Engineering Physics (Theory & Lab)

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

Course Objective:

The objective of the course is to understand the basic concepts of nature around us and to synthesize the knowledge from different areas of physics for analysing and solving various critical problems.

Course Outcome (CO):

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

CO1	Understand and apply the principle of conservation of momentum, the theory of relativity.	Understand	K2, K1
CO2	Understand the basics of quantum mechanics and apply its principles to learn the phenomenon that occurs at subatomic dimensions.	Apply	K3, K1
CO3	Understand Maxwell's equations of electromagnetic theory with the aim to apply them in a communication system.	Evaluate	K5, K1
CO4	Apply the fundamentals of material science, especially to dielectric materials, semiconducting materials, nanomaterials, and Superconducting Materials.	Understand	K2, K1
CO5	Understand the statistical behavior of the constituent particles and apply the principles of statistical mechanics in the formation of materials and basics of LASERs	Analyze	K4, K1

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	PO12
NPH-101/102: Engineering Physics													
NPH 101/102	**CO1**	3.00	3.00	1.00	2.00	1.00	2.00	-	-	-	-	-	3.00
NPH 101/102	**CO2**	3.00	3.00	1.00	2.00	1.00	2.00	-	-	-	-	-	3.00
NPH 101/102	**CO3**	3.00	3.00	1.00	2.00	1.00	2.00	-	-	-	-	-	3.00
NPH 101/102	**CO4**	3.00	3.00	3.00	2.00	1.00	3.00	3	-	-	-	-	3.00
NPH 101/102	**CO5**	3.00	3.00	2.00	3.00	3.00	3.00	-	-	-	-	-	3.00

Course Content

UNIT- 1

Relativistic Mechanics:

Inertial and Non- Inertial Frames of references, Galilean transformation equations, Michelson Morley Experiment, 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, Significance of wave function, Derivation of Schrodinger equation for time independent and time dependent cases.

Applications of Schrodinger wave equation for a free particle, Particle in a box (one dimensional and three dimensional cases), Simple harmonic oscillator (one dimensional case).

UNIT- 3

Electromagnetic Theory:

Ampere's law and Faraday's law of electromagnetic induction, 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 and velocity of e.m. wave, Comparison with free space, Maxwell's equations in conducting media & solution of differential equation in this case, penetration depth & its significance.

UNIT- 4

Statistical Mechanics & Lasers:

Macrostates and Microstates, Phase space, probability of distribution, most probable distribution, Maxwell-Boltzmann Statistics, Applications of Maxwell-Boltzmann Statistics, derivation of average velocity, RMS velocity and most probable velocity in the above cases, Bose-Einstein Statistics & its application in case of black body radiation, distribution law of energy, Planck's radiation formula, derivation of Wien's law, Rayleigh-Jeans law and Stefan's law from Planck's radiation formula. Fermi – Dirac statics, application in case of free electrons in metals, energy distribution, Fermi energy.

Lasers: Spontaneous and stimulated emission of radiations, Einstein's theory of matter-radiation interaction, Einstein's coefficients and relation between them, Population inversion, components of a laser, different kinds of lasers, Ruby laser, He-Ne laser, solid state lasers, properties of laser beams, mono-chromaticity, coherence, directionality and brightness, applications of lasers in various technological

applications.

UNIT- 5

Materials of Technological Importance:

Dielectric Materials: Electric field in presence of dielectric medium, concept of electric polarization, different types of polarizations, behaviour of dielectric in a.c. field, concept of dielectric loss and loss energy and their importance.

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

Nano Materials: Basic principles of nanoscience and technology, preparation, structure and properties of fullerene and carbon nanotubes, applications of nanotechnology.

Superconducting Materials: Resistivity and susceptibility ofSuperconductors, Type – I and Type – II superconductors, Meissner effect, Low temperature Superconductors, Organic Superconductors, Oxide Superconductors, High temperature Superconductors, BCS theory (Qualitative).

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

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]