SUBJECT CODE:UPH162C	ENGINEERING PHYSICS	Credits: 4
L:T:P - 3: 2:0		CIE Marks: 50
Total Hours/Week: 66		SEE Marks: 50

UNIT-I	L-10Hrs.T-6Hrs

Quantum Mechanics:

Introduction, Quantization of energy levels, Frank-Hertz experiment. de-Broglie hypothesis, phase velocity group velocity. Expression for de-Broglie wavelength using the concept of group velocity. Heisenberg's uncertainty principle and its physical significance (no derivation). Application of Heisenberg's uncertainty principle (non-existence o electron in the nucleus). Wave function, properties, probability density and normalization of a wave function. Setting up of one dimensional time independent Schrodinger wave equation. Eigen functions and eigen values. Application o Schrodinger wave equation- eigen function and energy eigen values of a particle in a one dimensional potential well o infinite height. Numerical Problems.

Lasers:

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 of a laser. Characteristics of a laser Classification of lasers. Construction and working of Nd:YAG, carbon dioxide and semiconductor diode lasers. Lase safety. Applications of lasers- industry, defense, medical and environmental. Numerical Problems.

UNIT–II	L-10Hrs.T-6Hrs

Electrical Properties of Metals and Semiconductors:

Free electron concept (Drude-Lorentz theory). Classical free electron theory- assumptions. Derivation of electrica conductivity for metals. Effect of impurity and temperature on electrical resistivity of metals (Matthiessen's rule).Failure of classical free electron theory. Quantum free electron theory- assumptions. Fermi-Dirac statistics. Density of state (qualitative). Fermi energy, 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, concentration of electrons and holes in intrinsic and extrinsic semiconductors (qualitative). Fermi level in intrinsic and extrinsic semiconductors (qualitative). Direct and indirect band gap semiconductors. Derivation of electrica conductivity for semiconductors. Hall effect, derivation of Hall voltage and Hall coefficient, experimental measurement o Hall voltage and Hall coefficient. Applications of Hall effect. Numerical Problems.

Superconductivity: Temperature dependence of resistance in conductors and superconductors. Meissner effect, critical magnetic field, Type I and Type II superconductors. BCS theory (qualitative).Applications of superconductors – Maglev vehicles and SQUID. Numerical Problems.

UNIT–III	L-10Hrs.T-6Hrs

Crystal Structure:

Introduction, Directions and planes in a crystal. Miller indices. Expression for interplanar spacing in terms of Miller indices. Coordination number, atomic packing factor for SC, BCC, FCC and HCP. Relation between lattice constant and density of a material. Crystal structures of CsCl, NaCl and Diamond. Bragg's Law and Bragg's X-ray spectrometer- determination of wavelength. Determination of cubic crystal structures using diffractrograms. Numerical Problems.

Dielectric materials:

Polar and non-polar dielectrics. Dielectric polarization, polarization process in polar and non-polar dielectrics, polarization mechanisms. Dielectric constant, relation between polarization and dielectric constant. Internal field and derivation of internal field in solids and liquids (one dimensional). Clausius–Mossotti relation. Dielectric loss (derivation). Applications of dielectric materials. Numerical Problems.

UNIT–IV	L-10Hrs.T-8Hrs

Electromagnetic waves:

Introduction, Scalar and Vector, Cartesian coordinate system, Spherical coordinate system, cylindrical coordinate system. Coulomb's law, electric field intensity, electric potential at a point. Biot-Savart's law, Amperes law. Maxwell's four equations (qualitative). Wave propagation in free space. Application of EM waves – wireless communication. 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. Applications-optical fiber communication system, optical fiber as a sensor. Numerical Problems.

Ultrasonic Waves:

Introduction, generation of ultrasonic waves (piezoelectric method) and properties. Measurement of velocity of ultrasonic waves in solids and liquids. Applications of ultrasonic waves- non destructive testing of materials, medical and elastic constants of solids and liquids. Numerical Problems.

Nanoscience:

Introduction, Density of states in 1D, 2D and 3D structures. Nanomaterials, Synthesis: Top-down and Bottom-up approach - Ball Milling and Sol-Gel methods. CNT electrical properties and applications.

Numerical Problems.

