MOHAMMED SATHAK A J COLLEGE OF ENGINEERING

Siruseri IT park, OMR, Chennai - 603103

LESSON PLAN

Department of Physics

Name of the Subject	Physics for Electronic Engineering	Name of the handling Faculty	
Subject Code	PH8253	Year / Sem	I Year / II Sem
Acad Year		Batch	

Course Objective

To understand the essential principles of Physics of semiconductor device and Electron transport properties. Become proficient in magnetic and optical properties of materials and Nano-electronic devices.

Course Outcome

At the end of the course, the students will able to,

CO1 - Gain knowledge on classical and quantum electron theories, and energy band structures

CO2 - Acquire knowledge on basics of semiconductor physics and its applications in various devices,

CO3 - Get knowledge on magnetic and dielectric properties of materials.

CO4 - Have the necessary understanding on the functioning of optical materials for optoelectronics.

CO5 - Understand the basics of quantum structures and their applications in spintronics and carbon electronics

Lesson Plan

Sl. No.	Topic(s)	T / R* Book	Periods Required	Mode of Teaching (BB / PPT / NPTEL / MOOC / etc)	Blooms Level (L1-L6)	CO	PO
UNIT I - ELECTRICAL PROPERTIES OF MATERIALS							
1	Classical free electron theory of metals	T1 / R1	1	BB	L1	CO1	PO1
2	Electrical and Thermal Conductivity of Metal, Wiedemann Franz law, Lorentz number	T1 / R4	1	BB	L2	CO1	PO1
3	Success and failures of classical theory	T1 / R1	1	BB	L2	CO1	PO12
4	Electrons in a metal and Particle in a 3D box and degenerate states	T1 / R4	1	BB	L3	CO1	PO3
5	Fermi Dirac Statistics and density of energy states	T1 / R1	1	BB	L3	CO1	PO1
6	Electrons in a periodic potential: Bloch theorem	T1 / R1	1	BB	L3	CO1	PO5
7	Energy band in a solids and Threshold approximation	T1 / R4	1	BB	L2	CO1	PO3
8	Electron effective mass, concept of hole	T1 / R4	1	BB	L2	CO1	PO7
9	Problems	T1 / R1	1	BB	L3	CO1	PO2
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any Assignment							
Evaluation method Marks out of 10							
UNIT II - SEMICONDUCTOR PHYSICS							
10	Types of Semiconductors, direct & indirect semiconductors, carrier concentration in Intrinsic semiconductor	T2 / R4	1	PPT	L2	CO2	PO1
11	Carrier concentration in Extrinsic semiconductor	T2 / R4	1	BB	L3	CO2	PO3
12	Carrier concentration in N-type Semiconductor	T2 / R4	1	BB	L3	CO2	PO1
13	Carrier concentration in P-type Semiconductor	T2 / R4	1	BB	L3	CO2	PO1
14	Variation of carrier concentration with temperature	T2 / R4	1	BB	L3	CO2	PO1
15	Variation of Fermi level with temperature and impurity concentration	T1 / R4	1	PPT	L3	CO2	PO1
16	Carrier transport in Semiconductor : random motion, drift, mobility and diffusion	T1 / R4	1	PPT	L3	CO2	PO5
17	Hall effect and Devices	T1 / R4	1	PPT	L2	CO2	PO7
18	Ohmic contacts, Schottky Diode and Problems	T1 / R4	1	BB	L3	CO2	PO2
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any Assignment							

