

# Manipur University

## Course Structure

For Undergraduate Course: B. Sc. (Physics)

### Semester I

Course		Marks
FC- 1	Foundation Course (General English)	100
<b>PHY- 101</b>	Mechanics	75
	Laboratory	25
E <sub>2</sub> -101		100
E <sub>3</sub> -101		100

### Semester II

Course		Marks
FC- 2	Foundation Course ( General English)	100
<b>PHY- 202</b>	Thermal Physics and Optics	75
	Laboratory	25
E <sub>2</sub> -202		100
E <sub>3</sub> -202		100

### Semester III

Course		Marks
FC- 3	Foundation Course ( Environmental Studies)	100
<b>PHY- 303</b>	Electricity and Magnetism	75
	Laboratory	25
E <sub>2</sub> -303		100
E <sub>3</sub> -303		100

## Semester IV

Course		Marks
FC- 4	Foundation Course ( Environmental Studies)	100
<b>PHY-404</b>	Atomic and Nuclear Physics	75
	Laboratory	25
E <sub>2</sub> -404		100
E <sub>3</sub> -404		100

## Semester V (Honours)

Course		Marks
<b>PHY-505</b>	Electronics	100
<b>PHY-506</b>	Mathematical Physics	100
<b>PHY-507</b>	Laboratory	100

## Semester VI (Honours)

Course		Marks
<b>PHY-608</b>	Quantum Mechanics	100
<b>PHY-609</b>	Physics of Materials	100
<b>PHY-610</b>	Laboratory	100

**Manipur University**  
**B.Sc. Physics Syllabus**

**Semester I**

**PHY- 101: MECHANICS**

**Marks: 75**

**Fundamentals of Dynamics**

Dynamics of a single particle. Dynamics of a system of particles, Centre of mass. Conservation of momentum, Idea of conservation of momentum from Newton's third law, Impulse, Momentum of variable mass system; motion of rocket, Work-energy theorem, Potential energy, Energy diagram, Stable and unstable equilibrium, Conservative and non-conservative forces, Force as gradient of potential energy

10 marks

**Rotational Dynamics**

Angular momentum of a particle and system of particles, Torque, Conservation of angular momentum, Rotation about a fixed axis, Moment of inertia; its calculation for rectangular, spherical and cylindrical bodies; Kinetic energy of rotation

15 marks

**Gravitation and Central Force Motion**

Law of gravitation, Inertial and gravitational mass and their equivalence, Potential energy and field due to spherical shell and solid sphere, Self energy, Motion of a particle under central force field, Angular momentum conservation, one body problem, two body problem and its reduction to one body problem and its solution, The energy equation and energy diagram

15 marks

**Oscillatory Motion**

Motion of simple and compound pendulum. Loaded spring, Energy considerations, Time average of energy, Damped harmonic oscillator, Resonance in a lightly damped system, Free oscillations of system with one degree of freedom, Linearity and superposition principle, Superposition of (i) two and (ii) N collinear harmonic oscillations; beats

15 marks

**Special theory of Relativity**

Michelson-Morley experiment and its outcome, Postulates of special theory of relativity, Lorentz transformations, Simultaneity and order of events, Lorentz contraction and time dilation, Relativistic transformation of velocity, frequency and wave number, Velocity dependence of mass and equivalence of mass and energy, Relativistic Doppler effect, Relativistic kinematics, Transformation of energy and momentum

20 marks

**Suggested Books:**

1. An introduction to mechanics by Daniel Kleppner, Robert J. Kolenkow (McGraw-Hill, 1973)
2. Berkeley Physics Course Vol 1 Mechanics: Charles Kittel, Walter Knight, Malvin
3. Ruderman, Carl Helmholtz, Burton Moyer, (Tata McGraw-Hill, 2007)

4. Mechanics: D S Mathur (S. Chand & Company Limited, 2000)
5. The physics of waves and oscillations: N.K. Bajaj (Tata McGraw-Hill, 1988)
6. Berkeley Physics Course Vol 3 Waves: Franks Crawford (Tata McGraw-Hill, 2007)

**Laboratory:****Marks: 25**

1. Determination of 'g' by using a compound pendulum (bar with holes)
2. Determination of moment of inertia of a body using a torsion pendulum
3. Determination of frequency of a tuning fork by means of a sonometer
4. Determination of 'g' by Kater's pendulum
5. Determination of surface tension of a given liquid by capillary rise method and verification of the Jurin's law
6. Determination of coefficient of viscosity of water by Poiseuille's method
7. Verification of Stoke's Law and determination of coefficient of viscosity of a liquid
8. Determination of Young's modulus by Searle's method
9. Determination of rigidity modulus by statical method

