SYLLABUS 2019-20

18UPHC100/18UPHC200	Engineering Physics	(3-2-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

Engineering Physics course is designed to deliver optimum knowledge of materials and energy concepts. Content explores the fundamental theories, experimental demonstrations and their applications in various engineering fields. Scope of the curriculum includes the study of quantum mechanics, electrical and dielectric properties of materials, photonics, oscillations and waves.

Course Outcomes (COs):

COs	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs (1-12)		
		Mastering 3	Moderate 2	Introductory 1
CO-1	Describe dual natures of energy and matter. Derive one-dimensional Schrödinger wave equation and its relevance in understanding quantum structures.		1	2
CO-2	Compare Classical and Quantum free electron theories. Explain the basics of semiconductors and their electrical characterization.		2	1
CO-3	Express basics of dielectrics, Identify the properties, synthesis methods, characterization techniques and applications of nanomaterials.		1	2
CO-4	Discuss the optical phenomena, lasing action, applications of LASER beam. Explicate the basics of optical fiber and application in optical sensors.	1	2	
CO-5	Distinguish Electrical and mechanical oscillations, and its implications, fundamental elastic properties of the materials and applications in engineering.		2	1

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
Mapping Level	1.8	1.6										

Contents:

1) Modern Physics and Quantum Mechanics: Introduction to Modern Physics, de-Broglie hypothesis, Davisson-Germer's experiment (demonstration). Concept of phase velocity, group velocity and particle velocity. Relation between group velocity and particle velocity. Expression for de Broglie wavelength using group velocity concept. Application of de-Broglie hypothesis.

Heisenberg's uncertainty principle and applications. Wave function, properties and physical significance of a wave function. Probability density and normalization of wave function, setting up of 1-dimensional time independent Schrödinger wave equation (qualitative). Applications of Schrödinger wave equation – (a) Energy Eigen values and (b) Eigen functions of a particle in a one-dimensional potential well of infinite height and for a free particle.

Numerical examples.

10 L + 2 T Hrs.

2) Electrical properties of materials: Conductors: Review of classical free electron theory. Quantum free electron theory – assumptions, Fermi level, Fermi energy, Fermi velocity, Fermi temperature and Fermi factor and its temperature dependence, concept of density of states (bulk) and Fermi Dirac distribution. Expression for electrical conductivity and success of QFET. Effect of impurity, lattice defect and temperature on resistivity of metal (Matteissen's rule). Numerical examples.

Semiconductors: Direct and indirect band gap semiconductors, Fermi level in semiconductor, carrier concentration and electrical conductivity in semiconductors. Hall effect – determination of Hall voltage and Hall coefficient. Numerical examples.

8 L + 2 T Hrs.

3) Dielectrics and Nanomaterials: Dielectrics: Dielectric polarization, types of dielectric polarization, polar and non-polar dielectrics, dielectric constant, internal field in solids (qualitative), Clausius-Mosotti equation. Dielectric losses and its effect on electromagnetic spectrum – Ferro-electricity and Piezoelectricity. Solid, liquid and gases dielectric materials and their applications. Numerical examples.

Nanomaterials: Introduction, size dependent properties of materials, classification – based on intrinsic property and confinement, variation of DOS, Syntheses - top down and bottom up approach one example each. Characterization techniques. Carbon nanostructures – properties and applications.

8 L + 2 T Hrs.

4) Photonics: Laser: Basics of light amplification, Einstein's coefficients (expression for energy density), principle and operation of CO_2 and

semiconductor diode laser. Applications - LIDAR, laser cooling, laser fusion. Engineering applications of lasers - welding, drilling and cutting.

Optical Fiber: Principles of optical fiber (total internal reflection), Angle of acceptance, Numerical aperture, Fractional Index change, V-number and Modes of propagation. Types of Optical fibers, Attenuation co-efficient and fiber losses. Discussion of block diagram of point to point communication System, optical fiber sensors (temperature, displacement and force) Numerical examples.

8 L + 2 T Hrs.

5) **Oscillations and Elasticity:** Introduction (Simple harmonic motion, frequency and time period of oscillation, types of oscillations). Free oscillations: Mechanical oscillators-expression for time period of horizontal spring oscillator and torsional pendulum. Electrical oscillators – expression for frequency of LC oscillators. Theory of damped oscillations (expression for angular frequency): Over damping, critical & under-damping. Forced oscillations (qualitative) and resonance.

   Numerical examples

   Elasticity: Introduction, stress strain graph, factors affecting the elasticity of materials. Expression for Young's modulus (Y), bulk modulus (K) and rigidity modulus (n) in terms of α and β. Relation between Y, n and K, Expression for couple per unit twist of wire (derivation) using tensional oscillation theory. Numerical examples.

8 L + 2 T Hrs.

Beyond the Syllabus Coverage: Seminar, Quiz and Assignments

Reference books:

1) Oscillations and waves in physics- Ian G. Main: 3rd Ed, Cambridge University Press - 1993 (online publication 2012).
2) Engineering Physics - Avadhanalu and Kshirasagar - S. Chand Publication
3) Introduction to Mechanics — M K Verma: 2nd Ed, University Press (India) Pvt Ltd, Hyderabad 2009.
4) O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010.
5) B.G. Streetman, "Solid State Electronic Devices", Prentice Hall of India, 1995.
6) Concepts of Modern Physics-Arthur Beiser: 6th Ed;Tata McGraw Hill Edu Pvt Ltd- New Delhi 2006
7) Introduction to Nanotechnology – C. P. Poole - John Wiley & Sons

18UPHL100/18UPHL200 Engineering Physics Laboratory (0-0-2) 1

Contact Hours: 26

Course Learning Objectives (CLOs):

Engineering Physics laboratory course provides real time experience in handling equipments and measurement techniques. Experiments are designed to learn the material characterization techniques and realization of material properties. Basic objective of the course is to learn the experimental procedure and carry out analysis.

Course outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Demonstrate the procedural preparation skill to conduct the experiment	1	2	
CO-2	Perform the experiment and tabulate the observations made.	1	2	
CO-3	Obtain & compare experimental results by different techniques.		2	1
CO-4	Interpret experimental results and draw conclusions.		1	2
CO-5	Articulate the relevant theory.	1		2

POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
Mapping Level	2.4	1.6										

Contents:

1) Determination of the value of Young's modulus of the given wooden bar by single cantilever method.
2) Study of Photocell and determination of the Plank's constant.
3) To study the frequency response of series and parallel LCR circuits.
4) Determination of the Fermi Energy of a given material.
5) Verification of Stefan's Law by electrical method.
6) Determination of the energy gap of a given semiconductor.
7) Determination of numerical aperture and acceptance angle of an optical fiber.
8) Determination of the dielectric constant of a dielectric material by charging & discharging method.
9) Study of the characteristics of a given laser source using diffraction method.
10) Determination of resistivity of semiconductor using Four Probe method.
11) Study of Basic and Universal Logic gates.
12) Study of transistor characteristics.

Note: Minimum ten experiments are to be performed to complete the course.

Reference Books:

1) Edward R. Shaw, "Physics by Experiment", Create Space Independent Publishing Platform, 2014.