

Subject code	NS-203f	Course Title	Semiconductor Optoelectronic Devices
Contact Hours	L-3, T-0, P-0	Credits	04
Programme	B.Tech. Semester IV onwards		
Pre-requisites	NIL		
Evaluation scheme	Quiz I (10%), Mid Sem Exam (30%), Quiz II (10%), End Sem Exam (50%)		
Module 1: Fundamental Concepts and Processes		[12 H]	
<p>Wave nature of light, brief review of quantum mechanical concepts, materials and band gap, types of semiconductors, density of states, Fermi energy and band occupancy, Intrinsic semiconductors, carrier concentration, mobility and temperature dependence, Extrinsic semiconductors, dopant types and materials, conductivity, Fermi energy position, temperature dependence.</p> <p>Brief introduction to metal-semiconductor junctions, Schottky, Ohmic junctions, and their I-V characteristics, Band diagrams, p-n junctions, equilibrium and under bias (forward and reverse), junction breakdown. Heterojunctions & quantum wells, Photoluminescence, Cathodoluminescence, and Electroluminescence.</p>			
Module 2: Light Sources		[9 H]	
<p>Optoelectronic materials, a brief introduction to thin films and growth techniques. LED: device structure, electrical and optical characteristics, materials for visible and UV-LEDs, organics LEDs, and LED Displays. Laser applications, light emission, absorption, population inversion, optical feedback, threshold condition, classes of lasers, Rates of emission and absorption, mode locking, the semiconductor laser: basic structure, theory and device characteristics; quantum-well lasers.</p>			
Module 3: Conversion and Detection of Light-Energy		[12 H]	
<p>Solar terminologies, advantages and state-of-the art of photovoltaic (PV) technology, device structure and basic operation principle, electrical characteristics, quantum efficiency and spectral response, anti-reflection coatings, light trapping, heterojunction solar cells, the p-i-n structure, organic solar cells. Photodetectors, operation principle and types of photodetectors, single junction under illumination: photon and carrier-loss mechanisms, noise in photodetection; PIN diodes and avalanche photo diodes: structure, materials, characteristics, and device performance. Photo-transistors, CCDs, and Optoelectronic integrated circuits.</p>			
Module 4: Fabrication Processes and Handling		[9 H]	
<p>Introduction to semiconductor manufacturing, thermal oxidation, doping (thermal diffusion and ion implantation), lithography, etching and deposition, metallization, device evaluation, and packaging, contamination control & clean rooms, device fabrication research facilities in India.</p>			
Text/Reference books:			
<ol style="list-style-type: none"> 1. Donald A. Neamen, <i>Semiconductor Physics and Devices</i>, Third Edition, Tata McGraw-Hill, 2004 (ISBN: 0-07-052905-1) 2. S.M. Sze and Kwok K. Ng, <i>Physics of Semiconductor Devices</i>, New York, Wiley-Interscience, 2006 (ISBN: 9780471143239) 3. Pallab Bhattacharya, <i>Semiconductor Optoelectronic Devices</i>, 2nd edition, Prentice-Hall, 1997 (ISBN: 0-13-495656-1). 4. S. O. Kasap, <i>Optoelectronics and Photonics: Principles and Practices</i>, Prentice-Hall, 2001 (ISBN: 978-0132151498). 5. J. Singh, <i>Semiconductor Optoelectronics: Physics and Technology</i>, McGraw-Hill Inc. 1995 (ISBN: 978-0070576377). 			