**Semester II****PHY-202: THERMAL PHYSICS AND OPTICS****Marks: 75****Thermodynamics**

First and second laws of thermodynamics, Carnot theorem, Thermodynamic scale of temperature, Entropy, Entropy of a mixture, Third law of thermodynamics, Thermodynamic potentials: Enthalpy, Gibbs and Helmholtz functions, First- and second- order phase transitions, Chemical potential, Maxwell relations and their applications, Clausius-Clapeyron's equation, Ehrenfest's equation, Joule- Thomson effect and its theory, Magnetic cooling by adiabatic demagnetization, approach to absolute zero.

15 marks

**Kinetic Theory of Gases and Radiation**

Derivation of Maxwell's law of distribution of velocities, Mean free path, Transport phenomena, viscosity, conduction, diffusion and Brownian motion Equation of state for ideal gases. Equation of state for real gases, Deviations from the ideal gas equation, The virial equation, Derivation of Van-der-Waal's equation, Critical constants and law of corresponding states

Blackbody radiation, Wien's displacement law, Rayleigh-Jeans' law and ultraviolet catastrophe, derivation of Planck's radiation law

20 marks

**Interference and Diffraction:**

Interference in thin films, Fringes of equal thickness and equal inclination, Theory of Newton's rings, Michelson's interferometer and Fabry-Perot interferometer.

Difference between Interference and diffraction, Theory of Plane diffraction grating, Resolving power and dispersive power of a plane diffraction grating, Fresnel's integrals, Cornu's spiral, Fresnel diffraction pattern at a straight edge

20 Marks

**Polarization**

Polarization by reflection, double refraction, wave surfaces at uniaxial crystal, production and detection of elliptically and circularly polarised light, Babinet's compensator-theory and uses, optical activity and polarimeter

10 marks

**Elements of Quantum Optics**

Stimulated emission, population inversion, mechanism of population inversion, spontaneous and stimulated emission, Einstein's coefficients, Threshold condition for laser action, He-Ne laser, Ruby laser, application of lasers, Elements of second harmonic generation

10 marks

**Suggested Books:**

1. A treatise on heat: including kinetic theory of gases, thermodynamics and recent
2. advances in statistical thermodynamics: Meghnad Saha, B. N. Srivastava (Indian Press, 1958)
3. Heat and thermodynamics: an intermediate textbook: Mark Waldo Zemansky, Richard Dittman (McGraw-Hill, 1981)
4. Thermodynamics, kinetic theory, and statistical thermodynamics: Francis W. Sears & Gerhard L. Salinger. (Narosa, 1986).
5. Fundamentals of optics: Francis Arthur Jenkins and Harvey Elliott White (McGraw-Hill, 1976)
6. Optics: Ajoy Ghatak (Tata McGraw Hill, 2008)
7. A Textbook of Light: B. Ghosh and K.G. Mazumdar, (5<sup>th</sup> Edition) Sreedhar Publishers, Kolkata
8. Thermal Physics – P K Chakrabarti, New Central Book Agency 2006, Kolkata

**Laboratory:****Marks: 25**

1. To construct a thermocouple with the elements supplied and to determine the melting point of the given substance and the thermoelectric power
2. Determination of J by Callendar and Barne's method
3. Determination of co-efficient of linear expansion of a metallic rod by optical lever method
4. Verification of Newton's law of cooling
5. Determination of apparent expansion of a liquid by weight thermometer method
6. Determination of frequency of a tuning fork by Melde's method
7. Determination of thermal conductivity of a metallic rod by Searle's method
8. Determination of the refractive index of the given liquid with help of a plane mirror, convex lens and a spherometer
9. Determination of the refractive index of a given liquid by travelling microscope method

## Semester III

## PHY -303: ELECTRICITY AND MAGNETISM

Marks: 75

**Vector and scalar fields**

Fields-scalar and vector, examples, directional derivative and gradient of a vector field, flux and divergence of a vector field, circulation and curl of vector field, algebra of the del operator and Laplacian operator, Gauss's theorem, Stoke's theorem and Green's theorem

15 marks

**Electric Field**

Electric field and electric lines, Gauss's Law and applications, electrostatics of conductor, Electric potential, multipole moments and multipole expansion, force, torque and energy of a dipole in an external electric field, Poisson's and Laplace's equations, uniqueness theorem, solutions to Laplace's equations in spherical coordinates, zonal harmonics, conducting sphere in uniform electric field

