FYUP 2024
PHYSICS
Minor

PHYSICS- MINOR

Pre-requisite : Physics and Mathematics in class XII

Semester	Course Title	Course Code	Breakup Credit	Classes/week	Total Credit
I	Mechanics Lab1	24-PHY-M-112 24-PHY-M-110	Lecture -3 Lab -1	Lecture - 3 Lab - 2	4
II	Math Physics Lab2	24-PHY-M-161 24-PHY-M-160	Lecture -3 Lab -1	Lecture - 3 Lab - 2	4
III	Electronics Lab3	24-PHY-M-222 24-PHY-M-220	Lecture -3 Lab -1	Lecture - 3 Lab - 2	4
IV	Thermal Physics Lab 4	24-PHY-M-262 24-PHY-M-260	Lecture -3 Lab -1	Lecture - 3 Lab - 2	4
V	Wave Optics Lab 5	24-PHY-M-321 24-PHY-M-320	Lecture -3 Lab -1	Lecture - 3 Lab - 2	4
VI	Electromagnetism Lab 6	24-PHY-M-362 24-PHY-M-360	Lecture -3 Lab -1	Lecture - 3 Lab - 2	4
VII	Ele. Quant. Mech Lab 7	24-PHY-M-422 24-PHY-M-420	Lecture -3 Lab -1	Lecture - 3 Lab - 2	4
VIII	Solid State Physics Lab 8	24-PHY-M-461 24-PHY-M-460	Lecture -3 Lab -1	Lecture - 3 Lab - 2	4

Semester - I

Course Title - Mechanics

Course Type – Minor

Course Code – 24-PHY-M-112

Course Level – 100

Total Credits – 3

Classes /week – 3

Max. Marks - 75

Prerequisite – Physics in class XII

Course Advisor's Name :

Course Advisor's Email :

Expected Learning Outcome – The objective of this course is to impart the fundamental knowledge on mechanics. The course first teaches the fundamentals of linear and rotational motions to understand any dynamical systems. The laws of motion, the laws of conservations and other fundamental ideas will be given. The students will also learn about different kind of oscillations.

Reference Books:

1. An introduction to mechanics : Kleppner & Kolenkow.
2. Classical Mechanics : David Tong,
3. Newtonian Mechanics : A.P.French,
4. Mechanics : Berkeley Physics Course
5. Vibrations and Waves : A. P. French.
6. Introduction to Classical Mechanics : Tukwale and Puranik

Course Syllabus -

Unit I: Fundamentals of Dynamics

Reference frames. Inertial frames; Galilean transformations; Galilean invariance. Newton's Laws of motion, dynamics of a system of particles, centre of mass, conservation of momentum, impulse, Work-energy theorem, potential energy, conservative and non-conservative forces, force as gradient of potential energy. Stable and unstable equilibrium, Work done by non-conservative forces. Law of conservation of Energy and momentum.

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; Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.

Unit III: System of particles

Collisions : Elastic and inelastic collisions between particles, Elastic scattering : centre of mass and laboratory frame. Kinematics of elastic scattering in the laboratory system, Bouncing balls and other problems, Inelastic scattering : cross-section, The Rutherford formula, Problems. Variable mass problems : Rockets and other problems with things fall apart, Avalanche and other problems with stuff gathering.

Unit IV: Harmonic Oscillations

Simple Harmonic Motion, Simple pendulum, Compound pendulum, Linearity and Superposition Principle, Superpositions of two and N collinear oscillations, Superposition of two perpendicular oscillations, Graphical and Analytical method, Lissajous Figures, Free Damped oscillation. Forced oscillations: Transient and steady states; Resonance, Power Dissipation and Quality Factor

Semester - I

Course Title - Lab I - Mechanics & Oscillation I

Course Type – Minor (Lab)

Course Code – 24-PHY-M-110

Course Level – 100

Total Credits – 1

Classes /week – 2

Max. Marks – 25

Prerequisite – Mechanics

Course Advisor's Name :

Course Advisor's Email :

List of Experiments :

1. Measurements of length using vernier caliper, screw gauge and travelling microscope.
2. To determine **g** using simple pendulum.
3. To study the Motion of Spring and calculate Spring constant by static and dynamic method.
4. To determine the value of g using Bar Pendulum. (4)
5. To determine the value of g using Kater's Pendulum. (4)

Semester - II

Course Title - Mathematical Physics

Course Type – Minor

Course Code – 24-PHY-M-161

Course Level – 100

Total Credits – 3

Classes /week – 3

Max. Marks - 75

Prerequisite – Mathematics in class XII

Course Advisor’s Name :

Course Advisor’s Email :

Expected Learning Outcome - Physics is generally referred as mathematical description of nature. To understand the underlying physical laws in nature one has to be equipped with proper mathematical training. In this mathematical physics course students will be exposed to different mathematical topics which they need to understand other areas of physics which they will read in their first year. It will also help them to understand the next level courses of mathematical physics as well.

