

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-1/2 EXAMINATION – WINTER 2021****Subject Code:3110018****Date:22/03/2022****Subject Name:Physics****Time:10:30 AM TO 01:00 PM****Total Marks:70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

|            |  | Marks     |
|------------|--|-----------|
| <b>Q.1</b> | (a) Define absorption, spontaneous emission and stimulated emission for bulk semiconductors.   | <b>03</b> |
|            | (b) Write a short note on P-N junction diode.  | <b>04</b> |
|            | (c) Give assumptions of classical free electron theory and discuss its limitations.  | <b>07</b> |
| <b>Q.2</b> | (a) Find the temperature at which there is 1% probability that a state with energy 2eV is occupied. Given that Fermi energy is 1.5 eV.   | <b>03</b> |
|            | (b) What is drift and diffusion current in p-n junction diode?   | <b>04</b> |
|            | (c) Explain the Kronig-Penny model of solids and show that how it explains the origin of band gap in solids.   | <b>07</b> |
|            | <b>OR</b>  |           |
|            | (c) Explain intrinsic and extrinsic (N & P type) semiconductors with the help of energy band diagram.  | <b>07</b> |
| <b>Q.3</b> | (a) In an N-type semiconductor, the Fermi level lies 0.3 eV below the conduction band at room temperature. If the temperature is increased to 330°K, Find the position of Fermi level.   | <b>03</b> |
|            | (b) Write an expression for Fermi Dirac distribution function $f(E)$ . Show that at all temperatures ( $T > 0K$ ) probability of occupancy of Fermi level is 50%.  | <b>04</b> |
|            | (c) Discuss the effect of temperature on the Fermi level in extrinsic (N & P type) semiconductors.   | <b>07</b> |
|            | <b>OR</b>  |           |
| <b>Q.3</b> | (a) Find the concentration of holes and electrons in N-type silicon if the conductivity is $0.1 \Omega\text{-cm}^{-1}$ , mobility of electrons is $1300 \text{ cm}^2/\text{V-s}$ and total carrier concentration is $1.5 \times 10^{10} \text{ carriers / cm}^3$ . | <b>03</b> |
|            | (b) Establish the relation between Einstein's coefficients.  | <b>04</b> |
|            | (c) Explain Meissener's effect in detail and show that for superconductor, $\chi_m = -1$ .   | <b>07</b> |
| <b>Q.4</b> | (a) Write a short note on effective mass of electron.  | <b>03</b> |
|            | (b) What is mass action law?<br>Explain Schottky junction.   | <b>04</b> |
|            | (c) Explain Drude model and discuss how it is used for Hall measurements and magnetoresistance.  | <b>07</b> |
|            | <b>OR</b>  |           |
| <b>Q.4</b> | (a) What is an exciton?<br>What is DLTS?<br>Define Hall mobility.  | <b>03</b> |

- (b) What is Fermi level and Fermi energy? **04**  
What is Photovoltaic Cell?
- (c) Explain four point probe method with diagram for the measurement of resistivity of bulk sample. **07**
- Q.5** (a) Explain Fermi Golden rule for transition probability. **03**  
(b) What is Josephson junction? Write a short note on SQUID. **04**  
(c) Explain how to measure band gap of the semiconductor using UV-Vis spectroscopy. **07**
- OR**
- Q.5** (a) Calculate the critical current for a superconducting wire of lead having a diameter of 1mm at 4.2 K. Critical temperature for lead is 7.18 K and  $H_c(0) = 6.5 \times 10^4$  A/m. **03**  
(b) Write a short note on Hot-point probe measurement technique. **04**  
(c) What is superconductivity? Explain any six properties of superconductor. **07**

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