reflection. EM waves in conductors, absorption and dispersion.

Unit IV: Waveguides

Cylindrical cavities and Waveguides, Wave guides, Modes in Rectangular wave guides, Energy flow and attenuation in Waveguides

Reference Books:

1. Introduction to Electrodynamics : D.J. Griffiths
2. Foundations of Electromagnetic Theory : Reitz, Millford and Christy
3. Classical Electrodynamics : J.D.Jackson
4. Introduction to Electromagnetic Field and Waves : Corson and Lorrain

Semester V

Core Course **Atomic and Molecular Physics** **PHB-52P**

Unit I: Introduction

Brief review of early models of atomic structure. Rutherford scattering, Limitation of Bohr-Sommerfeld theory. Frank & Hertz experiment. Addition of angular momenta.

Unit II: Atomic structure

Pauli's Exclusion Principle; Fine structure; Spin-orbit coupling; Vector model; L-S and J-J couplings. Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms.

Unit III: Interaction with Electromagnetic field

Spin angular momentum; Larmors Theorem; Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman effect; Normal and Anomalous Zeeman Effect; Paschen Beck effect; Stark effect

Unit IV: Molecular Spectra

Rotational Energy levels, Selection rules and pure rotational spectra; Vibrational energy levels, selection rules and vibration spectra; Rotation-vibration energy levels, selection rules and spectra. Determination of internuclear distance. Raman Effect, Stoke's and Anti-Stoke's Lines.

Reference Books:

1.Concepts of Modern Physics : Arthur Beiser .
2. Introduction to Atomic Spectroscopy : H.E. White.
3. Modern Physics : Mani and Mehta
4. Physics of Atoms and Molecules : Bransden and Joachain.
5. Molecular Spectroscopy : C.N. Banwell.

Semester V

Physical Practical **Lab V** **PHB-52L**

Modern Physics

List of Experiments :

1. Determination of Planck's constant by photocell and verify the radiation law. (2)
2. Determination of wavelength of Sodium light using Michelson's Interferometer (2)
3. Determination of the band gap of a semiconductor using four probe method. (2)
4. Determination of magnetic susceptiblity of $MnCl_2$ by Quinck's method (2)
5. Determination of Planck's constant by cut off method. (2)
6. e/m by Thomson's method. (2)
7. To determine the Hall coefficient of a semiconductor sample.(2)
8. To demonstrate the concept of quantisation of energy levels using Franck Hertz Experiment (1)
9. To determine the ionization potential of mercury (1)
10. To determine the Zeeman splitting with Mercury. (1)

Semester VI

Core Course **Solid State Physics** **PHB-61P**

Unit I: Crystal Structure Defects

Crystalline state of solids, Lattice Translation Vector, Unit cell, Wigner- Seitz cell, Number of lattice point per unit cell, packing fraction, Bravais lattice, Miller indices, Interplaner spacing, Symmetry elements, types of lattices Brillouin zone, reciprocal lattice. Point defects-Frenkel and Schottky vacancies, Line defects-Edge and screw dislocations, Planer defects, Stacking faults

Unit II: X-rays and Atomic Bonding

X-Rays: Continuous and characteristic X-rays spectra, Absorption of X-rays, Diffraction of X-rays, Bragg's law, Laue's equations, Powder method. Atomic Bonding: Interatomic forces and classification of solids, Bond dissociation Energy, Cohesive Energy of ionic crystal, Types of Bonds; Ionic bond, Covalent bond, Metallic Bonding, Van der Waals Bonding

Unit III: Elementary Lattice Dynamics

Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic molecules chains, Acoustical and Optical Phonons, Qualitative Description of the Phonon spectrum in solids, Dulong and Petit law, Einstein and Debye theories of specific heat of solids, Debye T3 law.

Unit IV: Electrical Conductivity

Free electron theory, Sommerfeld model, Fermi level, Density of states, Electrical conductivity of metals and its temperature dependence, Weidemann-Franz law, Hall Effect.

Reference Books:

1. Introduction to Solid State Physics : Charles Kittle
2. Solid state physics : Rita John
3. Introduction to Solids : Azaroff L. V
4. Solid State Physics : N.W. Ashcroft and N.D. Mermin
5. Solid-state Physics : H. Ibach and H. Luth
6. Elements of Solid State Physics : J.P. Srivastava.