

**B. TECH**  
**(SEM III) THEORY EXAMINATION 2022-23**  
**ELECTRONIC DEVICES**

*Time: 3 Hours**Total Marks: 100***Note:** Attempt all Sections. If require any missing data, then choose suitably.**SECTION A****1. Attempt all questions in brief. 2 x 10 = 20**

- (a) Classify the materials on the basis of energy band gap theory.
- (b) State the de Broglie principle of duality
- (c) Define sheet resistance.
- (d) Differentiate between drift and diffusion current.
- (e) Draw the I-V characteristics of pn junction diode.
- (f) Define the depletion region in a pn junction.
- (g) Draw the input and output characteristics of BJT in CE configuration
- (h) Determine the current gain  $\beta$  in CE configuration of BJT, if  $\alpha=0.98$ .
- (i) Draw the small signal model of NMOS transistor.
- (j) Explain the photovoltaic effect.

**SECTION B****2. Attempt any three of the following: 10x3=30**

- (a) What do you mean by effective mass of electron? Derive the relation between effective mass and curvature of energy band.
- (b) A Si sample is doped with  $10^{17}$  arsenic (As) atoms /  $\text{cm}^3$ . Calculate the equilibrium concentration of electrons and holes at 300K. What is the position of fermi level ( $E_F$ ) relative to intrinsic energy level ( $E_i$ )? Also draw the energy band diagram showing the position of fermi level and intrinsic energy level. Given that intrinsic carrier concentration ( $n_i$ ) for Si is  $1.5 \times 10^{10} / \text{cm}^3$
- (c) Using the concept of drift and diffusion of carriers, derive the continuity equation.
- (d) Explain Zener and Avalanche breakdown in detail.
- (e) Write short note on following-
  - (i) LED
  - (ii) Solar cell

**SECTION C****3. Attempt any one part of the following: 10x1=10**

- (a) Derive the time dependent and time independent Schrodinger wave equation.
- (b) Differentiate between direct and indirect band gap semiconductors. Also discuss the variation of energy band with alloy composition.

4. Attempt any *one* part of the following: 10x1=10

- (a) Define Fermi-Dirac distribution function. Discuss the temperature dependence of Fermi-Dirac distribution function for semiconductor material
- (b) Derive the Einstein's relation for electron.

5. Attempt any *one* part of the following: 10x1=10

- (a) Derive the expression of depletion width in a p-n junction.
- (b) Consider a Si abrupt p-n junction at 300K with  $N_a = 10^{18} / \text{cm}^3$  and  $N_d = 10^{15} / \text{cm}^3$ . Determine the value of contact potential and width of depletion region. Given that intrinsic carrier concentration ( $n_i$ ) for Si is  $1.5 \times 10^{10} / \text{cm}^3$  and dielectric constant (K) for Si is 11.8.

6. Attempt any *one* part of the following: 10x1=10

- (a) Discuss Schottky diode in detail and write its application.
- (b) Draw and illustrate the Ebers-Moll model of BJT.

7. Attempt any *one* part of the following: 10x1=10

- (a) Explain the accumulation mode, depletion mode and inversion mode with energy band diagram for a MOS capacitor.
- (b) Explain the construction and working of N channel Enhancement type MOSFET and draw its drain characteristics and transfer characteristics.