Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–I & II (NEW) EXAMINATION – SUMMER 2024

Subject Code:3110018 Date:10-07-2024

Subject Name:Physics

Time:02:30 PM TO 05:00 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 following terms. i. Critical Temperature ii. Persistent Current iii. Isotope effect	**03**
	(b)	Explain hot point probe method with necessary diagrams.	**04**
	(c)	Explain in detail how Kronig and Penney model explains the origin of band gap in semiconductors.	**07**
Q.2	**(a)**	Compare n-Type and p-Type Semiconductors.	**03**
	(b)	Distinguish between Type-I and Type-II Superconductivity.	**04**
	(c)	Determine the necessary formula for density of hole in Valence Band for Intrinsic Semiconductors.	**07**
		OR	
	(c)	What are Einstein's coefficients? Give relation between them and discuss the result.	**07**
Q.3	**(a)**	Define: i. Energy Gap ii. Fermi Function iii. Density of states	**03**
	(b)	Estimate the position of Fermi Level at 300 K for a material with E_C = 0.8 eV and E_V = 0.5 eV ($m_e^* = 0.14m_0$ and $m_h^* = 0.28m_0$, m_0 is rest mass of an electron).	**04**
	(c)	Illustrate Four probe method for thin sheet and bulk sample in detail.	**07**
		OR	
Q.3	**(a)**	What are the postulates for free electron theory?	**03**
	(b)	In an intrinsic semiconductor, energy gap is 1.3 eV. Evaluate the ratio between its conductivity at temperature 700 K and 400 K.	**04**
	(c)	Show that Junction capacitance is inversely proportional to square root of Reverse biasing Voltage.	**07**
Q.4	**(a)**	What do you mean by Photo Voltaic Effect? Write its three applications in the field of engineering.	**03**
	(b)	Using Fermi function, evaluate the temperature at which there is 20 % probability that an electron in solid will have energy 0.3 eV above E_F of 3 eV.	**04**

(c) Explain at least seven properties of Superconductors in detail with necessary diagram and equations. **07**

OR

Q.4 **(a)** Define : **03**

i. Population Inversion
ii. Meta stable state
iii. Active Medium

(b) Explain how the materials are classified into conductors, semiconductors and insulators with the help of energy band diagrams. **04**

(c) Briefly outline the mechanism of superconductivity using BCS theory and explain penetration depth. **07**

Q.5 **(a)** Compare Direct Band Gap semiconductors and Indirect Band Gap semiconductors **03**

(b) What are Excitons? explain the types of Exciton. **04**

(c) (i) Estimate the concentration of holes and electrons in n-type silicon at 300 K. If the conductivity is 8 X 10^4 ʊ/m. also find these value for p-type Si. $n_i = 2.5 \times 10^{16}$ m^{-3} ,electron and hole mobility is 1600×10^{-4} m^2/V.Sec and 700×10^{-4} m^2/V.Sec respectively. **04**

(ii) Evaluate the Electron and Hole concentration at room temperature, for a intrinsic semiconductor, if its conductivity at room temperature is 8×10^{-4} ʊ/m. The mobility of Electron and Hole are 0.24 m^2/V.Sec and 0.08 m^2/V.Sec respectively. **03**

OR

Q.5 **(a)** List difference between drift and diffusion current **03**

(b) Explain in detail the Fermi's Golden Rule. **04**

(c) (i)In a solid consider an energy level lying 0.2 eV above Fermi level. Estimate the probability of this level not being occupied by an electron at room temperature. **04**

(ii)A rectangular semiconductor specimen of thickness 1 mm is placed in the magnetic field of flux density 0.5 Wb/m^2. Current of 1.5 mA is flowing through the specimen in one direction. Evaluate Hall coefficient of the material if generated hall voltage is 7.5 mV. **03**

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