INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

APPLIED PHYSICS								
I Semester: CSE / CSE (CS) / CSE (DS) **II Semester:** AE / ME / CE / ECE / EEE / CSE (AI & ML) / IT								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AHSD07	**Foundation**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Basic principles of physics								

I. COURSE OVERVIEW:

The aim of this course is to enhance understanding of fundamental knowledge in physics needed for the future technological advances. The framework prepares students to engage in scientific questioning and extend thinking to investigations. The concepts cover current topics in the fields of solid state physics, modern physics, superconductors and nanotechnology. This knowledge helps to develop the ability to apply the principles in many technological sectors such as nanotechnology, optical fiber communication, quantum technology etc.

II. COURSES OBJECTIVES:

The students will try to learn

I. Fundamental concepts needed to explain a crystal structure in terms of atom positions, unit cells, and crystal symmetry.
II. 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.
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, superconducting and nanomaterials required for various engineering applications.

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO 1 Use the general rules of indexing of directions and planes in lattices to identify the crystal systems and the Bravais lattices.
CO 2 Use the concepts of dual nature of matter and Schrodinger wave equation to a particle enclosed in simple systems.
CO 3 Analyze the concepts of laser with normal light in terms of mechanism for applications in different fields and scientific practices.
CO 4 Strengthen the knowledge on functionality of components in optical fiber communication system by using the basics of signal propagation, attenuation and dispersion.
CO 5 Gain deeper understanding on properties of magnetic and superconducting materials suitable for engineering applications.
CO 6 Review the principle factors, fabrication, characterization techniques and the applications of nanomaterials.

IV. COURSE CONTENT:

MODULE - I: CRYSTAL STRUCTURES (10)

Introduction, space lattice, basis, unit cell, lattice parameter, Bravais lattices, crystal systems, structure and packing fractions of simple cubic, body centered cubic, face centered
cubic crystals, directions and planes in crystals, Miller indices, separation between successive [h k l] planes.

MODULE –II: QUANTUM PHYSICS (09)

Waves and particles, de Broglie hypothesis, matter waves, Davisson and Germer's experiment, Schrödinger's time independent wave equation, physical significance of the wave function, infinite square well potential.

MODULE –III: LASERS AND FIBER OPTICS (10)
Characteristics of lasers, spontaneous and stimulated emission of radiation, population inversion, lasing action, Ruby laser, He-Ne laser, 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, applications of optical fibers.

MODULE –IV: MAGNETIC AND SUPERCONDUCTING PROPERTIES (10)
Permeability, field intensity, magnetic field induction, magnetization, magnetic susceptibility, origin of magnetic moment, Bohr magneton, classification of dia, para and ferro magnetic materials on the basis of magnetic moment, Hysteresis curve.
Superconductivity, general properties, Meissner effect, effect of magnetic field, type-I & type-II superconductors, BCS theory, applications of superconductors.

MODULE –V: NANOTECHNOLOGY (09)
Nanoscale, quantum confinement, surface to volume ratio, bottom-up fabrication: Sol-gel, precipitation, combustion methods, top-down fabrication: Ball milling, physical vapor deposition, chemical vapor deposition, characterization techniques: X-ray diffraction, transmission electron microscopy, applications of nanomaterials.

V. TEXT BOOKS:

1. Arthur Beiser, Shobhit Mahajan and Rai Choudhary, *Concepts of Modern Physics*, Tata McGraw Hill, 7th Edition, 2017.

VI. REFERENCE BOOKS:

1. H J Callister, *A Textbook of Materials Science and Engineering*, Wiley Eastern Edition, 8th Edition, 2013.
2. Halliday, Resnick and Walker, *Fundamentals of Physics*, John Wiley &Sons,11th Edition, 2018.
3. Charles Kittel, *Introduction to Solid State Physics*, Wiley Eastern, 2019.
4. S.L. Gupta and V. Kumar, *Elementary Solid State Physics*, Pragathi Prakashan, 2019.
5. K K Chattopadhyay and A N Banerjee, *Introduction to Nanoscience and Nanotechnology*, Prentice Hall India, 2nd Edition, 2011.

VII. ELECTRONICS RESOURCES:

1. NPTEL :: Physics - NOC:Quantum Mechanics I
2. NPTEL :: Physics - NOC:Introduction to Solid State Physics
3. NPTEL :: Physics - NOC:Solid State Physics
4. https://nptel.ac.in/courses/104104085
5. NPTEL :: Metallurgy and Material Science - NOC: Nanotechnology, Science and Applications

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Tech-talk topics
5. Assignments
6. Model question paper - I
7. Model question paper - II
8. Lecture notes
9. Early learning readiness videos (ELRV)
10. Power point presentations