Evaluation method Marks out of 10							
UNIT III - MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS							
19	Magnetic dipole moment and Atomic magnetic moments and magnetic permeability and susceptibility	T2 / R4	1	PPT	L2	CO3	PO1
20	Classification of Dia, Para, Ferro, Anti-ferro & Ferri magnetism	T2 / R4	1	PPT	L3	CO3	PO1
21	Ferromagnetism: Origin and exchange interaction, saturation magnetization and curie temperature	T2 / R4	1	BB	L2	CO3	PO3
22	Domain theory of Ferromagnetism	T2 / R4	1	BB	L2	CO3	PO3
23	Hysteresis of M Vs H behavior	T1 / R4	1	BB	L3	CO3	PO3
24	Dielectric materials, polarisation process	T1 / R4	1	BB	L3	CO3	PO1
25	internal field, Clausius -Mosotti relation	T1 / R4	1	BB	L3	CO3	PO7
26	dielectric breakdown, dielectric loss, dieletric strength	T2 / R4	1	PPT	L3	CO3	PO5
27	Problems	T2 / R4	1	BB	L3	CO3	PO2
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any **QUIZ**							
Evaluation method Marks out of 10							
UNIT IV - OPTICAL PROPERTIES OF MATERIALS							
28	Classification of Optical Materials	T1 / R4	1	BB	L1	CO4	PO1
29	Carrier concentration and recombination process	T1 / R4	1	BB	L2	CO4	PO3
30	Absorption, emission and scattering of light in metals,	T1 / R4	1	PPT	L2	CO4	PO1
31	Insulators and semiconductors (concepts only)	T1 / R4	1	PPT	L2	CO4	PO1
32	Photo current in P-N diode, solar cell	T1 / R4	1	PPT	L3	CO4	PO5
33	Photo detectors – LED, organic LED	T1 / R4	1	PPT	L3	CO4	PO3
34	Laser diodes	T2 / R4	1	BB	L3	CO4	PO5
35	quantum dot laser	T2 / R4	1	PPT	L3	CO4	PO7
36	Problems	T1 / R4	1	BB	L3	CO4	PO2
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any Assignment							
Evaluation method Marks out of 10							
UNIT V - NANOELECTRONIC DEVICES							
37	Introduction, Electron density in bulk materials	T3 / R3	1	PPT	L1	CO5	PO1
38	Size dependence of Fermi energy, quantum confinement and structures	T3 / R3	1	PPT	L2	CO5	PO1
39	Density of states in quantum well, quantum wire and quantum dot structures	T3 / R3	1	BB	L3	CO5	PO2
40	Band gap of nano materials and Tunneling	T3 / R3	1	BB	L2	CO5	PO3
41	Single electron phenomena and transistor	T3 / R3	1	PPT	L2	CO5	PO3
42	Quantum dot laser	T3 / R3	1	PPT	L2	CO5	PO7
43	Conductivity of metallic nano wires,	T1 / R4	1	PPT	L3	CO5	PO12
44	Ballistic transport – Quantum resistance and conductance	T1 / R4	1	PPT	L3	CO5	PO5
45	Carbon nanotubes: Properties and Applications	T1 / R4	1	PPT	L3	CO5	PO5
Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any **TUTORIAL**							
Evaluation method Marks out of 10							
Content Beyond the Syllabus Planned							
1	Ferrites						

2	CNT Fabrication

Text Books

1	Kasap, S.O. ―Principles of Electronic Materials and Devices‖, McGraw-Hill Education, 2007
2	Umesh K Mishra & Jasprit Singh ―Semiconductor Device Physics and Design, Springer, 2008
3	Wahab, M.A. ―Solid State Physics: Structure and Properties of Materials. Narosa Publishing House, 2009.

Reference Books

1	Garcia, N. & Damask, A. ―Physics for Computer Science Students‖. Springer-Verlag, 2012.
2	Hanson, G.W. ―Fundamentals of Nanoelectronics‖. Pearson Education, 2009.
3	Rogers, B., Adams, J. & Pennathur, S. ―Nanotechnology: Understanding Small Systems‖. CRC Press, 2014.
4	Senthil Kumar G. " Physics for Electronic Engineering", VRB Publications Pvt. Ltd, 2017

Website / URL References

1	classical free electron theory of metals - https://www.youtube.com/watch?v=ttdtdLfn9HU
2	Photodiode - https://youtu.be/8k9UIlwo7W4
3	Organic LED - https://youtu.be/OADeLn3KBjM
4	Carbon Nanotube - https://youtu.be/aVvgEMhOYfo
5	magnetic properties of solids - https://www.youtube.com/watch?v=5A3vh84eq04