Reference Books *

1. S.O.Pillai, ”Solid State Physics”, Sixth edition, New Age International, 2010.
2. R.K.Puri and V.K.Babbar, “Solid State Physics”, S. Chand, 2010.
3. Arthur Beiser, “Concepts of Modern Physics”, Sixth edition, T.M.H, 2006.
4. B. B. Laud, “Lasers and Non-Linear Optics”, Second edition, New Age International, 1991.
5. R.K. Gaur and S.L. Gupta, “Engineering Physics”, Dhanpat Rai, 2012.
6. Wiley Precise Textbook series, “Engineering Physics”, Wiley India Pvt. Ltd., 2014.
7. W. H. Hayt and J. A Buck, “Engineering Electromagnetics”, Seventh edition, MGH, 2006.

Course Outcomes**

After completion of the course student will be able to

1. apply one dimensional Schrödinger's wave equation for computing physical properties of a material theoretically.
2. analyse suitability of lasers for engineering applications.
3. verify conductivity of metals theoretically.
4. explain applications of semiconductors and superconductors.
5. identify crystal structure of cubic crystals.
6. analyse the necessity of dielectric materials for engineering applications.
7. apply suitability of electromagnetic waves and optical fibers for communication systems.
8. identify the properties of ultrasonic waves and nano materials for engineering applications.

Course Outcomes	Programme Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	1	-	1	-	-	-	1	1	-	1
CO2	3	2	1	-	1	1	1	1	1	1	-	1
CO3	3	2	1	-	1	-	-	-	1	1	-	1
CO4	3	2	1	-	1	-	-	-	1	1	-	1
CO5	3	2	1	-	1	1	1	-	1	1	-	1
CO6	3	2	1	-	1	1	1	1	1	1	-	1

SUBJECT CODE:UPH262C	ENGINEERING PHYSICS	Credits: 4
L:T:P - 3: 2:0		CIE Marks: 50
Total Hours/Week:66		SEE Marks: 50

UNIT-I	L-10Hrs.T-6Hrs.

Vector Mechanics:

Introduction, scalar and vector, representation of vectors, types of vectors, position vector, displacement vector, zero vector and its properties, addition and subtraction of vectors, resolution of vectors, multiplication of vectors by scalar, dot product and cross product. Laws of mechanics –Triangle law, Parallelogram law, Polygon law, Newton's laws. Rectangular component of a vector. Numerical Problems.

Crystal Structure:

Introduction, Directions and planes in a crystal. Miller indices. Expression for interplanar spacing in terms of Miller indices. Coordination number, atomic packing factor for SC, BCC, FCC and HCP. Relation between lattice constant and density of a material. Crystal structures of CsCl, NaCl and Diamond. Bragg's Law and Bragg's X-ray spectrometer-determination of wavelength. Determination of cubic crystal structures using diffractrograms. Numerical Problems.

UNIT–II	L-10Hrs.T-6Hrs.

Electrical Properties of Metals:

Free electron concept (Drude-Lorentz theory). Classical free electron theory- assumptions. Derivation of electrical conductivity for metals. Effect of impurity and temperature on electrical resistivity of metals (Matthiessen's rule). Failures of classical free electron theory. Quantum free electron theory- assumptions. Fermi-Dirac statistics. Density of states (qualitative). Fermi energy, 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.

Dielectric materials:

Polar and non-polar dielectrics. Dielectric polarization, polarization process in polar and non-polar dielectrics, polarization mechanisms. Dielectric constant, relation between polarization and dielectric constant. Internal field and derivation of internal field in solids and liquids (one dimensional). Clausius-Mossotti relation. Dielectric loss (derivation). Applications of dielectric materials. Numerical Problems.

UNIT–III	L-10Hrs.T-6Hrs.

Thermodynamics:

Thermodynamics-definition, scope, microscopic and macroscopic approaches. Thermodynamic system-closed system, open system (control volume), isolated system, physical examples. Thermodynamic properties–definition, intensive and extensive. Thermodynamic - state point, state diagram, path, process, quasi-static process, cyclic and non-cyclic processes. Thermodynamic equilibrium-definition, equilibrium attained keeping pressure constant, thermal equilibrium, chemical equilibrium, diathermic wall. Temperature concepts, Equality of temperature, Zeroth law of thermodynamics. Thermometer and thermometric property. Temperature scale, standard scale, standard scale of temperature and temperature measurement. International practical temperature scale. Numerical Problems.

Fluid Mechanics:

Introduction, Definition–fluid mechanics, fluid statics, fluid kinematics and fluid dynamics. Properties of fluids, viscosity Newton's law of viscosity. Types of fluids, thermodynamic properties, compressibility and bulk modulus, adiabatic and isothermal processes. Surface tension, capillarity, vapor pressure. Fluid pressure at a point. Pascal's law with proof. Numerical Problems.

