APPLIED PHYSICS

II Semester: CSE / CSE (AI & ML) / CSE (DS) / CSE (CS) / CSIT / IT)

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSC09	Foundation	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes:45		

Prerequisite: Basic principles of semiconductors

I. COURSE OVERVIEW:

This course is structured specifically to make the students understand some of the core topics in physics essential for further studies in engineering. It focuses on illustrating and developing an understanding of the interplay between problem solving and their practical applications which include experimental techniques and modern equipment. The topics include quantum mechanics, semiconductors, opto-electronic devices, magnetism, dielectrics, lasers and fiber optics. At the end, this course helps students to appreciate the diverse real-time applications in technological fields in respective branches.

II. COURSE OBJECTIVES:

The students will try to learn:

I. Basic formulations in wave mechanics for the evolution of energy levels and quantization of energies for a particle in a potential box with the help of mathematical description.
II. Fundamental properties of semiconductors including the band gap, charge carrier concentration, doping and transport mechanisms.
III. The metrics of optoelectronic components, lasers, optical fiber communication and be able to incorporate them into systems for optimal performance.
IV. The appropriate magnetic and dielectric materials required for various engineering applications.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Apply** the concepts of dual nature of matter and Schrodinger wave equation to a particle enclosed in simple systems.	Apply
CO 2	**Demonstrate** the classification of Solids and important aspects of semi-conductors in terms of carrier concentration and Fermi level.	Understand
CO 3	**Make use of** the key concepts of semiconductors to explain the basic working mechanism of optoelectronic device characteristics of light-emitting diodes, photo detectors and solar cells.	Apply
CO 4	**Illustrate** the properties of dielectric and magnetic materials suitable for engineering applications.	Understand
CO 5	**Compare** the concepts of LASER and normal light in terms of mechanism and working principles for applications in different fields and scientific practices.	Understand
CO 6	**Explain** functionality of components in optical fiber communication system by using the basics of signal propagation, attenuation and dispersion.	Understand

IV. SYLLABUS:

MODULE-I: QUANTUM MECHANICS (09)

Introduction to quantum physics, de-broglie's hypothesis, Wave-particle duality, Davisson and Germer experiment, Time-independent Schrodinger equation for wave function, Physical significance of the wave function, Schrodinger equation for one dimensional problems–particle in a box.

MODULE –II: INTRODUCTION TO SOLIDS AND SEMICONDUCTOTS (09)

Introduction to classical free electron theory and quantum theory, Bloch's theorem for particles in a periodic potential (Qualitative treatment), Kronig-Penney model (Qualitative treatment), classification: metals, semiconductors, and insulators. Intrinsic and extrinsic semiconductors, Carrier concentration, Dependence of Fermi level on carrier-concentration and temperature, Hall effect.

MODULE –III: SEMICONDUCTOR DEVICES (09)

Direct and indirect band gaps, p-n junction, V-I characteristics, Energy Band diagram, Biasing of a junction, Zener diode.

Construction and working of LED, Photo detectors, PIN, Avalanche photodiode, Solar cell.

MODULE –IV: ENGINEERED ELECTRIC AND MAGNETIC MATERIALS (09)

Polarisation, Permittivity, Dielectric constant, Internal field in solids, Clausius Mosotti equation, Electronic, Ionic and Orientational polarization (Qualitative), Ferroelectricity; Magnetisation, Permeability, Susceptibility, Classification and properties of dia, para and ferro magnetic materials on the basis of magnetic moment, Hysteresis curve.

MODULE –V: LASERS AND FIBER OPTICS (09)

Characteristics of lasers, Spontaneous and stimulated emission of radiation, Metastable state, Population inversion, Lasing action, Ruby laser, He-Ne laser and Applications of lasers. Principle and construction of an optical fiber, Acceptance angle, Numerical aperture, Types of optical fibers (Single mode, multimode, step index, graded index), Optical fiber communication system with block diagram and Applications of optical fibers.

V. TEXT BOOKS:

1. Dr. K Vijay Kumar and Dr. S Chandralingam, “Modern Engineering Physics” Volume-1&2, S Chand.Co, 2018.
2. Dr. M. N. Avadhanulu, Dr. P. G. Kshirsagar, “A Text Book of Engineering Physics”, S. Chand.
3. B. K Pandey and S. Chaturvedi, “Engineering Physics”, Cengage learning.

VI. REFERENCE BOOKS:

1. J. Singh, “Semiconductor Optoelectronics: Physics and Technology”, McGraw-Hill Inc. (1995).
2. P. Bhattacharya, “Semiconductor Optoelectronic Devices”, Prentice Hall of India (1997).
3. Monica Katiyar and Deepak Gupta, "Optoelectronic Materials and Devices", NPTEL Online course.

VII. WEB REFERENCES:

1. http://link.springer.com/book
2. http://www.thphys.physics.ox.ac.uk
3. http://www.sciencedirect.com/science
4. http://www.e-booksdirectory.com

VIII. E-TEXT BOOKS:

1. http://www.peaceone.net/basic/Feynman/
2. http://physicsdatabase.com/free-physics-books/
3. http://www.damtp.cam.ac.uk/user/tong/statphys/sp.pdf
4. http://www.freebookcentre.net/Physics/Solid-State-Physics-Books.html