Blooms Level

Level 1 (L1) : Remembering **Level 2 (L2) : Understanding** **Level 3 (L3) : Applying**	Lower Order Thinking	Fixed Hour Exams	**Level 4 (L4) : Analysing** **Level 5 (L5) : Evaluating** **Level 6 (L6) : Creating**	Higher Order Thinking	Projects / Mini Projects

Mapping syllabus with Bloom's Taxonomy LOT and HOT

Unit No	Unit Name	L1	L2	L3	L4	L5	L6	LOT	HOT	Total
Unit 1	ELECTRICAL PROPERTIES OF MATERIALS	1	4	4	0	0	0	9	0	9
Unit 2	SEMICONDUCTOR PHYSICS	0	2	7	0	0	0	9	0	9
Unit 3	MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS	0	3	6	0	0	0	9	0	9
Unit 4	OPTICAL PROPERTIES OF MATERIALS	1	3	5	0	0	0	9	0	9
Unit 5	NANOELECTRONIC DEVICES	1	4	4	0	0	0	9	0	9
Total		3	16	26	0	0	0	45	0	45
Total Percentage		6.67	35.56	57.78	0.00	0.00	0.00	100.00	0.00	100.00

CO PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	2	-	1	-	-	-	-	2	-	-
CO2	3	3	3	-	2	-	2	-	-	-	-	2	-	-
CO3	3	3	3	-	1	-	2	-	-	-	-	1	-	-
CO4	3	3	2	-	2	-	-	-	-	-	-	2	-	-
CO5	3	3	2	-	2	-	1	-	-	-	-	1	-	-
Avg	3	3	3	-	2	-	2	-	-	-	-	2	-	-

Justification for CO-PO mapping

CO1	Applying the concepts of classical and quantum electron theories, and energy band structures strongly (PO1) helps to analyze the problems strongly (PO2). This will help in design and development of solution to some extent (PO3). This may help to know the modern tool usage moderately (PO5). (PO7) gives the knowledge of engineering solutions in society and environment weakly and (PO12) recognizes the need for life-long learning to some extent.
CO2	Applying the fundamentals and applications of semiconductors in Engineering field strongly (PO1) helps in problem analysis to greater extent (PO2). This may help in design and development of solutions strongly (PO3). PO5 attributes to the usage of modern tools to some extent and to assess the health and safety of society as well as environment and sustainable development moderately (PO7). Semiconductors may be of some use to know the life-long technological changes in electronic devices (PO12).
CO3	Concepts of various magnetic materials, dielectric materials and its breakdown attribute to strong Engineering knowledge (PO1). This will help in problem solving (PO2) as well as design and development of solution (PO3) to a greater extent. Developing simple model helps to learn the techniques (PO5) weakly. PO7 helps to understand the impact of magnetic and dielectric materials to environment to some extent and PO12 recognizes the need for life-long learning weakly.
CO4	While understanding the nature, properties and application of optical materials for optoelectronics, strong Engineering knowledge (PO1) is developed. This will help in problem solving (PO2) strongly and design and development of solution (PO3) to some extent. Optical materials help in applying appropriate techniques and tools with an understanding of the limitations (PO5) moderately. Optical materials may be of some use to know the life-long technological changes in optoelectronics (PO12).

CO5	Understand the basics of quantum structures and their applications and carbon electronics attributes to strong Engineering knowledge (PO1). This will help in problem solving (PO2) as well as design and development of solution (PO3) to a greater extent. Selecting suitable algorithm helps in learning the commercial software (PO5) to some extent. PO7 gives the knowledge of engineering solutions in society and environment moderately. PO12 recognizes the need for life-long learning to some extent.				
3	**High level**	**2**	**Moderate level**	**1**	Low level
Name & Sign of Faculty Incharge :					
Name & Sign of Subject Expert :					
Head of the Department :					

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