Seat No.: _____ Enrolment No._____

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 Ω-cm^{-1}, mobility of electrons is 1300 cm^2/V-s and total carrier concentration is 1.5x10^{10} 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? What is Photovoltaic Cell?	**04**
	(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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