Reference Books:

1. Vector Analysis : Schaum Series
2. Advanced Engineering Mathematics : Kreyzig
3. Linear Algebra : Schaum Series
4. Complex Variable : Spiegel
5. Linear Vector Spaces : M. C. Jain

Course Syllabus -

Unit I: Matrices and Linear Vector Space :

Different types of matrices; Matrix algebra, Applications of matrices in solving simple linear equations, Systems of Linear Equations, Eigenvalues and Eigenvectors, Geometric interpretation of vectors, Definition of a linear vector space, Examples of linear vector spaces Subspaces, Linear combination of vectors, Linear dependence and independence, Basis and dimension of a finite-dimensional vector space, Row space, column space, and null space, Coordinate representation of vectors with respect to a basis

Unit II: Vector Calculus :

Vector algebra; normal derivative; Gradient; Divergence; Curl; Laplacian, Vector identities, Ordinary Integrals of Vectors, Notion of infinitesimal line, surface, volume elements; Line, surface, volume integrals of vector fields. Flux of a vector field, Gauss theorem, Green's theorem and Stokes Theorems, Orthogonal curvilinear coordinates: Calculation of divergence, gradient, curl and Laplacian in spherical polar and cylindrical coordinates. Multiple Integrals, Jacobian. Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials.

Unit III: Ordinary Differential Equations :

Classifying equations by order, degree, and linearity; understanding general vs. particular solutions, Solving equations via separation of variables and the integrating factor method for linear equations. Applications, Homogeneous Equations: Solving second-order linear equations with constant coefficients using the characteristic equation., Non-Homogeneous Equations: Finding particular solutions using the method of undetermined coefficients.

Unit IV: Fourier Series and Dirac Delta Function:

Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function Properties and representation of Dirac delta function in 1D, 2D, 3D; integral representation; Fourier series: Periodic functions; Dirichlet Conditions; Fourier coefficients; complex form, Expansion of arbitrary period function, non-periodic function, even and odd functions; Half range expansions; Summing of infinite series; Parseval Identity.

Semester - II

Course Title - Lab 2 – Mechanics & Oscillation II

Course Type – Minor (Lab)

Course Code - 24-PHY-M-160

Course Level – 100

Total Credits – 01

Classes /week – 02

Max. Marks – 25

Prerequisite – Mechanics

Course Advisor’s Name :

Course Advisor’s Email :

List of Experiments :

1. To determine the Moment of Inertia of a Flywheel.
2. To determine surface tension of a fluid by capillary rise method.
3. To determine the coefficient of viscosity of a liquid by Stoke’s law.
4. To determine Coefficient of Viscosity of water by Capillary Flow Method .
5. To determine the Young's Modulus of a rod.
6. To determine the surface tension of a liquid by Jaeger’s method.

Semester - III

Course Title – Electronics

Course Type – Minor

Course Code - 24-PHY-M-222

Course Level – 200

Total Credits – 3

Classes /week – 3

Max. Marks – 75

Prerequisite – Physics in class XII

Course Advisor's Name :

Course Advisor's Email :

Expected Learning Outcome – The objective of this course is to impart basic background in analog circuits. The course would use simple models; description of the semiconductors, different diodes and applications, transistors and applications and operational amplifiers will be covered. The broad behavioral description of the blocks in the op-amp will be used to explain the circuit operation.

Reference Books:

1. Basic Electronics : D C Tayal,.
2. Principles of Electronics : V. K. Mehta.
3. Electronic Devices and Circuit : Robert Boylestad, Louis Nashelsky,
4. Basic Electronics and Linear Circuits : N. N. Bhargava, D. C. KulShreshtha.

Course Syllabus -

Unit I: Circuits Analysis

Kirchhoffs Laws, Mesh and Node Analysis of Circuits. RC circuits, Networks, Equivalent Star (T) and delta Networks. Star to Delta and Delta to Star Conversion. Network Theorems, Superposition theorem, Thevenin Theorem, Norton theorem.

