

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-I (NEW) EXAMINATION – WINTER 2023****Subject Code:3110018****Date:12-01-2024****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.

- Q.1 (a)** Mention any three postulates of classical free electron theory proposed by Lorents and Drude. **03**
- (b)** (i) State any two points of differences between intrinsic and extrinsic semiconductors. **04**
(ii) State any two points of differences between *n*-type and *p*-type semiconductors.
- (c)** What is superconductivity? Discuss any three properties of superconductors in detail. **07**

- Q.2 (a)** Obtain Fermi factor $f(E)$ for energy 0.01 eV above Fermi energy (E_f) at 500 K. **03**
- (b)** State and discuss Wiedemann-Franz law. **04**
- (c)** Define density of states and derive its expression. **07**

OR

- (c)** What is E-k diagram? Discuss direct and indirect band gap semiconductors based on E-k diagram. **07**

- Q.3 (a)** (i) Write fermi distribution function and mention physical significance of it. **03**
(ii) Mention any two applications of solar cell.
- (b)** Derive formula of drift and diffusion current densities. **04**
- (c)** (i) Draw characteristic curve for *p-n* junction diode. **07**
(ii) Discuss forward bias characteristics with proper circuit diagram.
(iii) Discuss reverse bias characteristics with proper circuit diagram.

OR

- Q.3 (a)** A potential barrier of 0.6 V exists across of *p-n* junction. The intensity of the electric field in this region is 2.4×10^6 V/m. Find the width of depletion region. **03**
- (b)** (i) Mention any two applications of LED. **04**
(ii) Calculate the value of band gap for a LED for the emission of blue light of wavelength 452 nm. ($h = 6.63 \times 10^{-34}$ J s, $c = 3 \times 10^8$ m/s)
- (c)** Derive formula of fermi energy level for *n*-type semiconductor. **07**

- Q.4 (a)** (i) What is called optoelectronic device? **03**
(ii) Name the types of metal-semiconductor junction.

(iii) What is called exciton?

- (b) Discuss Frenkel and Wannier-Mott exciton in brief. 04
- (c) What is photovoltaic effect? Explain construction and working of solar cell in detail. 07

OR

- Q.4 (a) (i) What is Hall effect? 03
- (ii) The Hall coefficient of a semiconducting material is $2.4 \times 10^{-4} \text{ m}^3/\text{C}$. Calculate the mobility and carrier concentration of the carrier if resistivity is $6 \times 10^{-3} \Omega \text{ m}$.
- (b) Discuss Fermi's golden rule for transition probability. 04
- (c) Discuss in detail UV-VIS method for band gap measurement of semiconductor. 07

- Q.5 (a) Calculate the critical current through a long thin superconducting wire of radius 10^{-3} m . The critical magnetic field is $6.2 \times 10^3 \text{ A/m}$. 03
- (b) State any four points of differences between spontaneous and stimulated emission. 04
- (c) Discuss in detail experimental procedure for DLTS. 07

OR

- Q.5 (a) The critical temperature of a superconductor is 7.5 K. Calculate the critical field at 5 K. At 0 K the critical field is 0.24 T. 03
- (b) Write a short note on London penetration depth. 04
- (c) (i) Discuss BCS theory of superconductivity in brief. 07
- (ii) Draw constructive diagram of SQUID and mention its application.
