Course Code	18PYB103J	Course Name	PHYSICS: SEMICONDUCTOR PHYSICS	Course Category	B	Basic Sciences	L	T	P	C
							3	1	2	5

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Physics and Nanotechnology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR): The purpose of learning this course is to:

		Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Introduce band gap and fermi level in semiconductors			
CLR-2 :	Explain the concept of carrier transport mechanism in p-n and metal semiconductor junction			
CLR-3 :	Provide an insight on semiconductor optical transitions and photovoltaic effect			
CLR-4 :	Procure knowledge of electrical and optical measurements in semiconductor			
CLR-5 :	Develop necessary skills for low dimensional semiconductor material processing and characterization			
CLR-6 :	Utilize the concepts in physics for the understanding of engineering and technology			

Course Learning Outcomes (CLO): At the end of this course, learners will be able to:

		Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Identify the energy band in solids and electron occupation probability	2	85	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Analyze the working of optoelectronic devices	2	75	70	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Apply the knowledge to the development of new and novel optoelectronic devices	2	80	75	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Identify the working mechanism of electrical and optical measurements	2	75	70	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Utilize the knowledge of the low dimensional semiconductor material fabrication and characterization.	2	80	70	H	-	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Apply the concepts of semiconductor physics in real time applications	2	80	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		18	18	18	18	18
S-1	SLO-1	Classical Free electron theory	Intrinsic semiconductor	Concept of optical transitions in bulk semiconductors	Concept of electrical measurements	Density of states in 2D
	SLO-2	Quantum Free electron theory	Fermi level on carrier-concentration and temperature in Intrinsic semiconductor	optical absorption process	Two-point probe technique	Density of states in 1D and 0 D
S-2	SLO-1	Density of states	Extrinsic semiconductors	Concept of recombination process	Four-point probe technique-linear method	Introduction to low dimensional systems
	SLO-2	Energy band in solids	Fermi level on carrier-concentration and temperature in extrinsic semiconductors	Optical recombination process	Four-point probe technique-Van der Pauw method	Quantum well
S-3	SLO-1	Kronig-Penney model	Explanation for carrier generation	Explanation for spontaneous emission	Significance of carrier density	Quantum wire and dots
	SLO-2	Kronig-Penney model	Explanation for recombination processes	Explanation for stimulated emission	Significance of resistivity and Hall mobility	Introduction to novel low dimensional systems
S-4	SLO-1	Solving problems	Solving problem	Solving problem	Solving problem	Solving problem
	SLO-2	Solving problems	Solving problem	Solving problem	Solving problem	Solving problem
S 5-6	SLO-1 / SLO-2	Basics of experimentation	Study of I-V characteristics of a light dependent resistor (LDR)	Characterization of pn junction diode (Forward Bias)	Determine Particle Size of Semiconductor Laser	Determine of efficiency of solar cell
S-7	SLO-1	E-k diagram	Carrier transport - diffusion and drift current	Joint density of states in semiconductor	Hot-point probe measurement	CNT- properties and synthesis
	SLO-2	Direct and Indirect band gap	Continuity equation	Density of states for photons	capacitance-voltage measurements	Applications of CNT
S-8	SLO-1	Concept of phonons	p-n junction	Explanation of transition rates	Extraction of parameters in a diode	Fabrication technique-CVD
	SLO-2	Concept of Brillouin Zone	Biasing concept in p-n junction	Fermi's golden rule	I-V characteristics of a diode	Fabrication technique-PVD

S-9	SLO-1	*Energy band structure of semiconductor-Brillouin zone*	*Metal-semiconductor junction -Ohmic contact*	*Concept of optical loss*	*Principle of Deep-level transient spectroscopy (DLTS)*	*Characterizations techniques for low dimensional systems*
	SLO-2	*Concept of effective mass*	*Metal-semiconductor junction - Schottky junction*	*Concept of optical gain*	*Instrumentation of DLTS*	*XRD-Powder method*
S-10	SLO-1	*Solving problems*	*Solving problem*	*Solving problem*	*Solving problem*	*Solving problem*
	SLO-2	*Solving problems*	*Solving problem*	*Solving problem*	*Solving problem*	*Solving problem*
S 11-12	SLO-1 SLO-2	*Determine Hall coefficient of Semiconductor material*	*Determine Band Gap of semiconductor-Four probe method*	*Repeat/Revision of experiments*	*Attenuation, propagation characteristic of optical fiber cable using laser source*	*Determine lattice parameters using powder XRD*
S-13	SLO-1	*Classification of electronic materials*	*Semiconductor materials of interest for optoelectronic devices*	*Basic concepts of Photovoltaics*	*Significance of band gap in semiconductors*	*Principle of electron microscopy*
	SLO-2	*Fermi level*	*Photocurrent in a P-N junction diode*	*Photovoltaic effect*	*Concept of absorption and transmission*	*Scanning electron microscopy*
S-14	SLO-1	*Probability of occupation*	*Light emitting diode*	*Applications of Photovoltaic effect*	*Fundamental laws of absorption*	*Transmission electron microscopy*
	SLO-2	*Influence of donors in semiconductor*	*Classification of Light emitting diode*	*Determination of efficiency of a PV cell*	*Instrumentation of UV-Vis spectroscopy*	*Atomic force microscope*
S-15	SLO-1	*Influence of acceptors in semiconductor*	*Optoelectronic integrated circuits*	*Theory of Drude model*	*Determination of band gap by UV-Vis spectroscopy*	*Heterojunctions*
	SLO-2	*Non-equilibrium properties of carriers*	*Organic light emitting diodes*	*Determination of conductivity*	*Concept of Photoluminescence*	*Band diagrams of heterojunctions*
S-16	SLO-1	*Solving problems*	*Solving problem*	*Solving problem*	*Solving problem*	*Solving problem*
	SLO-2	*Solving problems*	*Solving problem*	*Solving problem*	*Solving problem*	*Solving problem*
S 17-18	SLO-1 SLO-2	*Determine Band Gap of semiconductor-Post Office Box method*	*Study of V-I and V-R characteristics of a solar cell*	*To verify Inverse square law of light using a photo cell.*	*Characteristic of p-n junction diode under reverse bias*	*Mini Project*

Learning Resources	*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.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
Level 2	Apply Analyze	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
Level 3	Evaluate Create	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Vinay Gupta, National Physical Laboratory, guptavinay@nplindia.org	*Prof. C. Vijayan, IITM, Chennai, cvijayan@iitm.ac.in*	*Dr. C. Preferencial Kala, SRMIST*
	Prof. S. Balakumar, University of Madras, balakumar@unom.ac.in	*Dr. M. Krishnamohan, SRMIST*