Electrostatic energy, system of point charges, system of continuous charge distribution, spherically symmetric charge distributions, charged capacitors

Dielectric properties of matter, polarization, electric field caused by polarised matter, Gauss's law in a dielectric, boundary conditions on  $\mathbf{E}$  and  $\mathbf{D}$ , capacitors filled with dielectric, dielectric sphere in a uniform electric field, Clausius- Mosseti equation

20 marks

**Magnetic field**

Magnetic field, magnetic force between currents and definition of  $\mathbf{B}$ , divergence and curl of  $\mathbf{B}$ , Ampere's circuital law, magnetic scalar and vector potentials, calculation of  $\mathbf{B}$  for a straight wire, a circular loop, and a solenoid, field of a dipole, force, torque and energy of a dipole in an external field, magnetic moment, Lorentz force, magnetic field energy

Magnetic properties of matter, magnetization, magnetic field caused by magnetized matter, field equations in a magnetized matter, Ampere's law in a magnetized matter, boundary conditions on  $\mathbf{B}$  and  $\mathbf{H}$ , magnetic shell, magnetic circuits, hysteresis and  $\mathbf{B}$ - $\mathbf{H}$  curve

20 marks

**Electromagnetic induction**

Electromagnetic induction, Faraday's laws of induction, curl  $\mathbf{E}$ , self and mutual inductance, reciprocity theorem, energy stored in a coil

Alternating current and transient phenomena, A C circuit, mean value of current and voltage, skin effect, power factor, A C in L-R, C-R, L-C-R circuits, series and parallel resonance, transient growth and decay of currents in L-R, C-R, L-C-R circuits, oscillatory discharge

Maxwell's equations, the equations and their physical meanings and the respective laws, equation of continuity, wave equations for  $\mathbf{E}$  and  $\mathbf{B}$ , plane wave solutions, transverse nature of electromagnetic wave, flow of electromagnetic power and the Poynting theorem

20 marks

**Suggested Books:**

1. Introduction to Electrodynamics: David J. Griffiths, 3rd edition, (Benjamin Cummings, 1998).
2. Elements of Electromagnetics: Mathew N.O. Sadiku ( Oxford University Press)

3. Electricity and magnetism: Edward M. Purcell (McGraw-Hill Education, 1986)
4. Electricity and magnetism: D C Tayal (Himalaya Publishing House, 1988).
5. Electricity and Magnetism: D Chattopadhyay and P Rakshit

**Laboratory:****Marks: 25**

1. Determination of the horizontal component of earth's magnetic field and the magnetic moment of the magnet with the help of a deflection magnetometer
2. Determination of self inductance by Rayleigh's method
3. Determination of frequency of the A.C. mains with the help of sonometer
4. Determination of capacitance by de Sauty's bridge
5. Determination of refractive index of a prism by using a spectrometer
6. Determination of capacitance by using ballistic galvanometer
7. Determination of ECE of copper
8. To convert the given galvanometer into an ammeter and calibrate it with the help of copper voltameter

**Semester IV****PHY -404: ATOMIC AND NUCLEAR PHYSICS****Marks: 75****Mass spectrographs and x-ray**

Atomic masses: Bainbridge and Aston mass spectrograph.

X-rays: continuous and characteristic X-rays; Mosley's law; absorption of X-ray and absorption spectra, X-ray diffraction and Bragg's law; measurement of X-ray wave length

10 Marks

**Atomic spectra**

Hydrogen spectrum, Bohr's theory, Sommerfeld's modification of Bohr's theory and relativistic correction, vector model of atom, electron spin, Pauli's exclusion principle, periodic table of elements; spin-orbit interaction - fine structure of hydrogen, spectra of alkali elements, selection rules, L-S and j-j coupling schemes, Zeeman Effect.

20 marks

**Radioactivity**

Law of radio-active decay and half-life, radio-active series; theory of successive transformations; secular and transient equilibrium; Carbon dating, artificial radioactivity; radio-isotopes and their uses; radiation hazards; theory of alpha decay; beta decay and neutrino hypothesis; gamma decay

10 Marks

**Particle accelerator:** Linear accelerator, Cyclotron; Betatron; Synchrotron.

**Nuclear detectors:** Proportional counter, G.M. counter, cloud chamber, bubble chamber, scintillation counter, nuclear emulsion

10 Marks

**Nuclei and their properties:** Rutherford's theory of alpha particle scattering and its experimental verification; Charge mass, size, constituents, spin and parity of nuclei; nuclear stability and binding energy; nuclear moments- electric dipole moment, electric quadrupole moment and magnetic moment, nuclear forces.