Unit II: Semiconductor Diodes

P and N Type Semiconductors. Energy Level Diagram. Conductivity and Mobility, Drift velocity, PN junction Diodes and its characteristics. Barrier Formation, Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode, Barrier Width and Current for Step Junction. PN junction Rectifier Diode, Half-wave Rectifier, Full-wave Rectifiers its Ripple Factor and Efficiency. Idea of Filters. Zener diode and voltage regulation,Photo diode, varactor diode, LED, solar cell.

Unit III: Transistors and Amplifiers

N-P-N and P-N-P Transistors, Characteristics of CB, CE and CC configurations. Active, Cut-off, and Saturation Regions. Load line and Q- point. Current gains and relation between them, Amplifiers and their classification, Class A, B, and C Amplifiers. Ideal amplifier, Voltage gain, current gain, Power gain, Input resistance, output resistance, load line. Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. RC-coupled amplifier and its frequency response.

Unit IV: AC circuits

AC Circuits: Alternating currents, mean and r.m.s. values, Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. phase diagrams, Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit. Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. CDR. Oscillators : Barkhausen criterion for self-sustained oscillations, Hartley oscillator, Colpitts oscillator, RC phase shift oscillator, multivibrators, crystal oscillator.

Semester - III

Course Title - Lab 3 - Basic Electronics I

Course Type – Minor (Lab)

Course Code - 24-PHY-M-220

Course Level – 200

Total Credits – 01

Classes /week – 02

Max. Marks - 25

Prerequisite – Electronics

Course Advisor's Name :

Course Advisor's Email :

Expected Learning Outcome –

After completing this course, the students will be able to -
1. Analyze and interpret electrical and electronic circuits' behavior.
2. Apply theoretical knowledge to practical experiments.
3. Demonstrate understanding of semiconductor devices' characteristics.
4. Design and test simple electronic circuits.
5. Measure and calculate electrical parameters accurately.

List of Experiments :

1. To study V-I characteristics of PN junction diode
2. To study the V-I characteristics of a Zener diode
3. To study use of Zener diode as voltage regulator.
4. To study growth and decay of charge on a condenser in RC circuit.
5. To verify the network theorems - Superposition theorem and Maximum power transfer

Semester - IV

Course Title – Thermal Physics

Course Type – Minor

Course Code - 24-PHY-M-262

Course Level – 200

Total Credits – 3

Classes /week – 3

Max. Marks – 75

Prerequisite – Physics in class XII

Course Advisor's Name :

Course Advisor's Email :

Expected Learning Outcome –

After completing this course, the students will be able to -
1. Apply kinetic theory and thermodynamic principles to explain physical phenomena.
2. Analyze and interpret data related to gas behavior and thermodynamic processes.
3. Demonstrate understanding of fundamental laws and equations governing thermodynamics.
4. Apply mathematical models to solve problems in thermodynamics.
5. Develop problem-solving skills using analytical and numerical methods.

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

Course Syllabus

Unit I: Kinetic theory of gases

Basic postulates of kinetic theory, Pressure of an ideal gas, Maxwell-Boltzmann Law of Distribution of velocities and energy of an Ideal Gas. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy and its applications, Specific heats of Gases Mean Free Path, Collision Probability, Distribution of Mean Free Paths,

Unit II: Ideal and Real gases

Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance. Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO_2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants.

Unit III: Thermodynamics

Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics, Concept of Temperature, Work and Heat, State Functions, Internal Energy, First Law of Thermodynamics, General Relation between Cp and Cv, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient. Reversible and Irreversible process, Conversion of Work and Heat. Heat Engines. Carnot's Cycle, Carnot engine and efficiency, Refrigerator and coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements, Carnot's Theorem. Thermodynamic Scale of Temperature

Unit IV: Entropy, Thermodynamic Potentials and Maxwell's relations

Entropy, Clausius Theorem, Clausius Inequality, Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes. Entropy of the Universe. Temperature–Entropy diagrams for Carnot's Cycle, Third Law of Thermodynamics. Unattainability of Absolute Zero, Thermodynamic Potentials : Enthalpy, Helmholtz Free Energy, Gibbs Free Energy: Properties and applications, Maxwell's Thermodynamic Relations - Derivations and applications of Maxwell's Relations such as Clausius-Clapeyron Equation, Cp-Cv, TdS Equations,

Semester - IV

Course Title - Lab 4 - Basic Electronics II

Course Type – Minor (Lab)

Course Code - 24-PHY-M-260

Course Level – 200

Total Credits – 01

Classes /week – 02

Max. Marks - 25

Prerequisite – Electronics

Course Advisor's Name :

Course Advisor's Email :

Expected Learning Outcome –

After completing this course, the students will be able to -
1. Analyze and interpret electrical and electronic circuits' behavior.
2. Apply theoretical knowledge to practical experiments.
3. Demonstrate understanding of semiconductor devices' characteristics.
4. Design and test simple electronic circuits.
5. Measure and calculate electrical parameters accurately.

