ENGINEERING PHYSICS

Course Code: 14PY1ICPHY

Learning Objectives: The student will learn the following:

- The limitations of classical physics and the need for the development of quantum mechanics, understand the dual nature of matter, uncertainty arising out of wave nature of matter, develop one dimensional Schrodinger's equation and apply it to simple physical systems.
- The basic crystal structure, the planes, crystal classification, interatomic spacing, imperfections in crystals and understand the structure determination technique using X-rays.
- The electrical and thermal conduction in metals, the concept of Fermi energy, the density of states and the Wiedmann-Franz law.
- The domain theory of ferromagnetic materials, polarization mechanisms and the concept of internal fields
- The physical principle of LASER, the working of LASER, applications of LASER and holography. Propagation of light in optical fibers, numerical aperture, fiber classification, energy losses in fibers and applications of optical fibers.

ENGINEERING PHYSICS

Syllabus from the year 2014-2018

Course Code: 14PY1ICPHY/ 14PY2ICPHY L-T-P-S: 4-0-1-0

Credits: 05 Hours/Week: 06

UNIT – 1: Quantum Mechanics

De-Broglie hypothesis. Definition and expression of phase velocity and group velocity. Relation between group velocity and phase velocity, relation between group velocity and particle velocity, relation between group velocity, phase velocity and velocity of light. Derivation of de-Broglie wavelength using group velocity. Matter waves – characteristic properties. Problems.

Heisenberg's uncertainty principle – statement and physical significance. Application of uncertainty principle - Non-existence of electron in the nucleus. Wave function- properties and physical significance. Probability density and normalization of wave function. Setting up of one-dimensional time independent Schrödinger wave equation. Eigen functions and eigen values. Applications of Schrodinger's wave equation: 1. Free particle, 2. Particle in a one dimensional potential well of infinite height (eigen functions, probability density and eigen values for the first three states). Problems.

10 Hours

UNIT – 2: Crystal Structure

Introduction, lattice parameters, directions and planes in a crystal. Miller indices – procedure for finding Miller Indices, derivation for inter-planar spacing in terms of Miller indices. Expression for angle between crystal directions (qualitative). Imperfections in crystals: point defects (Schottky and Frenkal defects), line defects (edge dislocation and screw dislocations). Bragg's law - derivation. Bragg's diffractometer, powder diffraction method of finding lattice parameters. Problems.

10 Hours

UNIT – 3: Electrical and Thermal Properties of Solids

Electric Properties: Introduction, limitations of classical free electron theory. Postulates of quantum free electron theory, Fermi energy, Fermi factor, dependence of f(E) on temperature, Fermi velocity, Fermi temperature. Electrical conductivity (qualitative expression using effective mass and Fermi velocity). Merits of quantum free electron theory. Problems.

Thermal Properties: Thermal conductivity, expression for thermal conductivity of a conductor using classical free electron theory, Wiedemann – Franz law, calculation of Lorentz number using classical and quantum assumptions. Theory - determination of thermal conductivity using Forbe's and Lee – Charlton's methods. Problems.

9 Hours

UNIT – 4: Magnetic and Dielectric Properties of Solids

Magnetic Materials: Ferromagnetic materials – characteristic features, Weiss's domain theory. B-H graph in ferromagnetic materials using the concept of domains. Soft and hard magnetic materials – characteristic features, explanation using domain theory and applications. Anti-ferromagnetic materials, Ferrites – features and applications.

Dielectric Materials: Introduction, polarization – types of polarization. Derivation of electronic polarizability, Frequency dependence of dielectric constant. Derivation of dielectric loss. Expression for internal fields in liquids and solids (one dimensional). Clausius – Mossotti relation. Problems.

9 Hours

UNIT – 5: Lasers and Optical Fibers

Lasers: Introduction, interaction of radiation with matter, derivation of energy density of radiation in terms of Einstein's coefficients. Characteristics of lasers, condition for laser action using Einstein's coefficients, basic requisites of a laser system. Construction and working of He-Ne laser and semiconductor laser. Mention of any five applications of lasers. Holography – recording of hologram and reconstruction of image. Problems.

Optical Fibers: Introduction. Principle of propagation in optical fibers. Angle of acceptance, expression for numerical aperture and condition for propagation. Fractional index change. Classification of optical fibers. Number of modes – V number. Attenuation – causes of attenuation, coefficient of attenuation. Mention of any five applications optical fibers. Problems.

10 Hours

LIST OF EXPERIMENTS

(Ten to be performed)

No.	Name of the experiment	Remarks
1	Planck's constant or determination of wavelength of different LED's.	UNIT-1
2	Determination of interplanar spacing using x-ray data.	UNIT-2
3	Measurement of Fermi energy of copper using Calender and Griffith's bridge.	UNIT-3
4	Thermal conductivity of a bad conductor by Lee Charlton's method.	UNIT-3
5	Thermal conductivity of a metal by Forbe's method.	UNIT-3
6	Determination of electrical conductivity of a semiconductor using four probe method.	UNIT-3
7	Determination of dielectric constant of the material by charging and discharging of the capacitor.	UNIT-4
8	B-H Curve of ferrites/soft iron (absolute method).	UNIT-4
9	B-H Curve of ferrites/soft iron (using CRO).	UNIT-4
10	Measurement of wavelength of semiconductor laser source using diffraction grating.	UNIT-5
11	To study the divergence of semiconductor laser beam.	UNIT-5
12	Experiment on optical fibers (numerical aperture/attenuation).	UNIT-5
13	Measurement of energy gap of a semiconductor.	General Physics
14	Frequency response of series and parallel LCR circuits and study of quality factor.	General Physics
15	Measurement of elastic constants.	General Physics
16	Experiments on resonance.	General Physics
17	Reddy's shock tube and its characteristics.	General Physics

Experiment numbers 13-16 are suggested as open end experiments.

Text Books:

1. Solid State Physics – Sixth Edition – S. O Pillai – New Age International Publishers.

2. Engineering Physics – V Rajendran – Tata Mcgraw–Hill.

Reference Books:

1. Concepts of Modern Physics – Fifth edition- Arthur Beiser – Tata Mcgraw-Hill.

2. Engineering Physics – R K Gaur and S L Gupta – Dhanpat Rai Publications.

E-Books/Resources:

http://de.physnet.net/PhysNet/education.html

http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html

Online digital courses:

1. https://www.edx.org

2. https://www.coursera.org

Reference Book: (Laboratory)

1. Practical Physics - Harnam Singh and Dr. P. S. Hemne - S Chand and Co Ltd.

CO1: Apply the knowledge of basic quantum mechanics, to set up one-dimensional Schrodinger’s wave equation and its application to few physical problems.

CO2: Recognize various planes in a crystal and describe the structure determination using x-rays.

CO3: Summarize the importance of free electrons in determining the properties of metals; understand the concept of Fermi energy.

CO4: Describe the basic magnetic and dielectric properties of solids.

CO5: Describe the basic laser physics, working of lasers, holography and principle of propagation of light in optical fibers.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										
CO2	√	√										
CO3	√	√										
CO4	√	√										
CO5	√											