ENGINEERING PHYSICS

[As per Choice Based Credit System (CBCS) & OBE Scheme]

SEMESTER – I / II

Course Code:	**P21PH102 / 202**	**Credits:**	**03**
Teaching Hours/Week (L:T:P):	**2:2:0**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**40**	**SEE Marks:**	**50**

Course Learning Objectives: This course will enable the students to:

- Define the laws and principles of Physics used in the topics of the course pertaining to the engineering field.
- Explain the concepts and theories used in the topics to understand the properties and applications relevant to engineering field.
- Build a foundation in formulating the expressions for the quantities and solve the problems by applying the knowledge of Mathematical science pertaining to engineering and technology.

UNIT – I	**Quantum Mechanics**	**8 Hours**

Quantum theory of radiation: Properties of photons, Assumptions of Planck's law of radiation, Planck's radiation formula (Qualitative).

Matter waves*:* Wave-Particle duality, definitions of phase velocity, group velocity and particle velocity. Expression for deBroglie wavelength using group velocity concept. Heisenberg's uncertainty principle and its illustration**.** Application: Non-existence of electrons in the nucleus.

Wave function: Statement, Physical significance and properties. Definitions for Eigen functions and Eigen values. Time-independent one dimensional Schrodinger's wave equation. Applications: Particle in one dimensional potential well – Expression for Eigen functions, Eigen values and normalized wave function - Numerical Problems.

Pedagogy	➢ Chalk and talk; power point presentation and videos. ➢ **Self-study component:** Concept of Black body radiation spectrum, Wien's law, Rayleigh-Jean's law, Stefan-Boltzmann's law and their limits. ➢ **Practical Topics:** Stefan's law; Planck's constant.

UNIT – II	**Properties of Engineering Materials**	**8 Hours**

Elastic materials: Concept of elasticity, definition for stress and strain, different elastic moduli, Poisson's ratio and its limits. Relation between the elastic constants and expression for poisson's ratio in terms of elastic constants. Expression for bending moment of a beam with rectangular cross section. Applications: Couple per unit twist of a wire; I - shaped girders.

Dielectric Materials: Electric dipole, dipole moment, Dielectric constant, polarization of dielectric materials and types of polarization. Expression for internal field in solids (one dimension). Expression for Clausius-Mossotti equation. Applications of dielectrics in transformers.

Superconducting Materials: Properties of superconductors - Zero resistance, Meissner's effect, Critical field (Qualitative), BCS theory. Types of Superconductors: Type-I and Type-II. Applications of superconductivity – i) Superconducting magnets and ii) Maglev vehicle. Numerical Problems.

Pedagogy	➢ Chalk and talk; power point presentation and videos. ➢ **Self-study component:** Hooke's law and stress-strain diagram. Application of superconductors in medicine (SQUIDS) ➢ **Practical Topics:** Uniform bending; Torsional pendulum; Dielectric constant.

UNIT – III	**Electrical Conductivity in Solids**	**8 Hours**

Metals: Quantum free electron theory – Assumptions, Fermi Dirac Statistics (qualitative), Fermi level, Fermi energy, Fermi temperature, Fermi velocity and Fermi factor. Variation of Fermi factor with Energy and temperature, Expression for density of states. Mention the expression for Fermi energy and Electron density. Merits of quantum free-electron theory.

Semiconductors: Classification of Semiconductors, Fermi level in intrinsic and extrinsic semiconductors. Expression for electron concentration in conduction band and Mention the expression for hole concentration in valance band of an intrinsic semiconductor. Relation between E_F and E_g. Expression for conductivity and resistivity of an intrinsic semiconductor in terms of mobility of charge carriers. Numerical Problems.

Pedagogy	➢ Chalk and talk; power point presentation and videos. ➢ **Self-study component:** Expressions for carrier concentration, conductivity and resistivity in terms of energy gap of an intrinsic semiconductor. ➢ **Practical Topics:** Fermi energy, Energy gap of a semiconductor; Transistor Characteristics.

