Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. /B. Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, APR / MAY 2025

COMMON TO EEE AND E & I BRANCHES

II Semester

PH23C10 & ELECTRONIC PROPERTIES OF MATERIALS

(Regulation 2023)

Time: 3hrs **Max. Marks: 100**

CO1	Knowledge of the electrical properties of materials
CO2	Acquire an adequate understanding of semiconductor physics and the functioning of semiconductor devices
CO3	Come to have firm knowledge of the dielectric and magnetic properties of materials and their applications
CO4	Understand the optical properties of materials and working principles of various optical devices
CO5	Appreciate the importance of nanotechnology, the physics of nano devices, low-dimensional structures and their applications

BL – Bloom's Taxonomy Levels

(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

Q. No	Questions	Marks	CO	BL
1.	State Wiedemann-Franz law and give it's signifance.	2	1	L1
2.	What is meant by effective mass of an electron?	2	1	L2
3.	What are direct and indirect band gap semiconductors?	2	2	L1
4.	What is meant by Ohmic contacts?	2	2	L2
5.	Define electric dipole moment and give its unit of measurement.	2	3	L1
6.	What is meant by GMR effect?	2	3	L2
7.	What do you understand by group velocity and group index?	2	4	L2
8.	State the principle behind the optical data storage in Blu-ray disc.	2	4	L1
9.	What are quantum confined structures? How are they classified?	2	5	L2
10.	Write any two applications of spintronics devices.	2	5	L1

PART- B (5 x 13 = 65 Marks)

Q. No	Questions	Marks	CO	BL
11(a)	(i) What are density of energy states? Derive an expression for density of energy states in a metal.	10	1	L3
	(ii) Calculate the Fermi energy for a metal at **0**K, if its electron concentration is **64 x 10^{27}** /m^3 at **0**K.	3	1	L5
	(OR)			
11(b)	(i) Discuss the motion of an electron in a periodic potential field and explain the formation of energy bands in solids.	10	1	L3
	Find the temperature at which there is **1%** probability that a state with energy **0.1eV** above Fermi energy level.	3	1	L5

12(a)	(i) Derive an expression for carrier concentration in an intrinsic semiconductor.	10	2	L3
	(ii) If the conductivity of an intrinsic semiconductor is **250 $ohm^{-1}m^{-1}$** at 27°C and is **1000 $ohm^{-1}m^{-1}$** at 127°C. What is its band gap energy in eV?	3	2	L5
	(OR)			
12(b)	(i) Derive an expression for Fermi level in **n -type** semiconductor and hence obtain an expression for concentration of electrons in the conduction band.	10	2	L3
	(ii) The Hall coefficient (R_H) of a given semiconductor is **$-3.7x10^{-6}$** $m^3 C^{-1}$ and its conductivity is **112** $ohm^{-1} m^{-1}$. Find the mobility and nature of the semiconductor.	3	2	L5
13(a)	(i) What is meant by electric polarization? Derive an expression for electronic polarization in terms of the radius of the atom.	10	3	L3
	(ii) Calculate the electric polarization produced in a dielectric material with dielectric constant **21** when it is subjected to an electric field of **400V/m**.	3	3	L5
	(OR)			
13(b)	(i) What are ferromagnetic materials? Explain the hysteresis curve of ferromagnetic materials on the basis of domain theory.	10	3	L3
	A magnetic material has a magnetization of **3600A/m** and flux density of **0.135Wb/m^2**. Calculate the magnetizing force and relative permeability of the material.	3	3	L5
14 (a)	(i) Derive the dispersion relation (n versus λ) for a light wave propagating in homogeneous medium.	7	4	L3
	(ii) With a neat diagram, elucidate Fresnel's equations (reflection and transmission coefficients) for a light wave at a boundary.	6	4	L2
	(OR)			
14(b)	(i) Describe in detail the method of construction and working of the LCD display system.	7	4	L3
	(ii) With principle, explain the construction and working of a Laser diode.	6	4	L2
15(a)	(i) With neat diagram, state and explain the density of states for quantum wells, quantum wires and quantum dots.	7	5	L2
	(ii) Write a note on the significance of Fermi energy level and band gap in nanomaterial.	6	5	L6
	(OR)			
15(b)	(i) With neat diagram, explain the principle and working of single electron transistors.	7	5	L2
	(ii) Write a note on the properties and applications of Carbon nanotubes.	6	5	L6

PART- C (1 x 15 = 15 Marks)

Q. No	Questions	Marks	CO	BL
16	(i) Derive an expression for electrical conductivity of a metal based on classical free theory of metals. For a metal there are **$5.85x10^{28}$** conduction electrons /m^3 If the resistivity is **$1.5x10^{-8}$ ohm-m** then find the charge mobility and electrical field needed to produce a drift velocity of **0.7m** per second.	12	1	L3
	(ii) Differentiate between hard and soft magnetic materials.	3	3	L4

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