	DPG Institute of Technology and Management **Sector 34, Gurugram HR -122004**
	Lesson Plan
	Course Name: Semiconductor Physics
	Faculty Name: Dr. Dhananjay Verma

Lesson Plan

No. of Lecture Hours/Week	**5**	**Exam Hours**	**3**
Total No. of Lecture Hours	**45**	**Exam Marks**	**70**
Course Code	**25BSC-PHY-103H**		

Objectives of the course:

1. To give knowledge of shortcomings of classical mechanics and fundamentals of quantum mechanics.
2. To teach the origin of energy bands in solids and different types of electronic materials.
3. To introduce the students to semiconducting devices.
4. To develop a basic understanding of lasers and optical fibres and their usage in communication, optoelectronic devices, medical, etc.

Detailed Lesson Plan

Lecture No.	Topic	Teaching Methodology	Class Activity	Remarks
Unit-1				
1	Limitations of classical mechanics	Chalk & Lecture	Lecture with Interaction	
2	Black body radiation	Chalk & Lecture	Lecture with Interaction	
3	Planck's radiation law	Chalk & Lecture	Lecture with Interaction	
4	Photoelectric effect	Chalk & Lecture	Lecture with Interaction	
5	Compton effect	Chalk & Lecture	Lecture with Interaction	
6	de-Broglie's hypothesis	Chalk & Lecture	Lecture with Interaction	
7	Wave-particle duality	Chalk & Lecture	Lecture with Interaction	

8	Uncertainty principle	Chalk & Lecture	Lecture with Interaction	
9	Physical significance of wave function ψ	Chalk & Lecture	Lecture with Interaction	
10	Time-dependent Schrodinger wave equation	Chalk & Lecture	Lecture with Interaction	
11	Time-independent Schrodinger wave equation	Chalk & Lecture	Lecture with Interaction	
12	Particle in a 1-D box	Chalk & Lecture	Lecture with Interaction	
Unit-2				
13	Free electron theory	Chalk & Lecture	Lecture with Interaction	
14	Drude model	Chalk & Lecture	Lecture with Interaction	
15	Kronig-Penny model	Chalk & Lecture	Lecture with Interaction	
16	Origin of band gap	Chalk & Lecture	Lecture with Interaction	
17	E-k diagram	Chalk & Lecture	Lecture with Interaction	
18	Direct and indirect band gaps	Chalk & Lecture	Lecture with Interaction	
19	Energy bands in solids	Chalk & Lecture	Lecture with Interaction	
20	Types of electronic materials: metals, semiconductors and insulators	Chalk & Lecture	Lecture with Interaction	
21	Occupation probability	Chalk & Lecture	Lecture with Interaction	
22	Fermi level	Chalk & Lecture	Lecture with Interaction	
23	Density of states	Chalk & Lecture	Lecture with Interaction	
24	Effective mass	Chalk & Lecture	Lecture with Interaction	
25	Phonons	Chalk & Lecture	Lecture with Interaction	
Unit-3				

26	Intrinsic and extrinsic semiconductors	Chalk & Lecture	Lecture with Interaction	
27	Dependence of Fermi level on carrier-concentration and temperature	Chalk & Lecture	Lecture with Interaction	
28	Carrier transport: diffusion and drift	Chalk & Lecture	Lecture with Interaction	
29	p-n junction	Chalk & Lecture	Lecture with Interaction	
30	Heterojunctions	Chalk & Lecture	Lecture with Interaction	
31	Metal-semiconductor junction (Ohmic and Schottky)	Chalk & Lecture	Lecture with Interaction	
32	Photoconductivity and Photovoltaic effect	Chalk & Lecture	Lecture with Interaction	
33	Optoelectronics devices-photoconductive cell, photodiode	Chalk & Lecture	Lecture with Interaction	
34	Solar cell and LED	Chalk & Lecture	Lecture with Interaction	
Unit-4				
34	Einstein's theory of matter radiation interaction-absorption & emission	Chalk & Lecture	Lecture with Interaction	
36	Spontaneous and stimulated emission of radiation	Chalk & Lecture	Lecture with Interaction	
37	Relation between Einstein's coefficient of stimulated emission and absorption	Chalk & Lecture	Lecture with Interaction	
38	Population inversion & pumping	Chalk & Lecture	Lecture with Interaction	
39	Three and four level laser systems	Chalk & Lecture	Lecture with Interaction	
40	Characteristics of laser beam	Chalk & Lecture	Lecture with Interaction	
41	Gas laser (He-Ne)	Chalk & Lecture	Lecture with Interaction	
42	Solid-state laser (Ruby),	Chalk & Lecture	Lecture with Interaction	
43	Semiconductor laser	Chalk & Lecture	Lecture with Interaction	
44	Applications of lasers	Chalk & Lecture	Lecture with Interaction	

Suggested Reference Books:

1. Ajoy Ghatak and S. Lokanathan, Quantum Machenics: Theory and Applications, Springer Science (2004).
2. Aurthur Beiser, Concept of Modern Physics, McGrawHill (2003).
3. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
4. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
5. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
6. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).
7. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
8. Online course: "Semiconductor Optoelectronics" by M R Shenoy on NPTEL
9. Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta on NPTEL

Course Outcomes:

At the end of the course, the student will be able:

CO103.1	To analyse the difference between classical and quantum mechanical phenomena. Students will have knowledge of the dual nature of matter and the fundamental equation of motion in quantum mechanics.
CO103.2	Understanding the origin of energy bands in solids and analyse the differences between different types of electronic materials.
CO103.3	Understanding the physics and applications of semiconducting materials. Getting the knowledge of charge carrier flow mechanisms in semiconductors and optoelectronic devices.
CO103.4	Understanding spontaneous and stimulated emission of radiation, optical pumping, population inversion, three-level and four-level lasers. Ruby, He-Ne laser in detail and its applications.

CO-PO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1															
CO2															
CO3															
CO4															

Signature of Staff In-charge Signature of HOD