5 Marks

**Nuclear models:** Liquid drop model, semi-empirical mass formula and its applications, shell model.

10 Marks

**Nuclear reactions:** Q-value of a reaction; kinematics of nuclear reactions; types of nuclear reactions; cross sections for nuclear reactions; nuclear fission -elementary theory of nuclear fission, energy and mass distribution of fission fragments, fission neutrons, four factor formula, nuclear reactor and its types, breeder reactor; nuclear fusion reaction in the sun; controlled nuclear fusion

10 Marks

**Suggested Books:**

1. Atomic and Nuclear Physics: Gopalakrishnan (McMillan)
2. Concepts of Modern Physics: A Beiser
3. Concepts of Nuclear Physics: Bernard L Cohen
4. Nuclear Physics: S N Ghosal
5. Nuclear Physics: D C Tayal

**Laboratory:**

**Marks: 25**

1. To draw the (i-D) curve for a prism using a spectrometer and to find the minimum deviation using sodium light
2. To draw the (i-D) curve for a prism using a spectrometer and to find the refractive index of the prism using sodium light( angle of prism given)
3. Determination of radius of curvature of a convex lens by Newton's ring method
4. Determination of dispersive power of a prism for sodium light using a spectrometer
5. Determination of width of a single slit from a diffraction pattern and verification of the value by means of a travelling microscope
6. Determination of wavelength of sodium light using a plane transmission grating
7. Determination of internal resistance of a cell using potentiometer
8. To measure current in an external circuit with the help of a potentiometer
9. Calibration of an ammeter with the help of potentiometer



## Semester V

## PHY -505: ELECTRONICS

Marks: 100

**Basic circuit analysis**

Circuit models, Kirchoff's law, single equation loops, single node pair circuit, voltage and current divider rules, principle of superposition, Thevenin and Norton's theorems, two-port analysis of an electrical network.

10 marks

**Semiconductor diodes**

p-n junction diode, I-V characteristics, application in rectifiers, clippers and limiters, Zener diode and its applications

10 marks

**Bi-polar junction transistors(BJT)**

p-n-p and n-p-n structures, active and saturation regions, characteristics of BJT, common-emitter configuration, input and output characteristics,  $z$  and  $h$  parameters, common-base configuration, output characteristics, two-port analysis of a transistor using  $z$  and  $h$  parameters, load line concept, emitter follower, biasing methods, stability factor, low frequency model

Derivation of current gain, input resistance, voltage gain and output resistance of the CB, CE amplifier configurations ( for small signals) and the CE configuration with an emitter resistor ( also for small signals), bypassing of the emitter resistor with a bypass capacitor.

30 marks

**Field effect transistor (FET)**

Classification of various types of FETS, constructional details of junction field-effect transistor, drain characteristics of JFET, biasing of JFET, operating regions, pinch-off voltage, idea of metal-oxide-semiconductor-field-effect-transistor (MOSFET)

10 marks

**Amplifiers**

Resistance- capacitance and transformer coupled amplifiers, power amplifiers-class A, B, AB and C operations, Concept of negative and positive feedback, representation of a single – loop negative feedback amplifier, transfer gain with feedback, merits and demerits of negative feedback, Differential amplifiers, principles of operational amplifiers, transfer characteristics, offset parameters, differential gain, CMR, inverting and non-inverting operational amplifier, operational amplifier adder, differentiator, integrator, applications of operational amplifiers

25 marks

**Oscillators**

Wave-form generators: Barkhausen criterion, RC oscillator, Wien Bridge oscillator, phase shift oscillator

5 marks

**Digital circuits**

Binary system, Boolean algebra, NOR, NAND gates, half and full adders, minimization of Boolean expressions using K-map

10 marks

**Suggested Books:**

1. Digital principles and applications: Donald P. Leach & Albert Paul Malvino, (Glencoe, 1995).
2. Electronic Principles: Albert Paul Malvino (Tata McGraw Hill)
3. Basic Electronics and Linear Circuits: N.N. Bhargava, D.C. Kulshreshtha and S.C. Gupta (Tata McGraw Hill, 2006)
4. Integrated Electronics: Millman and Halkias
5. Electronics : D Chattopadhyay and P C Rakshit