List of Experiments :

1. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
2. To study Half wave rectifier and find their ripple factor with various filters.
3. To study Full wave rectifier and find their ripple factor with various filters.
4. To verify the network theorems - Norton and Thevenin theorem
5. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.

Semester - V

Course Title – Wave Optics

Course Type – Minor

Course Code - 24-PHY-M-321

Course Level – 300

Total Credits – 3

Classes /week – 3

Max. Marks - 75

Prerequisite – Physics in class XII & Mechanics

Course Advisor's Name :

Course Advisor's Email :

Expected Learning Outcome –

After completing this course, the students will be able to -
1. Understand wave motion, interference, diffraction, and polarization principles.
2. Apply mathematical models to describe wave phenomena.
3. Analyze optical systems and instruments.
4. Explain electromagnetic nature of light.
5. Demonstrate problem-solving skills in wave optics.

Reference Books:

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

Course Syllabus

Unit I: Wave Motion

Wave Equation. Solutions of wave equation. Wave front. Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave, Energy Transport, Intensity of Wave, Water Waves: Ripple and Gravity Waves. Superposition of Harmonic Waves: Standing (Stationary) Waves in a String: Fixed and Free ends, Phase and Group Melde's experiment. Longitudinal Standing Waves and normal modes, Open and Closed Pipes.

Unit II: Interference :

Electromagnetic nature of light. Definition and properties of wave front, Huygens Principle. Temporal and Spatial Coherence.
Division of amplitude and wavefront. Young's double slit experiment. Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings, Michelson Interferometer, Fabry-Perot interferometer. Applications.

Unit III: Diffraction :

Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.
Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Unit IV: Polarization :

Polarisation of light by reflection – Brewster's – law; Double refraction – ordinary and extraordinary ray; Optic axis; Huygen's construction for uniaxial crystals; Nicol prism, polaroids; Production and analysis of (i) plane polarized, (ii) circularly polarized and (iii) elliptically polarized light; Double refraction, Wave plates, Optical activity, Babinet's compensator.

Semester - V

Course Title - Lab 5 - Optics I

Course Type – Minor (Lab)

Course Code - 24-PHY-M-320

Course Level – 300

Total Credits – 01

Classes /week – 02

Max. Marks - 25

Prerequisite – Wave Optics

Course Advisor's Name :

Course Advisor's Email :

Expected Learning Outcome –

After completing this course, the students will be able to -
1. Measure optical properties of materials and systems.
2. Apply principles of optics to experimental techniques.
3. Analyze data from optical experiments.
4. Demonstrate understanding of diffraction, refraction, and polarization.
5. Develop problem-solving skills in optics.

List of Experiments :

1. Focal length of two lenses by Nodal Slide method and verification of Newton's formula.
2. To determine wavelength of Na source using plane diffraction grating
3. Determination of refractive Index and dispersive power of a prism using spectrometer.
4. Determination of wavelength of LASER using plane transmission diffraction grating.
5. Determination of wavelength of sodium light by Newton's Rings method.

Semester - VI

Course Title – Electromagnetism

Course Type – Minor

Course Code - 24-PHY-M-362

Course Level – 300

Total Credits – 3

Classes /week – 3

Max. Marks – 75

Prerequisite – Mathematical Physics

Course Advisor’s Name :

Course Advisor’s Email :

Expected Learning Outcome –

After completing this course, the students will be able to -
1. Apply mathematical techniques to solve problems in electromagnetism.
2. Analyze and interpret physical phenomena using vector calculus.
3. Demonstrate understanding of fundamental laws and principles in electromagnetism.
4. Apply theoretical knowledge to solve practical problems.
5. Develop problem-solving skills using analytical and numerical methods

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)

Course Syllabus

Unit I: Electrostatics

Coulomb's law, Electric field, Continuous charge distribution, Divergence of Electric field, Electric flux. Gauss' Law with applications, Curl of Electric field, Electrostatic potential,. Conservative nature of Electrostatic Field, Laplace's and Poisson equations, Work and energy, Conductors, Surface charge and force on a conductor. Capacitors, Uniqueness Theorems, Boundary conditions, Method of images and application, Separation of variables. Problems.

