**Syllabus from the year 2018-2019**

| | |
|---|---|
| Course Title: **APPLIED PHYSICS** | L-T-P: 4-0-1 |
| Course Code: 18PY1BSPHY / 18PY2BSPHY | Hours/Week: 06 |
| Credits: 05 | Theory : 48 Hours, Practical : 24 Hours |

**Course Objectives:** To disseminate to the students, the concepts of quantum mechanics, electrical and thermal properties of solids, materials science, lasers, optical fibers, oscillations and facilitate students to apply in their area of specialization.

## UNIT – I : 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 and finite width (eigen functions, probability density and eigen values for the first three states). Problems.

**[10 hour]**

## UNIT – II : Electrical and Thermal Properties of Solids

Electric Properties: Review of classical free electron theory, limitations of classical free electron theory. Postulates of quantum free electron theory, Fermi energy, Fermi velocity, Fermi temperature. Expression for Fermi energy. Fermi factor and its dependence on energy and temperature. Electrical conductivity (qualitative expression using effective mass and Fermi velocity). Merits of quantum free electron theory. Density of states (qualitative), 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 and determination of thermal conductivity using Forbe's and Lee – Charlton's methods. Problems.

**[9 hour]**

## UNIT – III : Materials Science

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

Physics of Semiconductor: Introduction, Fermi level in intrinsic and extrinsic semiconductors, Expression for concentration of electrons in conduction band. Mention of the expression for hole concentration in valance band, Expression for intrinsic carrier concentration, Conductivity of semiconductors, Hall effect, Expression for Hall coefficient. Problems. **[10 hour]**

## UNIT – IV : Lasers and Optical Fibers

Lasers: Introduction, characteristics of lasers, interaction of radiation with matter, expression for energy density of a system under thermal equilibrium in terms of Einstein's coefficients, condition for laser action using Einstein's coefficients, basic requisites of a laser system. Construction and working of He-Ne laser and semiconductor diode laser. 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. Number of modes – V number, inter-modal dispersion. Classification of optical fibers. Attenuation – causes of attenuation, expression for coefficient of attenuation. Applications of optical fibers. Problems. **[10 Hour]**

## UNIT – V : Theory of Oscillations

Theory of free vibrations: Periodic motion, simple harmonic motion, equation of a simple harmonic oscillator, expressions for period and frequency, energy considerations-total energy, conversion of energy from kinetic to potential in SHM, electric to magnetic in an LC circuit. Theory of damped vibrations: Resistive forces, equation of motion-expression for decaying amplitude, cases of damping. Logarithmic decrement, relaxation time and quality factor. Theory of forced vibrations and resonance: Equation of motion-expression for amplitude, mechanical impedance, expression for maximum amplitude. Examples of resonance – ESR and NMR. Problems. **[9 hour]**

## LIST OF EXPERIMENTS

| No. | Name of the experiment | Skill |
|---|---|---|
| 1 | Wavelength of LEDs | Determine |
| 2 | Fermi energy of copper | Determine |
| 3 | Thermal conductivity of a poor conductor by Lee Charlton's method | Determine |
| 4 | Thermal conductivity of a metal by Forbe's method | Determine |
| 5 | Dielectric constant of a material by charging and discharging of a capacitor | Determine |
| 6 | Energy gap of a semiconductor using four probe method | Determine |
| 7 | Wavelength of semiconductor laser source using diffraction grating | Determine |
| 8 | Divergence angle of semiconductor laser beam | Determine |
| 9 | Numerical aperture of an optical fiber | Analyse |
| 10 | Series and parallel LCR circuits | Analyse |

**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:**


3. Concepts of Modern Physics – Fifth edition- Arthur Beiser – Tata Mcgraw-Hill.
4. Engineering Physics – R K Gaur and S L Gupta – Dhanpat Rai Publications.


**E-Books/Resources:**

5. http://de.physnet.net/PhysNet/education.html
6. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html

**NPTEL/SWAYAM/MOOCs:**

7. http://nptel.ac.in/
8. https://swayam.gov.in/

**Course outcomes:**

| | On completion of the course, the student will have the ability to: | POs Mapped | Strength of mapping |
|---|---|---|---|
| **CO1** | **Understand** the principles of quantum mechanics, transport phenomena, dielectric and semiconductor material properties of solids, laser and optical fiber and concept of vibrations. | -- | -- |
| **CO2** | **Apply** the principles of quantum mechanics, transport phenomena, dielectric and semiconductor material properties of solids, laser and optical fiber and types of vibrations to obtain desired parameters. | PO1 | 3 |
| **CO3** | Conduct experiments to obtain the desired parameter of the given material / physical system. | PO4 | 3 |

********