Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER– I & II EXAMINATION – SUMMER 2026

Subject Code:3110018 Date:02-07-2026

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)**	State the assumptions of classical free electron theory.	**03**
	(b)	For a given intrinsic semiconductor with energy gap E_g = 0.44 eV, calculate the position of Fermi Level at 300 K. (Where m = m_e* = m_0 which is rest mass of an Electron).	**04**
	(c)	What is superconductivity? Explain any six properties of superconductor.	**07**
Q.2	**(a)**	Explain the light material interaction in terms of absorption, spontaneous emission and stimulated emission in semiconductors with proper diagrams.	**03**
	(b)	Calculate (i) the value of band gap for a LED for the emission of blue light of wavelength 452 nm. (ii) the value of wavelength for LED having band gap 2.0 eV. ($h = 6.63 \times 10^{-34}$ Js, $c = 3 \times 10^8$ m/s)	**04**
	(c)	Define resistivity and explain four point probe method with diagram for the measurement of resistivity of bulk sample.	**07**
		OR	
	(c)	What is deep level in band theory? Describe the experimental procedure for DLTS method to study deep levels.	**07**
Q.3	**(a)**	Define :(i) Forbidden Gap (ii)Fermi Function, (iii) Density of states	**03**
	(b)	A sample of pure Si at room temperature has a carrier concentration of 1.5×10^{16} /m^3. A donor impurity is added at ration $1/10^8$ to the silicon atoms. If the Si has atomic density 5×10^{28} atoms/ m^3, determined the resistivity of the sample. (Given μ_e = 0.135 m^2/V.s and μ_h = 0.048 m^2/ V.s)	**04**
	(c)	What is E-k diagram? Discuss direct and indirect band gap semiconductors based on E-k diagram.	**07**
		OR	
Q.3	**(a)**	Write a short note on P-N junction diode	**03**
	(b)	At what temperature, we can expect a 10% probability that electrons in metal have an energy, which is 1% above the Fermi energy? Fermi energy if the metal is 5.67 eV.	**04**
	(c)	Explain the Kronig-Penny model of solids and show that how it explains the origin of band gap in solids.	**07**
Q.4	**(a)**	Describe the hot probe method to identify the type of semiconductor (for	**03**

N-type semiconductor)

(b) Calculate the critical current for wire of metal alloy having diameter 1mm at 4.5 K. **04**
(Given Critical temperature for alloy is 9.0 K and $H_c(0) = 6.5x\ 10^4\ Am^{-1}$)

(c) What is photovoltaic effect? Explain construction and working of solar cell in detail. **07**

OR

Q.4 **(a)** Write the assumptions of four probe method. **03**

(b) In the Hall probe measurement, current of 300 mA is sent through a sample having length 10mm, width 5mm and height 0.2mm. The Hall voltage observed to be 150μV, when sample was exposed with 2000 gauss field perpendicularly. Calculate carrier concentration and drift velocity of the carrier in the sample. **04**

(c) What is light gain? Explain the Einstein's theory about interaction between matter and radiation in detail along with absorption and emission with necessary equation. **07**

Q.5 **(a)** State any three points of differences between intrinsic and extrinsic semiconductors. **03**

(b) For a metal sample, Density = $16.6x10^3\ kgm^{-3}$, Resistivity= 50 μΩ.cm and Atomic weight = 180.95, then calculate the mobility and the average collision time for metal through classical theory. **04**

(c) Explain Meissener's effect in detail and show that for superconductor, $\chi_m = -1$ **07**

OR

Q.5 **(a)** State any three points of differences between Ohmic junction and Schottky junction. **03**

(b) Calculate **04**
(i) Si wafer has been doped with donor atoms uniformly. The concentration of donor is $2.9\ x10^{15}$ atoms/ cm^3. Calculate the Fermi energy with respect to the pure silicon. ($ni = 1.45\ x10^{10}$ atoms/cm^3)
(ii) Electron mobility in pure Si is 50 m^2/ V.s at 4.5 K, what will be the mobility at 300K?

(c) Discuss BCS theory of superconductivity in brief. (ii) Draw constructive diagram of SQUID and mention its application. **07**