Unit II: Magnetostatics

Magnetic effect of steady current, Equation of continuity and steady current, Lorentz force and concept of magnetic induction, force on linear current element, Biot-Savart law and its simple applications: straight wire and circular loop, Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Divergence and curl of magnetic field, Vector potential. Boundary conditions, Problems.

Unit III: Electromagnetic induction

Electromagnetic induction: Integral and differential forms. Induced electric field and emf. Mutual and self-inductance. Transformers. Magnetic field energy. Electromotive Force, Motional e.m.f.-simple problems, Electromagnetic induction, Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Calculation of self and mutual inductance in simple cases, Energy stored in a Magnetic Field. Charge Conservation and Displacement current. Introduction to Maxwell's Equations.

Unit IV: Boundary Value Problems

Poisson's equation, Laplace's equation, boundary conditions, uniqueness theorem. Method of images, Separation of variable, Different image problems; Boundary value problems with linear dielectric materials and linear magnetic materials.

Semester - VI

Course Title - Lab 6 - Optics II

Course Type – Minor (Lab)

Course Code - 24-PHY-M-360

Course Level – 300

Total Credits – 01

Classes /week – 02

Max. Marks - 25

Prerequisite – Wave Optics

Course Advisor’s Name :

Course Advisor’s Email :

Expected Learning Outcome –

After completing this course, the students will be able to -
1. Measure optical properties of materials and systems.
2. Apply principles of optics to experimental techniques.
3. Analyze data from optical experiments.
4. Demonstrate understanding of diffraction, refraction, and polarization.
5. Develop problem-solving skills in optics.

List of Experiments :

1. Determination of specific rotation of sugar solution by Laurent's Half-Shade Polarimeter
2. Verification of Hartman's dispersion formula
3. To determine wavelength of spectral lines of Hg source using plane diffraction grating.
4. To determine dispersive power and resolving power of a plane diffraction grating
5. To determine the wavelength of Sodium light by using Fresnel’s Biprism.

Semester - VII

Course Title – Elementary Quantum Mechanics

Course Type – Minor

Course Code - 24-PHY-M-422

Course Level – 400

Total Credits – 3

Classes /week – 3

Max. Marks - 75

Prerequisite – Mechanics, Thermal Physics

Course Advisor’s Name :

Course Advisor’s Email :

Expected Learning Outcome –

After completing this course, the students will be able to -
1. Explain the principles of wave-particle duality and uncertainty.
2. Apply quantum mechanics to atomic and nuclear phenomena.
3. Describe the structure and properties of atomic nuclei.
4. Analyze radioactive decay and nuclear reactions.
5. Understand the principles of nuclear energy production.

Reference Books:

1. A. Beiser : Concepts of Modern Physics
2. H. S. Mani and G. K. Mehta : Modern Physics
3. I.Kaplan : Nuclear Physics
4. Cohen : Concepts of Nuclear Physics

Course Syllabus

Unit I: Wave Particle duality

Planck's quantum hypothesis, Blackbody Radiation, Planck radiation formula, Photo-electric effect, Compton scattering, X-ray diffraction. Wave-particle duality. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Probability. Wave amplitude and wave functions.

Unit II: Uncertainty Principle

Heisenberg uncertainty principle, Application, Matter waves and wave amplitude; Rutherford scattering, Atomic model. Atomic spectra, energy levels, Bohr theory, quantum numbers, Frank Hertz experiment, Qualitative idea of spin and Pauli exclusion principle.

Unit III: Schrodinger equations

Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions, Hamiltonian, stationary states and energy eigenvalues; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Ehrenfest theorem. Time independent Schrodinger equation.

Unit IV: One dimensional potentials

Continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-square well potential (infinite and finite), Potential barrier problems - step potential and rectangular potential. Quantum mechanics of simple harmonic oscillator-energy levels and eigen states.

