

Physics for Electrical and Electronics Engineering Stream

Course Code:	22PHYE12/22	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	3:0:2:0	Exam Hours	03
Total Hours of Pedagogy	40 hours Theory + 12 Hours Lab	Credits	04

Prerequisite:

Wave-Particle dualism, Classical Free Electron Theory, Properties of light, Electricity & Magnetism Basics of Semiconductors

Course objectives.

- To study the principles of quantum mechanics
- To understand the properties of dielectrics and superconductors
- To study the essentials of photonics for engineering applications.
- To understand fundamentals of vector calculus and EM waves.
- To study the knowledge about semiconductors and devices.

Modules	Teaching Hours
<p style="text-align: center;">Module-1</p> <p>Quantum Mechanics: de Broglie Hypothesis and Matter Waves, de Broglie wavelength and derivation of expression by analogy, Phase Velocity and Group Velocity, Heisenberg's Uncertainty Principle and its application (Non existence of electron inside the nucleus-Non Relativistic), Principle of Complementarity, Wave Function, Time independent Schrödinger wave equation, Physical Significance of a wave function and Born Interpretation, Expectation value, Eigen functions and Eigen Values, Particle inside one dimensional infinite potential well, Waveforms and Probabilities. Numerical Problems</p> <p>Pre-requisite: Wave-Particle dualism Self-learning: De Broglie Hypothesis</p>	08 Hours
<p style="text-align: center;">Module-2</p> <p>Electrical Properties of Solids: Conductors: Quantum Free Electron Theory of Metals: Assumptions, Fermi-energy, Fermi factor, Variation of Fermi Factor with Temperature and Energy, Mention of expression for electrical conductivity. Dielectric Properties: Polar and non-polar dielectrics, Electrical Polarization Mechanisms, internal fields in solids, Clausius-Mossotti equation (Derivation), Solid, Liquid and Gaseous dielectrics. Application of dielectrics in transformers, Capacitors, Electrical Insulation. Numerical Problems. Superconductivity: Introduction to Superconductors, Temperature dependence of</p>	08 Hours

<p>resistivity, Meissner Effect, Critical Field, Temperature dependence of Critical field, Types of Super Conductors, BCS theory (Qualitative), High Temperature superconductivity, SQUID, MAGLEV, Numerical problems.</p> <p>Pre-requisites: Classical Free Electron Theory Self-learning: Dielectrics Basics</p>	
<p style="text-align: center;">Module-3</p> <p>Lasers and Optical Fibers: Lasers: Characteristics of LASER, Interaction of radiation with matter, Expression for Energy Density and its significance. Requisites of a Laser System. Conditions for Laser action. Principle, Construction and Working of Carbon Dioxide Laser. Application of Lasers in Defense (Laser range finder) and Laser Printing. Numerical Problems Optical Fibers: Total Internal Reflection, Propagation mechanism, Angle of Acceptance, Numerical Aperture, Fractional Index Change, Modes of Propagation, Number of Modes and V Number, Types of Optical Fibers. Attenuation and Mention of Expression for Attenuation coefficient, Attenuation Spectrum of an Optical Fiber with Optical Windows. Discussion of Block Diagram of Point to Point Communication, Intensity based Fiber Optic Displacement Sensor, Merits and Demerits, Numerical problems.</p> <p>Pre-requisite: Properties of light Self-learning: Total Internal Reflection</p>	08 Hours
<p style="text-align: center;">Module - IV</p> <p>Maxwell's Equations and EM waves: Maxwell's Equations: Fundamentals of Vector Calculus. Divergence and Curl of Electric field and Magnetic field (static), Gauss' divergence theorem and Stoke's theorem. Description of laws of Electrostatics, Magnetism, Faraday's laws of EMI, Current Density, Equation of Continuity, Displacement Current (with derivation), Maxwell's equations in vacuum, Numerical Problems EM Waves: The wave equation in differential form in free space (Derivation of the equation using Maxwell's equations), Plane Electromagnetic Waves in vacuum, their transverse nature.</p> <p>Pre-requisite: Electricity & Magnetism Self-learning: Fundamentals of vector calculus.</p>	08 Hours
<p style="text-align: center;">Module - V</p> <p>Semiconductors and Devices: Fermi level in Intrinsic & Extrinsic Semiconductor, Expression for concentration of electrons in conduction band & holes concentration in valance band (only mention the expression), Relation between Fermi energy & Energy gap in intrinsic semiconductors(derivation), Law of mass action, Electrical conductivity of a semiconductor (derivation), Hall effect, Expression for Hall coefficient (derivation) and its application. Photo-diode and Power responsivity, Construction and working of Semiconducting Laser, Four probe method to determine resistivity, Phototransistor, Numerical problems.</p> <p>Pre-requisite: Basics of Semiconductors Self-learning: Fermi level in Intrinsic & Extrinsic Semiconductor</p>	08 Hours

TEXT BOOKS:

1. A Textbook of Engineering Physics- M.N. Avadhanulu and P.G. Kshirsagar, 10th revised Ed, S. Chand. & Company Ltd, New Delhi.
2. An Introduction to Lasers theory and applications by M.N. Avadhanulu and P.S. Hemne revised Edition 2012. S. Chand and Company Ltd -New Delhi.
3. Engineering Physics-Gaur and Gupta-Dhanpat Rai Publications-2017.
4. Concepts of Modern Physics-Arthur Beiser: 6th Ed; Tata McGraw Hill Edu Pvt Ltd- New Delhi 2006.
Fundamentals of Fibre Optics in Telecommunication & Sensor Systems, B.P. Pal, New Age International Publishers.

REFERENCE BOOKS:

1. Introduction to Electrodynamics, David Griffith, 4th Edition, Cambridge University Press 2017.
2. Lasers and Non Linear Optics – B.B. Laud, 3rd Ed, New Age International Publishers 2011.
3. LASERS Principles, Types and Applications by K.R. Nambiar-New Age International Publishers.
Solid State Physics-S O Pillai, 8th Ed- New Age International Publishers-2018.

PRACTICAL MODULE**List of Experiments**

1. Determination of wavelength of LASER using Diffraction Grating.
2. Determination of acceptance angle and numerical aperture of the given Optical Fiber.
3. Determination of Magnetic Flux Density at any point along the axis of a circular coil.
4. Determination of resistivity of a semiconductor by Four Probe Method
5. Study the I-V Characteristics of the Given Bipolar Junction Transistor.
6. Determination of dielectric constant of the material of capacitor by Charging and Discharging method.
7. Study the Characteristics of a Photo-Diode and to determine the power responsivity / Verification of Inverse Square Law of Intensity of Light.
8. Study the frequency response of Series & Parallel LCR circuits.
9. Determination of Plank's Constant using LEDs.
10. Determination of Fermi Energy of Copper.
11. Identification of circuit elements in a Black Box and determination of values of the components.
12. Determination of Energy gap of the given Semiconductor.
13. Step Interactive Physical Simulations.
14. Study of motion using spread Sheets
15. Study of Application of Statistics using spread sheets
16. PHET Interactive
17. Determination of frequency of alternating current using Sonometer
18. Interference at an Air wedge

Simulations(<https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html.prototype>)

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

C01 Describe the fundamental principles of the Quantum Mechanics and the essentials of Photonics

C02 Elucidate the concepts of conductors, dielectrics and superconductivity

C03 Discuss the fundamentals of vector calculus and their applications in Maxwell's Equations and EM Waves.

C04 Summarize the properties of semiconductors and the working principles of semiconductor devices.

C05 Practice working in groups to conduct experiments in physics and **Perform** precise and honest measurements.