1Engineering Physics (Theory & Lab)

NPH-101/102 **C[L-T-P]: 4[3-0-2]**

Course Objective:

The objective of the course is to provide a foundational understanding of core concepts in engineering physics and their practical applications, enabling students to analyze physical phenomena and apply scientific principles to solve engineering problems.

Course Outcomes (COs):

On successful completion of the course, the students will be able to:

COs		**Knowledge Level (KL)**
CO1	Understand the principle of relativity and its effect on mass, energy, and momentum.	**K1 - K5**
CO2	Understand the basics of quantum mechanics and apply its principles to solve problems that occur at subatomic dimensions.	**K2-K4**
CO3	Understand Maxwell's equations of electromagnetic theory and able to apply them in various systems.	**K2, K4, K5**
CO4	Understand the basics of semiconducting and nanomaterials materials and their applications	**K2-K5**
CO5	Get familiar with dielectric and superconducting materials and their applications	**K1-K4**
CO6	Use various physics equipment by conducting physics experiments	**K2, K3, K6**

K1-Remember, **K2**- Understand, **K3**-Apply, **K4**-Analyse, **K5**-Evaluate, **K6**-Create

Course	**COs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
NPH 101/102	**CO1**	3.00	3.00	-	1.00	1.00	-	3.00	1.00	2.00	-	3.00
NPH 101/102	**CO2**	3.00	3.00	-	2.00	-	-	3.00	1.00	2.00	-	2.00
NPH 101/102	**CO3**	3.00	3.00	-	3.00		-	3.00	1.00	2.00	-	3.00
NPH 101/102	**CO4**	3.00	3.00	2.00	1.00	1.00	-	3.00	2.00	2.00	-	3.00
NPH 101/102	**CO5**	3.00	3.00	2.00	1.00	1.00	-	3.00	2.00	2.00	-	3.00
NPH 101/102	**CO6**	3.00	1.00	3.00		3.00	2.00	3.00	3.00	3.00	2.00	3.00

Course Content

UNIT- 1

Relativistic Mechanics

Inertial and non- inertial frames of references, Michelson Morley experiment, Galilean transformation equations, Lorentz transformation equations, length contraction, time dilation and its experimental evidence, relativistic velocity addition formula, relativistic variation of mass with velocity, evidence of variation of mass with velocity, Einstein's mass-energy equivalence, examples from nuclear physics, relativistic energy-momentum relation.

UNIT- 2

Quantum Mechanics

Dual nature of matter & radiation, Heisenberg's uncertainty principle and their applications, wave packet concept, Davisson-Germer experiment, postulates of quantum mechanics, physical significance of wave function, Schrodinger equation for time-independent and time-dependent cases, applications of Schrodinger wave equation for a particle in a one-dimensional box

UNIT- 3

Electromagnetic Theory

Derivation of Maxwell's equations and their physical significance, correction of Ampere's law by Maxwell, concept of displacement current, Poynting theorem, Maxwell's equations in free space & velocity of electromagnetic waves, transverse character of the wave and orthogonality of **E**, **H** and **k** vectors, Maxwell's equation in dielectric medium andvelocity of electromagnetic wave, comparison with free space, Maxwell's equations in conducting media & solution of differential equation in this case, skin depth & its significance.

UNIT- 4

Materials of Technological Importance I

Semiconducting Materials: Concept of energy bands in solids, carrier concentration and conductivity in intrinsic and extrinsic semiconductors and their temperature dependence, compound semiconductors, amorphous semiconductors.

Nano Materials: Basic principles of nanoscience and technology, classification of nanomaterials, quantum dot, quantum wire, quantum well, basics of top down and bottom-up approach

UNIT- 5

Materials of Technological Importance II

Dielectric Materials: Dielectric materials, Types of dielectric materials, concept of dielectric polarization, different types of polarizations, concept of dielectric loss, and their importance.

Superconducting Materials: Resistivity of superconductors, Type – I and Type – II superconductors, Meissner effect, applications of superconducting materials

List of Experiments:

1. To determine the energy band gap of an N-type Germanium (Ge) semiconductor using four-probe method.
2. Verification of Stefan's fourth power law for black body radiation and determination of temperature exponent.

3. To study variation of magnetic field along axis of a current carrying coil and estimate its radius.
4. Determination of specific charge (e/m) of electron.
5. Determination of wavelength of spectral lines of mercury using plane transmission grating.
6. Determination of wavelength of hydrogen spectral lines and calculation of Rydberg constant.
7. Draw V-I characteristics of LED and determine Planck's constant.
8. Study of Carey Foster's bridge: determination of resistance per unit length and comparison of two equal resistances.

Text Books:

1. Engineering Physics, R. K. Shukla, Pearson Education, Vol.-II, 2014
2. Electrical Engineering Materials, R.K.Shukla, McGraw Hill, 1st Edition, 2012
3. Principles of Engineering Physics, R.K.Shukla, Ira Books, 1st Edition, 2011
4. Engineering Physics –I & II, S.K.Gupta, Krishna Prakashan Media (P) Ltd., 2014
5. Physics for Engineers, Alok Singh, Savita Singh, Sudhir Kumar Sharma, Cambridge, University Press, Ist Edition, 2026

References Books:

1. Fundamental university physics, Vol. - I: Mechanics, Marcelo Alonso, J. Finn Edwards, Addison-Wesley, 1st Edition, 1967
2. Concepts of Modern Physics, Arthur Beiser, McGraw Hill, 6th Edition, 2003
3. Introduction to Electrodynamics, David Griffiths, Cambridge University Press, 4th Edition, 2017
4. Introduction to Solid State Physics, Charles Kittel, Willey, 8th Edition, 2005
5. Introduction to Nanotechnology, Charles P. Poole Jr., Frank J. Owens, Wiley-Interscience, 1st Edition, 2003

Web Links:

1. https://nptel.ac.in/courses/122101002 [IIT Bombay, Prof. D.K. Ghosh]
2. https://nptel.ac.in/courses/122103011 [IIT Guwahati, Prof. Alika Khare, Prof. Pratima Agarwal, Prof. S.Ravi]
3. https://nptel.ac.in/courses/115105099 [IIT Kharagpur, Prof. Amal Kumar Das]
4. https://nptel.ac.in/courses/115101005 [IIT Bombay, Prof. D.K. Ghosh]
5. https://nptel.ac.in/courses/115106066 [IIT Madras, Prof. S. Lakshmi Bala]