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**PRESIDENCY UNIVERSITY
BENGALURU**

**SCHOOL OF ENGINEERING
MID TERM EXAMINATION - APR 2023**

Semester : Semester II - 2022

Course Code : PHY1002

Course Name : Sem II - PHY1002 - Optoelectronics and Device Physics

Program : CAI,COM,CSE,CSG

Date : 13-APR-2023

Time : 2:00PM - 3:30PM

Max Marks : 50

Weightage : 25%

Instructions:

- (i) Read all questions carefully and answer accordingly.
- (ii) Question paper consists of 3 parts.
- (iii) Scientific and non-programmable calculator are permitted.
- (iv) Do not write any information on the question paper other than Roll Number.

PART A

ANSWER ALL THE QUESTIONS

(5 X 2 = 10M)

1. Define Critical Temperature. (CO1) [Knowledge]
2. Define Superconductivity. (CO1) [Knowledge]
3. Why Carbon is not a semiconductor. (CO1) [Knowledge]
4. Define doping and write any two doping materials. (CO1) [Knowledge]
5. Charge carriers in conductors are called electrons. What is the name of the charge carriers in superconductors? Write about the charge carriers in superconductors, their momentum and their spin. (CO2) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS

(4 X 5 = 20M)

6. The conductivity of the semiconductor is $2.123 \text{ Ohm}^{-1}\text{m}^{-1}$. if the electron and hole mobilities are $0.38\text{m}^2\text{V}^{-1}\text{s}^{-1}$, $0.18\text{m}^2\text{V}^{-1}\text{s}^{-1}$ respectively, determine the charge carrier density and resistivity. (CO1) [Comprehension]
7. In N-type germanium, $n_i = 2.1 \times 10^{19} \text{ atoms/m}^3$ the density of Phosphorous $4.5 \times 10^{23} \text{ atoms/m}^3$. The electron and hole mobility is $0.4\text{m}^2\text{V}^{-1}\text{s}^{-1}$ and $0.2\text{m}^2\text{V}^{-1}\text{s}^{-1}$ respectively. Find its conductivity before and after the addition of Phosphorous atoms. (CO1) [Comprehension]

8. Superconductors are zero electrical resistance materials. What do you think about the magnetic nature of superconductors?
Differentiate superconductors based on the critical field.
(CO1) [Comprehension]
9. In one way of Biasing of P-N Junction width of the depletion region increases and in another way it decreases. Identify the ways of biasing in chronological order by the statement and discuss the I-V Characteristics of the P-N junction diode.
(CO2) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS

(2 X 10 = 20M)

10. a. If we decrease the temperature of a metal, resistance decreases, explain this on the basis of lattice vibration
b. Show the variation of resistivity with the temperature of superconductors and normal conductors with a labeled graph.
c. Explain critical temperature from the graph.
d. Explain the superconducting phenomenon from the formation of Cooper pairs in superconductors.
(CO1) [Application]
11. a. Can we determine the type of charge carriers from the Hall coefficient?
b. A current carrying conductor of length 'l', thickness 'd', and width 'w', carrying current 'I' in positive X- direction is subjected to a magnetic field 'B' in Z- direction, explain in which direction we get Hall voltage and how this potential difference is formed with suitable diagram.
c. Can we determine the charge carrier concentration from the Hall coefficient? Derive the required equation.
d. A semiconductor has a Hall coefficient $= -4.16 \times 10^{-5} \text{ m}^3 \text{ C}^{-1}$. Identify the type of semiconductor. The conductivity is $108 \Omega^{-1} \text{ m}^{-1}$. Calculate its charge carrier density and electron mobility at room temperature.
(CO1) [Application]