**PHY -506: MATHEMATICAL PHYSICS****Marks: 100****Complex variables and functions of a complex variable**

Complex numbers and their graphical representation, modulus and argument of a complex number, function of a complex variable, continuity and derivative, Cauchy-Reimann condition, analytic functions, integration of a function of a complex variable, Cauchy's theorem, Cauchy's integral formula, Taylor's series for an analytic function, Laurent series, singularities and their classification, residue and the residue theorem, evaluation of definite integrals

35 marks

**Special functions**

Gamma functions, recurrence relations, Beta function and recurrence relations, relation between gamma and beta function

Legendre, Hermite and Laguerre polynomials and associated Legendre functions, differential equations and series solutions, generating functions, recurrence relations, orthogonality relations

Bessel Differential equation, generating function, recurrence relation, zeroes of the Bessel function, orthogonality relation, series expansion of a function in terms of a complete set of orthogonal functions

30 marks

**Partial differential equations**

Vibrations of stretched string, derivation of the equation and its solution under various initial conditions, vibration of rectangular and circular membranes, heat conduction, derivation of the equation, solution for the temperature in a finite rod, semi-infinite rod, the classical wave equation and the Laplace equation

20 marks

**Fourier series**

Orthogonality of the sine and cosine functions, Fourier series of a function, Fourier series expansion of a periodic function, Parseval's theorem, sine and cosine series

15 marks

**Suggested Books**

1. Advanced Engineering Mathematics by Erwin Kreyszig

2. ~~Mathematical~~ Methods for Physicists by G. Arfken and Weber
3. Mathematical Physics by A. K. Ghatak, I Goyal and Chu
4. Applied Mathematics for Engineers and Physicists by L. A. Pipes and L. R. Harvell
5. Complex Variables (Schaum Series): M Spiegel

**PHY -507(P): Laboratory****Marks: 100**

1. To draw the characteristics of a transistor in the CE and CB configurations
2. To draw the resonance curve of series and parallel LCR circuit and to determine the Q-factor
3. Determination of the constant of a ballistic galvanometer by using a standard capacitor
4. To construct two input OR and AND logic gates using p-n junction/transistor and to verify their truth tables
5. To study the performance of NOT circuit using transistors
6. To draw the characteristic of a Zener diode and to study its use as a voltage regulator
7. To study solid state half- wave and full- wave rectifiers and to determine the ripple factor and p.c. of regulation and different types of filters
8. To plot the frequency response of an R.C.-coupled amplifier (i) without feedback and (ii) with negative feedback and to determine the bandwidth in each case
9. Determination of self inductance by Anderson's method
10. Determination of mutual inductance by using a ballistic galvanometer and to draw the M.O. curve
11. Determination of the band gap of a p-n junction diode (germanium)

**Semester VI****PHY -608: QUANTUM MECHANICS****Marks: 100****Origin of the Quantum theory**

Blackbody-radiation spectrum and Planck's hypothesis, Einstein's idea and the photoelectric effect, Compton Effect, Franck- Hertz experiment

Stability of the atom, Bohr's postulate of angular momentum quantization and the Bohr atom model, Bohr- Sommerfeld quantization rule

De Broglie wave and wave particle duality, Davisson Germer experiment, electron diffraction and neutron diffraction

Development of Quantum mechanics: Wave behaviour of matter, two-slit experiment with electron (thought experiment), superposition, description in terms of probability and need for probability amplitude, Wave packet, Heisenberg's uncertainty principle (thought experiment and applications), Bohr's complimentary principle, Bohr's correspondence principle

30 marks

**Basic postulates and formalism**

Schrodinger equation, wave function as probability amplitude and dynamical variables as operators, probability conservation and normalization of wave function, conditions for

physical acceptance of wave function, equation of continuity (differential probability conservation)

Eigenvalues and eigenfunction of a dynamical variable, Hermiticity and reality of eigenvalues, physical meaning of eigenvalues of a dynamical variable, superposition of wave functions and the expansion postulate, expectation value and Ehrenfest's theorem, the commutator and the quantum analogue of the classical equation of motion, constants of motion

The fundamental commutators, commutator algebra, precise definition of uncertainty and the uncertainty relation ( statement )

30 marks

### **Stationary states and Energy eigenstates**

Stationary states, time independent Schrodinger equation, the stationary state wave functions, free particle and plane wave

