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Roll No. | | | | | | | | | | | |

S. No. of Question Paper : **6467**

Unique Paper Code : **251203** **D**

Name of the Paper : **Semiconductor Devices (ELHT-202)**

Name of the Course : **B.Sc. (H) Electronics**

Semester : **II**

Duration : **3 Hours** Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *five* questions in all.

Question No. **1** is compulsory.

All questions carry equal marks.

Use of non-programmable scientific calculator is allowed.

1. Attempt any *five* of the following : 5×3=15

   (*a*) How does the Fermi level of extrinsic semiconductor change with increase in temperature ?

   (*b*) Describe briefly the physical mechanism of Zener breakdown.

   (*c*) A npn transistor $\alpha = 0.98$ is operating in common base configuration. If the emitter terminal current is 3 mA and reverse saturation current is 10 μA, find the base and collector current.

P.T.O.

(*d*) Draw the doping profile of silicon control rectifier (SCR). How does the breakdown voltage of SCR vary with gate current ?

(*e*) Define work function and electron affinity.

(*f*) State Moore's law.

(*g*) Distinguish between positive and negative photoresist.

2. (*a*) Show that the density of states for conduction band is given by : 8

$$N(E) = 4\pi\left[\frac{2m_n}{h^2}\right]^{3/2} (E - E_C)^{1/2} \text{ per unit volume.}$$

(*b*) Show that for any extrinsic semiconductor the product of electron and hole concentration is independent of Fermi level at thermal equilibrium. 7

3. (*a*) Starting from Poisson's equation, derive an expression for the depletion layer width of pn junction. How does it vary with the concentration of impurities ? 7

(*b*) Explain how barrier potential is formed in pn junction when p and n type semiconductors are joined metallurgically. 5

(*c*) Calculate the built in potential for Si diode with $N_A = 10^{18}/cm^3$ and $N_D = 10^{15}/cm^3$ at room temperature. 3

4. (*a*) Draw the energy band diagram of pnp bipolar junction transistor in thermal equilibrium. 3

(*b*) Derive the expression for emitter terminal current for a bipolar junction transistor in active mode of operation. 8

(*c*) For an ideal p-n-p transistor, the current components are given by I_{EP} = 3 mA, I_{EN} = 0.01 mA, I_{CP} = 2.99 mA, and I_{CN} = 0.001 mA. Determine (*i*) the emitter efficiency, (*ii*) the base transport factor, (*iii*) the common-base current gain and (*iv*) I_{CBO}. 4

5. (*a*) Define the transconductance (g_m) and channel conductance (g_d) of JFET, show that for JFET the transconductance in saturated region is given by : 8

$$g_m = \frac{2Z\mu_n qN_D a}{L}\left[1 - \sqrt{\frac{V_G + V_{bi}}{V_P}}\right]$$

where symbols have their usual meanings.

(*b*) Explain the working and construction of Unijunction transistor (UJT). 7

6. (*a*) Differentiate between depletion mode and enhancement mode MOSFET. Explain the operation of *n* channel depletion mode MOSFET. Can a depletion mode MOSFET be operated in enhancement mode ? 8

(*b*) Explain the working of thyristor using two transistor model. 7

7. (*a*) Explain the importance of epitaxial process in IC fabrication. Describe *one* of them in brief. 5

(*b*) Describe CVD method for deposition of thin films. 5

(*c*) Define dry and wet oxidation. Explain the importance of oxidation in semiconductor fabrication. 5