BVM ENGINEERING COLLEGE [AN AUTONOMOUS INSTITUTION]

BS104: SEMICONDUCTOR PHYSICS
CREDITS - 4 (LTP:3,0,1)

Course Objective:

1. To understand the fundamentals of basic semiconductor physics which includes the,
2. Electronic materials, Semiconductors,.
3. To understand the basic materials and properties of semiconductors
4. To provide problem solving experience and learning of concepts through it in Semiconductor Physics, in both the classroom and the laboratory learning environment.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No	Topics	Teaching Hours
1.	**Electronic materials** Free electron theory, Density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, Occupation probability, Fermi level, Effective mass, Phonons.	12
2.	**Semiconductors** Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices.	12
3.	**Light-semiconductor interaction** Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Joint density of states, Density of states for photons, Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect, Exciton, Drude model. Laser, Einstein's theory of matter radiation interaction and A and B coefficients, Amplification of light	12

Unit No	Topics	Teaching Hours
	by population inversion, different types of lasers: gas laser(He-Ne, CO_2), Solid state laser (Ruby, Neodymium), Dye laser, Properties of laser beams, Monochromaticity, Coherence, directionality and brightness, Applications of laser in science and medicines.	
4.	**Measurements** Four-point probe and van der Pauw measurements for carrier density, resistivity, and hall mobility; Hot-point probe measurement, capacitance-voltage measurements, parameter extraction from diode I-V characteristics, DLTS, band gap by UV-Vis spectroscopy, absorption/transmission.	6
	Total	**42**

List of References:

1. J. Singh, "*Semiconductor Optoelectronics: Physics and Technology*", McGraw-Hill Inc. (1995). 2. B. E. A. Saleh and M. C. Teich, "*Fundamentals of Photonics"*, John Wiley & Sons, Inc., (2007). 3. S. M. Sze, "*Semiconductor Devices: Physics and Technology*", Wiley (2008).
4. A. Yariv and P. Yeh, Photonics: "*Optical Electronics in Modern Communications*", Oxford University Press, New York (2007).
5. P. Bhattacharya, "*Semiconductor Optoelectronic Devices*", Prentice Hall of India (1997).
6. Online course: "*Semiconductor Optoelectronics*" by M R Shenoy on NPTEL
7. Online course: "*Optoelectronic Materials and Devices*" by Monica Katiyar and Deepak Gupta on NPTEL

Course Outcomes (COs):

At the end of this course, students will be able to:

1. Understand fundamentals of energy band theory in semiconducting materials.
2. Understand the basic of Intrinsic and Extrinsic Semiconductors.
3. Understand the concepts of light interaction with matter and its applications.
4. Analyze and apply the elementary understanding of the measurement techniques for semiconductor.