

## SEMICONDUCTOR PHYSICS

<b>II Semester: CSE / IT</b>																										
Course Code	Category	Hours / Week			Credits	Maximum Marks																				
AHSB13	Foundation	L	T	P	C	CIA	SEE	Total																		
		3	1	-	4	30	70	100																		
<b>Contact Classes:45</b>	<b>Tutorial Classes: 15</b>	<b>Practical Classes: Nil</b>			<b>Total Classes: 60</b>																					
<p><b>I. COURSE OVERVIEW:</b>            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, optoelectronic devices, magnetism, dielectrics, LASER and fiber optics. At the end, this course helps students to appreciate the diverse real-time applications in technological fields in respective branches.</p> <p><b>II. OBJECTIVES:</b>  <b>The course should enable the students to:</b></p> <ul style="list-style-type: none"> <li>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.</li> <li>II Fundamental properties of semiconductors including the band gap, charge carrier concentration, doping and transport mechanisms.</li> <li>III The metrics of optoelectronic components, LASER, optical fiber communication and be able to incorporate them into systems for optimal performance.</li> <li>IV The appropriate magnetic and dielectric materials required for various engineering applications.</li> </ul> <p><b>III. COURSE OUTCOMES:</b>  <b>After successful completion of the course, students should be able to:</b></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 80%;">CO 1 <b>Apply the concepts of dual nature of matter and Schrodinger wave equation to a particle enclosed in simple systems.</b></td> <td style="width: 20%; text-align: right;">Apply</td> </tr> <tr> <td>CO 2 <b>Demonstrate the classification of Solids and important aspects of semi-conductors in terms of carrier concentration and Fermi level.</b></td> <td style="text-align: right;">Understand</td> </tr> <tr> <td>CO 3 <b>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.</b></td> <td style="text-align: right;">Apply</td> </tr> <tr> <td>CO 4 <b>Illustrate the properties of dielectric and magnetic materials suitable for engineering applications.</b></td> <td style="text-align: right;">Understand</td> </tr> <tr> <td>CO 5 <b>Compare the concepts of LASER and normal light in terms of mechanism and working principles for applications in different fields and scientific practices.</b></td> <td style="text-align: right;">Understand</td> </tr> <tr> <td>CO 6 <b>Explain functionality of components in optical fiber communication system by using the basics of signal propagation, attenuation and dispersion.</b></td> <td style="text-align: right;">Understand</td> </tr> </table> <p><b>IV. SYLLABUS:</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%;"><b>MODULE-I</b></td> <td style="width: 60%;"><b>QUANTUM MECHANICS</b></td> <td style="width: 20%; text-align: right;"><b>Classes: 10</b></td> </tr> <tr> <td colspan="3">           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.         </td> </tr> </table>									CO 1 <b>Apply the concepts of dual nature of matter and Schrodinger wave equation to a particle enclosed in simple systems.</b>	Apply	CO 2 <b>Demonstrate the classification of Solids and important aspects of semi-conductors in terms of carrier concentration and Fermi level.</b>	Understand	CO 3 <b>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.</b>	Apply	CO 4 <b>Illustrate the properties of dielectric and magnetic materials suitable for engineering applications.</b>	Understand	CO 5 <b>Compare the concepts of LASER and normal light in terms of mechanism and working principles for applications in different fields and scientific practices.</b>	Understand	CO 6 <b>Explain functionality of components in optical fiber communication system by using the basics of signal propagation, attenuation and dispersion.</b>	Understand	<b>MODULE-I</b>	<b>QUANTUM MECHANICS</b>	<b>Classes: 10</b>	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.		
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<b>MODULE-II</b>	<b>ELECTRONIC MATERIALS AND SEMICONDUCTORS</b>	<b>Classes: 10</b>
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.		
<b>MODULE-III</b>	<b>LIGHT-SEMICONDUCTOR INTERACTION</b>	<b>Classes: 06</b>
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.		
<b>MODULE-IV</b>	<b>ENGINEERED ELECTRIC AND MAGNETIC MATERIALS</b>	<b>Classes: 09</b>
Polarisation, Permittivity, Dielectric constant, Internal field in solids, Clausius Mosotti equation, Ferroelectricity, Piezoelectricity, Pyroelectricity; Magnetisation, 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.		
<b>MODULE-V</b>	<b>LASERS AND FIBER OPTICS</b>	<b>Classes: 10</b>
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.		
<b>Text Books:</b>		
<ol style="list-style-type: none"> <li>1. Dr. K Vijay Kumar and Dr. S Chandralingam, "Modern Engineering Physics" Volume-1&amp;2, S Chand.Co, 2018.</li> <li>2. Dr. M. N. Avadhanulu, Dr. P. G. Kshirsagar, "A Text Book of Engineering Physics", S. Chand.</li> <li>3. B. K Pandey and S. Chaturvedi, "Engineering physics", Cengage learning.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. J. Singh, "Semiconductor Optoelectronics: Physics and Technology", McGraw-Hill Inc. (1995).</li> <li>2. P. Bhattacharya, "Semiconductor Optoelectronic Devices", Prentice Hall of India (1997).</li> <li>3. Monica Katiyar and Deepak Gupta on NPTEL.Online course: "Optoelectronic Materials and Devices".</li> </ol>		
<b>Web References:</b>		
<ol style="list-style-type: none"> <li>1. <a href="http://link.springer.com/book">http://link.springer.com/book</a></li> <li>2. <a href="http://www.thphys.physics.ox.ac.uk">http://www.thphys.physics.ox.ac.uk</a></li> <li>3. <a href="http://www.sciencedirect.com/science">http://www.sciencedirect.com/science</a></li> <li>4. <a href="http://www.e-booksdirectory.com">http://www.e-booksdirectory.com</a></li> </ol>		
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<ol style="list-style-type: none"> <li>1. <a href="http://www.peaceone.net/basic/Feynman/">http://www.peaceone.net/basic/Feynman/</a></li> <li>2. <a href="http://physicsdatabase.com/free-physics-books/">http://physicsdatabase.com/free-physics-books/</a></li> <li>3. <a href="http://www.damtp.cam.ac.uk/user/tong/statphys/sp.pdf">http://www.damtp.cam.ac.uk/user/tong/statphys/sp.pdf</a></li> <li>4. <a href="http://www.freebookcentre.net/Physics/Solid-State-Physics-Books.html">http://www.freebookcentre.net/Physics/Solid-State-Physics-Books.html</a></li> </ol>		