### **Particle in a one-dimensional box**

Energy eigenvalues and eigenfunctions, graphical illustrations, nodes as the energy quantum number, calculation of expectation values, qualitative estimation of the ground state energy from the uncertainty principle

### **Linear harmonic oscillator**

Solution of the Schrodinger equation for energy eigenvalues and eigenfunctions, calculation of expectation values and matrix elements, parity of eigenfunctions, the variational theorem

### **One dimensional potential barrier**

One-dimensional finite potential step, stationary solutions, reflection and transmission coefficients, phenomenon of barrier penetration

### **Hydrogen atom**

Solution for the energy spectrum and the eigenfunctions, the quantum numbers  $n, l, m$ , degeneracy, expectation values, the virial theorem

40 marks

### **Suggested Books:**

1. Quantum Mechanics: B H Bransden and C J Joachain (Pearson, 2008)
2. Quantum Mechanics: L. I. Schiff (McGraw Hill Book Co., New York, 1968).
3. Quantum Mechanics: E. Merzbacher, (John Wiley & Sons, Inc 1997)
4. Quantum Mechanics: J.L. Powell & B. Crasemann (Addison-Wesley Pubs.Co., 1965)
5. Quantum Mechanics: Theory and Applications: A. Ghatak & S. Lokanathan 5th Edition. (Macmillan India : 2004)

## **PHY -609: PHYSICS OF MATERIALS**

**Marks: 100**

### **Crystal structure**

Crystalline and amorphous materials, lattice and unit cell, lattice translational vectors, lattice with a basis- central and noncentral unit cell, reciprocal lattice, Bravais lattice types, Brillouin zones of sc, bcc, fcc lattices, X-ray diffraction: Bragg's Law, X-ray scattering, atomic structure factor and geometric structure factor

20 marks

**Electrical Properties of Materials**

Free electron model and its limitation, elementary band theory: Bloch theorem, Kronig Penney model, effective mass, concept of hole, band gaps, classification of solids, intrinsic and extrinsic semiconductors, p-type and n-type semiconductors, conductivity of semiconductors, concentration of charge carriers, Fermi level and its temperature dependence, classical Hall effect

20 marks

**Magnetic properties of Materials**

Types of magnetic materials, classical theory of diamagnetism and paramagnetism, quantum mechanical treatment of paramagnetism, Curies law, Weiss' theory of ferromagnetism, magnetic domains, soft and hard magnetic materials

20 marks

**Lattice Dynamics**

Lattice vibrations, monatomic and diatomic lattice vibrations, acoustic and optic modes, Einsteins' theory of specific heat, Density of states, Debye's theory of specific heat

15 marks

**Superconductivity**

Experimental properties, Meissner effect, London's theory and penetration depth, isotope effect, type I and type II superconductors, elementary idea of high  $T_c$  superconductivity

15 marks

**Physics of low dimension**

Density of states in low dimension, different types of nanomaterials, Blue shifting, quantum wells, wires and application of nanoscience

10 marks

**Suggested Text Books**

1. Solid State Physics – A J Dekkar
2. Introduction to Solid State Physics- C Kittel
3. Solid State Physics – A R Verma and O N Srivastava
4. Introduction to Nanoscience- Poole et al
5. Solid State Physics - Keer

**PHY -610: Laboratory****Marks: 100**

1. Determination of wavelength of monochromatic light source by using Fresnel's biprism
2. To draw the  $(\mu-\lambda)$  curve for the material of a prism by using spectrometer and verification of dispersion formula
3. To draw the  $(\mu-\lambda)$  curve for the material of a prism by using spectrometer and to determine the wavelength of the given source
4. To draw the  $(D-\lambda)$  curve for a given spectrometer and hence to determine the wavelength of the unknown source

5. Determination of the grating constant by using sodium light and hence to determine the wavelength of the unknown radiation
6. To calibrate a polarimeter and to determine the concentration of a given solution
7. Determination of electronic charge by Millikan's experiment
8. To study the hydrogen spectrum and to determine the Rydberg's constant with the given grating and spectrometer
9. Determination of  $e/m$  of electron by Thomson's method
10. To study the B-H curve and hysteresis loss by anchor ring method
11. To determine Planck's constant using a photocell

**Suggested Books:**

1. A Handbook of Advanced Practical Physics: C R Dasgupta
2. Advanced Practical Physics: K G Mazumdar
3. Practical Physics : D Chattopadhyay and P C Rakshit
4. A Textbook of Advanced Practical Physics: S K Ghosh