| 21UPH102C/21UPH202C | Engineering Physics | Credits:03 |
|---|---|---|
| Hrs/Week : 03 | | CIE Marks : 50 |
| Total Hours : 40 | | SEE Marks : 50 |

| UNIT – I | 10 Hrs |
|---|---|

**Modern physics:** Introduction, quantization of energy levels, Franck-Hertz experiment. Photoelectric effect, Compton effect and wave particle dualism. de-Broglie hypothesis, de-Broglie wavelength. Phase velocity and group velocity. Principle, construction and working of SEM. Numerical Problems.

**Quantum mechanics:** Heisenberg's uncertainty principle and its physical significance (no derivation). Application of uncertainty principle (non-existence of electron in the nucleus). Wave function, properties and physical significance of a wave function. Probability density and normalization of a wave function. Setting up of a one dimensional time independent Schrodinger's wave equation. Eigen functions and eigen values. Applications of Schrodinger's wave equation- eigen functions and energy eigen values of a particle in a one dimensional potential well of infinite height. Principle, construction and working of STM. Numerical problems.

| UNIT – II | 10 Hrs |
|---|---|

**Electrical properties of metals:** Free electron concept (Drude-Lorentz theory). Classical free electron theory-assumptions. Expression for electrical conductivity for metals (no derivation). Failures of classical free electron theory. Quantum free electron theory-assumptions, Fermi-Dirac statistics, Fermi energy, density of states (no derivation). Expression for electrical conductivity for metals (derivation based on QFET). Fermi factor and variation of Fermi factor with energy for different temperatures. Derivation of Fermi energy for 0K. Merits of quantum free electron theory. Numerical problems.

**Semiconductors:** Fermi level in intrinsic and extrinsic semiconductors (qualitative). Direct and indirect band gap semiconductors. Derivation of electrical conductivity for semiconductors. Hall effect, derivation of Hall voltage and Hall coefficient. Applications of Hall effect. Numerical problems.

**Superconductivity:** Temperature dependence of resistance in conductors and superconductors. Meissner's effect, critical magnetic field, Type-I and Type-II superconductors. BCS theory (qualitative). Applications of superconductors- Maglev vehicle and SQUID.

| UNIT – III | 10 Hrs |
|---|---|

**Crystal structure:** Directions and planes in a crystal. Miller indices, Expression for interplanar spacing in terms of Miller indices. Atomic packing factor for HCP. Relation between lattice constant and density of a material. Crystal structures of NaCl and Diamond. Bragg's law and Bragg's X-Ray spectrometer. Determination of cubic crystal structures using diffractograms. Numerical problems.

**Dielectric materials:** Polar and non-polar dielectrics. Dielectric polarization, polarization mechanisms (qualitative). Dielectric constant, internal field and derivation of internal field in solids and liquids (one dimensional). Clausius - Mossotti relation. Dielectric loss and its derivation. Applications of dielectric materials. Numerical problems.

| UNIT – IV | 10 Hrs |
|---|---|

**Laser:** Introduction, absorption, spontaneous emission and stimulated emission, Einstein's coefficients (expression for energy density). Conditions for laser action, requisites of a laser system, working mechanism. Characteristics of a laser. Classification of lasers. Construction and working of Nd: YAG and carbon dioxide lasers. Applications of lasers- industry, defence and medical. Numerical problems.

**Optical fibers**: Introduction, propagation mechanism in optical fibers, angle of acceptance, numerical aperture and its derivation. Modes of propagation (qualitative), types of optical fibers and attenuation (qualitative). Applications-optical fiber communication system. Numerical problems.

**Ultrasonic Waves:** Introduction, generation of ultrasonic waves by inverse piezoelectric method and its properties. Measurement of velocity of ultrasonic waves in solids by pulse echo method. Applications of ultrasonic waves - Non destructive testing of materials. Numerical problems.