Semester - VII

Course Title - Lab 7 - Electromagnetism I

Course Type – Minor (Lab)

Course Code - 24-PHY-M-420

Course Level – 400

Total Credits – 01

Classes /week – 02

Max. Marks - 25

Prerequisite – Electromagnetism

Course Advisor’s Name :

Course Advisor’s Email :

Expected Learning Outcome –

After completing this course, the students will be able to -
1. Measure electrical quantities using various instruments and techniques.
2. Analyze electrical circuits and determine circuit parameters.
3. Understand electromagnetic principles and applications.
4. Apply measurement techniques to electrical systems.
5. Develop problem-solving skills in electricity & magnetism.

List of Experiments:

1. Determination of E.C.E. of copper using a Copper Voltameter and checking the accuracy of ammeter.
2. Determination of Self Inductance of a coil using Anderson's Bridge.
3. Determination Self Inductance of a coil by Owen’s Bridge.
4. Study of LCR circuit and determination of impedence.
5. Determination of magnetic field by Helmholtz coil.

Semester - VIII

Course Title – Solid State Physics

Course Type – Minor

Course Code - 24-PHY-M-461

Course Level – 400

Total Credits – 3

Classes /week – 3

Max. Marks - 75

Prerequisite – Elementary Quantum Mechanics

Course Advisor's Name :

Course Advisor's Email :

Expected Learning Outcome –

After completing this course, the students will be able to -
1. Understand crystal structures and bonding in solids.
2. Analyze lattice dynamics and thermal properties.
3. Apply band theory to electronic structures in solids.
4. Explain transport properties in metals and semiconductors.
5. Model real-world phenomena using solid-state physics principles.

Reference Books:

1. Solid State Physics : Hook and Hall : Hook and Hall
2. Introduction to Solid State Physics : Kittel
3. Solid State Physics : Ibach and Luth
4. Introduction to the Theory of Solids : H. M. Rosenberg
5. Solid State Physics : Blakemore
6. Solid State Physics : Ashcroft and Mermin
7. Solid State Physics : M.A. Wahab

Course Syllabus

Unit I: Bonding in crystals

Covalent, ionic (including Madelung constant), metallic, hydrogen bond, van der Waal's bond. Orbital symmetry and crystal structure. Crystalline solids, unit cell, primitive cell, Bravis lattices, closed packed structures. Atomic radius, lattice constant, packing fraction, density, Miller indices. Scattering from periodic structures, Bragg's law, X-ray diffraction, atomic form factor, structure factor, Laue's equation, reciprocal lattice, Brillouin zones.

Unit II: Lattice Dynamics

Lattice dynamics of atoms in crystals, vibrations of monoatomic and diatomic linear chains, acoustic and optical phonon modes, density of states, thermal properties of crystal lattices, thermal energy of the harmonic oscillator, specific heat capacity of the lattice, Debye theory of specific heats.

Unit III: Band Theory

Free electrons in solids, density of states, Fermi surface, Fermi gas at T=0 K, Fermi statistics, specific heat capacity of electrons in metals, thermionic emission of electrons from metals. Electronic band structure in solids, Electrons in periodic potentials, Bloch's Theorem, Kronig-Penney model, Nearly free electron model, Insulator, semiconductor and metals. Tight-binding model: density of states, examples of band structures. Fermi surfaces of metals and semiconductors.

Unit IV: Transport properties

Motion of electrons in bands and the effective mass, currents in bands and holes, scattering of electrons in bands, Boltzmann equation and relaxation time, electrical conductivity of metals, thermoelectric effects, the Wiedemann-Franz Law. Intrinsic and Extrinsic Semiconductors, Carrier

Semester - VIII

Course Title - Lab 8- Electromagnetism II

Course Type – Minor (Lab)

Course Code - 24-PHY-M-460

Course Level – 400

Total Credits – 01

Classes /week – 02

Max. Marks - 25

Prerequisite – Electromagnetism

Course Advisor’s Name :

Course Advisor’s Email :

Expected Learning Outcome –

After completing this course, the students will be able to -
1. Measure electrical quantities using various instruments and techniques.
2. Analyze electrical circuits and determine circuit parameters.
3. Understand electromagnetic principles and applications.
4. Apply measurement techniques to electrical systems.
5. Develop problem-solving skills in electricity & magnetism.

List of Experiments:

1. To draw the B-H curve for the iron and to determine the energy loss due to hysterisis.
2. To determine the temperature coefficient of resistance by Platinum Resistance Thermometer (PRT).
3. Conversion of a moving coil galvanometer into an ammeter and voltmeter.
4. To determine the dielectric constants for solids.
5. Study of the Wien bridge oscillator and determine the frequency of the oscillator.