SEMICONDUCTOR PHYSICS

I Semester: CSE / IT								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AHSB13	**Foundation**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	1	-	4	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

OBJECTIVES:

The course should enable the students to:

I. Enrich knowledge in principals of quantum mechanics and semiconductors.
II. Develop strong fundamentals of electronic and optoelectronic materials.
III. Enrich knowledge about measuring resistivity, conductivity and other parameters.
IV. Correlate principles and applications of lasers and fiber optics.

COURSE LEARNING OUTCOMES (CLOs):

1. Recall the basic principles of physics and apply these concepts of physics in solving the real-time problems.
2. Acquire knowledge about fundamentals in quantum mechanics.
3. Interpretation of dual nature of matter wave concept using Davisson & Germer's experiment.
4. Estimate the energy of the particles using Schrödinger's wave equation and apply it to particle in potential box.
5. Understand the band structure of a solid and Classify materials as metals, insulators, or semiconductors, and sketch a schematic band diagram for each one.
6. Recollect the conductivity mechanism involved in semiconductors and calculate carrier concentrations.
7. Acquire knowledge about fundamentals in semiconducting devices
8. Understand the basics of a p-n junction and construction of optoelectronic devices like LED, photo diode, solar cell.
9. Recollect the concept of electric polarization and classify dielectric materials.
10. Recollect the concept of magnetization and classify magnetic materials.
11. Apply different laws of radiation to understand the phenomenon behind production of light.
12. Understand the basic principles involved in the production of Laser light and also Real-time applications of lasers.
13. Recollect basic principle, construction, types and attenuation of optical fibers.
14. Understand the importance of optical fibers in real-time communication system.

Module-I	**QUANTUM MECHANICS**	**Classes: 10**

Introduction to quantum physics, Black body radiation, Planck's law, Photoelectric effect, Compton effect, De-Broglie's hypothesis, Wave-particle duality, Davisson and Germer experiment, Time-independent Schrodinger equation for wave function, Born interpretation of the wave function, Schrodinger equation for one dimensional problems–particle in a box.

Module -II	**ELECTRONIC MATERIALS AND SEMICONDUCTORS**	**Classes: 10**

Free electron theory, Bloch's theorem for particles in a periodic potential, Kronig-Penney model (Qualitative treatment), Origin of energy bands, Types of electronic materials: metals, semiconductors, and insulators.

Intrinsic and extrinsic semiconductors, Carrier concentration, Dependence of Fermi level on carrier-concentration and temperature, Hall effect.		
Module-III	**LIGHT-SEMICONDUCTOR INTERACTION**	**Classes: 06**
Carrier generation and recombination, Carrier transport: diffusion and drift, Direct and indirect band gaps, p-n junction, V-I characteristics, Energy Band diagram, Biasing of a junction. Photo voltaic effect, Construction and working of LED, Photo detectors, PIN, Avalanche photodiode, Solar cell.		
Module-IV	**ENGINEERED ELECTRIC AND MAGNETIC MATERIALS**	**Classes: 09**
Polarization, Permittivity, Dielectric constant, Internal field in solids, Clausius Mosotti equation, Ferroelectricity, Piezoelectricity, Pyroelectricity. Magnetization, Permeability, Susceptibility, Classification of dia, Para and Ferro magnetic materials on the basis of magnetic moment, Domain theory of Ferro magnetism on the basis of hysteresis curve.		
Module-V	**LASERS AND FIBER OPTICS**	**Classes: 10**
Characteristics of lasers, Spontaneous and stimulated emission of radiation, Metastable state, Population inversion, Lasing action, Ruby laser, Semiconductor diode 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), Attenuation in optical fibers, Optical fiber communication system with block diagram.		
Text Books:		
1. Dr. K. Vijaya Kumar, Dr. S. Chandralingam, “Modern Engineering Physics”, Chand & Co. New Delhi, 1st Edition, 2010. 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		
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. Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta on NPTEL. 4. Halliday and Resnik, physics-Wiley.		
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		
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