UNIT–IV	L-10Hrs.T-6Hrs.

Lasers:

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 of a laser. Characteristics of a laser. Classification of lasers. Construction and working of Nd:YAG, carbon dioxide and semiconductor diode lasers. Applications of lasers-industry, defense, medical and environmental. Laser safety. Numerical Problems.

Ultrasonic Waves:

Introduction, generation of ultrasonic waves (piezoelectric method) and properties. Measurement of velocity of ultrasonic waves in solids and liquids. Applications of ultrasonic waves- non destructive testing of materials, medical and elastic constants of solids and liquid. Numerical Problems.

Nanoscience: Introduction, Density of states in 1D, 2D and 3D structures. Nanomaterials, Synthesis: Top-down and Bottom-up approach - Ball Milling and Sol-Gel methods.CNT-types, synthesis-Arc discharge and laser ablation methods. CNT mechanical properties and applications. Numerical Problems.

Reference Books *

1. Wiley Precise Textbook Series,2014 "Engineering Physics", Wiley India Pvt. Ltd.
2. F. P.Beer and E.R. Johnston, 2013"Vector Mechanics for Engineers", (Tenth edition), MGH.
3. R.K. Gaur and S.L. Gupta, 2012 "Engineering Physics", Dhanpat Rai.
4. R. K. Bansal, 2012 "A textbook of Fluid Mechanics", Laxmi.
5. R. K. Puri and V.K.Babbar, 2010"Solid State Physics", S. Chand.
6. Y. A. Cengel and M.A. Boles,2006 "Thermodynamics", Fifth edition, MGH .
7. B. B. Laud, 1991"Lasers and Non-Linear Optics", Second edition, New Age International.

Course Outcomes**

After completion of the course student will be able to

1. apply vector mechanics for solving engineering problems.
2. identify crystal structure of cubic crystals.
3. verify conductivity of metals theoretically.
4. analyse the necessity of dielectric materials for engineering applications.
5. apply basics of thermodynamics for solving engineering problems.
6. apply basics of fluid mechanics for solving engineering problems.
7. analyse suitability of lasers for engineering applications.
8. identify the properties of ultrasonic waves and nanomaterials for Engineering applications.

Course Outcomes	Programme Outcomes (POs)										
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	1	-	-	-	-	-	1	1	-	1
CO2	3	2	1	-	-	-	-	-	1	1	-	1
CO3	3	2	1	-	-	-	-	-	1	1	-	1
CO4	3	2	1	-	-	1	1	-	1	1	-	1
CO5	3	2	1	-	1	1	1	1	1	1		1
CO6	3	2	1	-	1	1	1	1	1	1		1

SUBJECTCODE:UPH166L	**Engineering Physics Laboratory**	**Credit :1.5**
Hrs/Week : 03		CIE Marks : 50
Total Hours: 30		SEE Marks : 50

LIST OF EXPERIMENTS	
Sl No	**Title of the Experiment**
1	The study of frequency response in series and parallel LCR circuits.
2	Black box experiment to identify passive components and estimate their values
3	Determination of Fermi energy for a conductor.
4	Determination of Planck's constant using LEDs.
5	Measurement of wavelength of a laser using diffraction grating.
6	Determination of dielectric constant of a material in a capacitor by RC charging and discharging method
7	Measurement of velocity of ultrasonic waves in a liquid using ultrasonic interferometer.
8	Determination of cubic crystal structures using diffractograms.
9	Determination of Young's modulus of a metal strip by single cantilever method.
10	Determination of Rigidity modulus of a wire by torsional pendulum method.

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

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

SUBJECTCODE:UPH266L	Engineering Physics Laboratory	Credit :1.5
Hrs/Week : 03		CIE Marks : 50
Total Hours: 30		SEE Marks : 50

LIST OF EXPERIMENTS

Sl No	Title of the Experiment
1	Black box experiment to identify passive components and estimate their values.
2	Determination of Fermi energy for a conductor.
3	Determination of Rigidity modulus of a wire by torsional pendulum method.
4	Determination of Young's modulus of a metal strip by single cantilever method.
5	Measurement of wavelength of a laser using diffraction grating.
6	Determination of cubic crystal structures using diffractograms.
7	Determination of dielectric constant of a material in a capacitor by RC charging and discharging method.
8	Measurement of velocity of ultrasonic waves in a liquid using ultrasonic interferometer.
9	Determination of viscosity of castor oil by Stokes method.
10	Determination of specific heat of a solid using calorimeter.

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

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