**Reference Books:**


1. M. N. Avadhanulu and P. G. Kshirsagar and TVS Arun Murty, 2019"A Text Book of Engineering Physics**"**, (11th revised edition) S. Chand & Company .
2. S. O. Pillai 2010"Solid State Physics", (Sixth edition), New Age International.
3. R. K. Puri and V. K. Babbar, 2010"Solid State Physics",( third edition), S.Chand.
4. Arthur Beiser, 2002"Modern physics", (sixth edition)T.M.H.
5. B. B. Laud, 1991"Lasers and non linear optics", (second edition), New Age International.
6. R. K. Gaur and S. L. Gupta, 2012"Engineering Physics", (eighth edition), Dhanpat Rai .


**Course Outcomes:**

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

1. Apply quantum mechanics principles for computing probability density and energy for simple systems
2. Verify conductivity of metals and semiconductors theoretically and explain applications of conductors, semiconductors and superconductors
3. Identify crystal structure of cubic crystals and explain physical properties and applications of dielectric materials
4. Analyze suitability of lasers, optical fibers and ultrasonic waves for engineering applications

| | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No | Programme Outcomes / Course Outcomes | | | | | | | | | | | | |
| 1 | Apply quantum mechanics principles for computing probability density and energy for simple systems. | 3 | 2 | 1 | | | | | | | | | 1 |
| 2 | Verify conductivity of metals and semiconductors theoretically and explain applications of conductors, semiconductors and superconductors. | 3 | 2 | 1 | | | | | | | | | 1 |
| 3 | Identify crystal structure of cubic crystals and explain physical properties and applications of dielectric materials. | 3 | 2 | 1 | | 1 | 1 | | | | | | 1 |
| 4 | Analyze suitability of lasers, optical fibers and ultrasonic waves for engineering applications. | 3 | 2 | 1 | | 1 | | 1 | | | | | 1 |

| 21UPH108L/21UPH208L | Engineering Physics Laboratory | Credit-01 |
|---|---|---|
| Hrs/Week : 02 | | CIE Marks : 50 |
| Total Hours: 30 | | SEE Marks : 50 |

**LIST OF EXPERIMENTS**

1. Determination of Fermi energy for a given conductor
2. Determination of dielectric constant by RC charging and discharging method
3. The study of frequency response in series and parallel LCR circuits
4. Identification of passive components and estimation of their values in a given black box
5. Determination of rigidity modulus of a wire by torsional pendulum method
6. Measurement of velocity of ultrasonic waves in liquid by using ultrasonic interferometer
7. The study of characteristics of a laser
8. Verification of Stefan's law
9. Determination of Young's modulus of a metal strip by single cantilever method
10. Determination of Planck's Constant (using LED's or photoelectric effect method)
11. Measurement of numerical aperture and attenuation of an optical fiber
12. Determination of electrical resistivity and energy gap of a semiconductor by four probe method
13. Determination of specific heat of a solid or liquid using calorimeter
14. Determination of viscosity of a liquid

**Note:**

1. Minimum eight experiments are to be conducted in a semester
2. The student has to perform one experiment during Lab CIE Test
3. The student has to perform one experiment during the SEE practical examination

**List of experiments (virtual laboratory)**

1. Franck- Hertz experiment
2. Hall effect experiment
3. Emission spectra
4. Magnetic field along the axis of a circular coil carrying current
5. Determination of Stefan's constant
6. Newton's rings- wavelength of light

**Note:**

1. Two virtual lab experiments are to be performed by students in a semester

**Course outcomes:**

1. Apply experimental skills for solving engineering problems
2. Use measuring tools for precision measurements
3. Measure properties of different materials
4. Exhibit documentation skill in the form of experimental write-up

**Course Articulation Matrix: Mapping of Course Outcomes (CO) with Programme Outcomes (PO)**

**Subject: Engineering Physics Laboratory** **Sub.Code: 21UPH108L/21UPH208L**

| | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO 8 | PO 9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **No** | **Programme Outcomes / Course Outcomes** | | | | | | | | | | | | |
| 1 | Apply experimental skills for solving engineering problems. | 3 | | | 1 | | 1 | | 1 | | | | 1 |
| 2 | Use measuring tools for precision measurements. | 3 | | | | | 1 | | 1 | | | | 1 |
| 3 | Measure properties of different materials. | 3 | 1 | | | 1 | 1 | 1 | 1 | | | | 1 |
| 4 | Exhibit documentation skill in the form of experimental write-up. | 1 | | | | | | | 1 | 1 | 1 | | 1 |