

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
Q.1	(a) Define absorption, spontaneous emission and stimulated emission for bulk semiconductors.	03
	(b) Write a short note on P-N junction diode.	04
	(c) Give assumptions of classical free electron theory and discuss its limitations.	07
Q.2	(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.	03
	(b) What is drift and diffusion current in p-n junction diode?	04
	(c) Explain the Kronig-Penny model of solids and show that how it explains the origin of band gap in solids.	07
	OR	
	(c) Explain intrinsic and extrinsic (N & P type) semiconductors with the help of energy band diagram.	07
Q.3	(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.	03
	(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%.	04
	(c) Discuss the effect of temperature on the Fermi level in extrinsic (N & P type) semiconductors.	07
	OR	
Q.3	(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 $1.5 \times 10^{10} \text{ carriers / cm}^3$.	03
	(b) Establish the relation between Einstein's coefficients.	04
	(c) Explain Meissener's effect in detail and show that for superconductor, $\chi_m = -1$.	07
Q.4	(a) Write a short note on effective mass of electron.	03
	(b) What is mass action law? Explain Schottky junction.	04
	(c) Explain Drude model and discuss how it is used for Hall measurements and magnetoresistance.	07
	OR	
Q.4	(a) What is an exciton? What is DLTS? Define Hall mobility.	03

- (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**
