Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE- SEMESTER–I & II EXAMINATION – WINTER 2025

Subject Code:3110018 **Date:01-01-2026**
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)**	Prove that Probability of occupancy of Fermi energy level is 0.5 at $T > 0$ K	**03**
	(b)	Explain how the materials are classified into conductors, semiconductors and insulators with the help of energy band diagrams.	**04**
	(c)	Explain in detail how Kroning and Penney model explains the origin of band gap in semiconductors.	**07**
Q.2	**(a)**	Define Following Terms (i)Population Inversion , (ii) Meta stable state (iii) Active Medium	**03**
	(b)	Define carrier transport and explore how charge carriers move within semiconductor materials, emphasizing the mechanisms of drift and diffusion.	**04**
	(c)	Describe how to formulate the density of holes in the valence band for intrinsic semiconductors.	**07**

OR

	(c)	Describe the definition of carrier concentration in intrinsic semiconductors and show how to derive the formula for electron density in the conduction band.	**07**

Q.3	**(a)**	Determine the band gap of the material when the light source composed of it emits radiation with a wavelength of 8628 Å.	**03**
	(b)	Explain construction and working of PV solar cell.	**04**
	(c)	Interpret the process of deriving the Fermi level expression for n-Type semiconductors, and subsequently, utilize this expression to compute the electron density in the conduction band.	**07**

OR

Q.3	**(a)**	The intrinsic carrier concentration at room temp in Germanium is 4.17×10^{18} m^{-3}. The mobility of Electron and Hole are 0.29 m^2/VSec and 0.16 m^2/vSec respectively. Find out its Resistivity	**03**
	(b)	The conductivity of a semiconductor at 30 °C is 742 Ʊ/m and at 90 °C is 2100 Ʊ/m. Calculate the Energy Band Gap.	**04**
	(c)	Discuss the Einstein's theory about interaction between matter and radiation in detail. Also discuss the absorption and emission with necessary equation.	**07**

Q.4	**(a)**	A Silicon plate of thickness 1mm, breadth 10 mm and length 100 mm is placed in a magnetic field of 0.5 Wb/m^2 acting along its thickness. If 0.01 A	**03**

current flows along its length, calculate the Hall coefficient if developed Hall voltage is 1.83 mV.

(b) Discuss in detail Four probe method used for resistivity measurements in thin sheet. **04**

(c) Define density of states and obtain expression for the density of states in terms of mass of electron(m), Planck's constant (h) and Energy (E). **07**

OR

Q.4 **(a)** What is hot point probe method? Explain **03**

(b) List the condition to be satisfied to use Vander Pauw technique and derive expression of bulk resistivity measurement using it. **04**

(c) What is Band gap? How can we use UV-VIS spectroscopy for band gap measurement for semiconductors explain in detail. **07**

Q.5 **(a)** Distinguish between Type-I and Type-II Superconductivity **03**

(b) The Fermi level in given material is 2.8 eV. What are the energies for which the probabilities of occupancy at 270K are 0.89,0.20, 0.02 and 0.5 **04**

(c) (i) Discuss BCS theory of superconductivity in brief **07**
(ii)What is cryotron? Discus

OR

Q.5 **(a)** Explain the Fermi's Golden Rule in brief. **03**

(b) The critical magnetic field of a given superconductor is 9.5 x 10^3 A/m at 0 K. At what temperature does the critical magnetic field of the sample drop to 5 x 10^3 A/m, given that the critical temperature of the sample is 7.2 K? Also, calculate the critical current density at that temperature if the radius of the wire is 0.4 mm. **04**

(c) List various properties of Superconductors and explain them in detail. **07**

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