UNIT – IV	**Photonics**	**8 Hours**

Lasers: Review of absorption, spontaneous and stimulated emission of radiation, Expression for energy density in terms of Einstein coefficients. Requisites and conditions for laser action. Principle, Construction and Working of CO_2 Laser. Applications: Range finder, data storage, welding and cutting.

Fibre Optics: Propagation mechanism. Expression for angle of acceptance and Numerical aperture. Fractional index change, V - number and number of modes. Types of optical fibres. Attenuation: Expression for attenuation coefficient. Application: Telecommunication system. Numerical problems.

Pedagogy	➢ Chalk and talk; power point presentation and videos. ➢ **Self-study component:** Construction and working of Ruby LASER. Application of Optical fibre: Sensors. ➢ **Practical Topics:** Wavelength of LASER source by diffraction; Optical fibre; Newton's rings.

UNIT – V	**Technical Acoustics**	**8 Hours**

Architectural Acoustics: Absorption, reverberation and time of reverberation, Sabine's formula (Mention the expression), Factors affecting acoustics of a building and their remedies.

Ultrasonics: Introduction, Principle, Measurement of ultrasonic velocity in liquids. Application: Non-destructive method of testing the materials.

Shock Waves: Mach number and Mach angle, properties of shock waves, construction and working of Reddy shock tube, characteristics of Reddy shock tube, applications of shock waves. Numerical Problems.

Pedagogy	➢ Chalk and talk; power point presentation and videos. ➢ **Self-study component:** Basics of SHM; free, damped and forced vibrations (Qualitative). ➢ **Practical Topics:** Spring constant; Ultrasonic interferometer; LCR resonance.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics – ***Quantum Mechanics, Properties of the Materials, Conductivity in Solids, Photonics and Technical Acoustics.***	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	**Recall** the fundamental **Definitions** or **Laws of physics** relevant to Engineering field.	Remember	L1
CO2	**Mention** the various **Properties** and **Applications** by understanding the course topics pertaining to Engineering field.	Understanding	L2
CO3	**Explain** various **Concepts** and **Principles** used in the topics to understand the theory related to Engineering field.	Understanding	L2
CO4	**Derive** the expressions for the **Physical Quantities** on the topics of the course by applying the theory relevant to Engineering field.	Applying	L3
CO5	**Solve** the numerical **problems** by applying proper solutions to verify the theoretical concepts related to Engineering field.	Applying	L3

Text Book(s):

1. Engineering Physics – Wiley precise textbook series, Wiley India Pvt. Ltd, New Delhi.
2. R. K. Gaur, S. L. Gupta ; Engineering Physics – Dhanpat Rai Publications; 2011 Edition
3. Hitendra K Malik, A K Singh; Engineering Physics – Tata McGraw Hill Education; 2017

Reference Book(s):

1. S. O. Pillai: Solid State Physics, (New Revised Sixth Edition) – New Age International (P) Limited, Publishers, New Delhi, 2009.
2. N. H. Ayachit, P. K. Mittal: Engineering Physics – I. K. International Publishing House Pvt. Ltd. New Delhi, 2011.
3. M. N. Avadhanulu and P.G. Kshirsagar: Engineering Physics – S Chand & Company Ltd., Ram Nagar, New Delhi, 2010.
4. D. Halliday, R. Resnick, and J. Walker: Fundamentals of Physics - Wiley publications, 2017.

Web and Video link(s):

1. Quantum Mechanics: https://youtu.be/xlrvgLUsKqU
2. Lasers: https://youtu.be/Ab1nxxkgjH8
3. Fiber optics: https://youtu.be/9seDKvbaoHU

E-Books/Resources:

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

Course Articulation Matrix [Engineering Physics - P21PH102 / 202]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO-1	***3***	***1***												
CO-2	***3***	***2***												
CO-3	***3***	***2***												
CO-4	***3***	***2***												
CO-5	***3***	***2***												
3 – HIGH, **2** – MEDIUM, **1** - LOW														