VIT

Vellore Institute of Technology

Final Assessment Test (FAT) – June 2022

Programme	B.Tech	Semester	Winter Semester 2021-22
Course Title	ELECTRONIC MATERIALS AND DEVICES	Course Code	BECE201L
Faculty Name	Prof. Sathya Sree J	Slot	F1+TF1
		Class Nbr	CH2021222300532
Time	3 Hours	Max. Marks	100

Answer all the questions

Part - A (10 X 10 Marks)
Answer All questions

1. (a) Explain skin effect with neat diagram. **[10]**
   (b) The hall effect of silicon specimen is 4.55×10^{-4} m^3C^{-1} and its resistivity is $8.88 \times 10^{-3}\Omega$ m. Determine the carrier concentration and mobility.

2. A new semiconductor has $N_c = 10^{19}$ cm^{-3}, $N_v = 5 \times 10^{18}$ cm^{-3}, and $E_g = 2$ eV. If it is doped with 10^{17} donors (fully ionized), calculate the electron, hole, and intrinsic carrier concentrations at 627° C. Sketch the simplified band diagram, showing the position of E_F. **[10]**

3. Draw the energy band diagram of n-type and p-type semiconductor and explain how the Fermi level varies with temperature and doping concentration with an example. **[10]**

4. (i) The electron concentration in silicon is given by $n(x) = 10^{15}e^{-(x/L_n)}$ cm^{-3} $(x \geq 0)$ where $L_n = 10^{-4}$ cm. The electron diffusion coefficient is $D_n = 25$ cm^2/s. Determine the electron diffusion current density at $x = 10^{-4}$ cm. **[10]**
   (ii) The required conductivity of a silicon material must be $\sigma = 1.5$ $(\Omega\text{-cm})^{-1}$. If $\mu_n = 1000$ cm^2 V-s and $\mu_p = 375$ cm^2/V-s, Find the electron concentration.

5. Explain the principle of operation of tunnel diode with energy band diagram. **[10]**

6. A PN silicon device is fabricated with a phosphorus donor concentration of 5×10^{15} cm^{-3}. The sample is bombarded with boron acceptors to create a P-type material of 1×10^{17} cm^{-3} concentration and a cross sectional area of 1×10^{-2} cm^2. Assume complete ionization KT/q = 26mV and intrinsic carrier concentration $n_i = 1.5 \times 10^{10}$ cm^{-3} at operating temperature T=300K. Calculate: **[10]**
   (i) The built-in potential at the PN junction.
   (ii) Total depletion width.
   (iii) Maximum electric field at the junction.

7. Explain the input and output characteristics of Common Emitter (CE) configuration of NPN transistor and draw the corresponding small-signal equivalent model. **[10]**

8. Explain the C-V characteristics of a MOS capacitor with a p-type substrate with the help of energy band diagram. **[10]**

9. If the drain of an n – channel MOSFET is shorted to the gate with a threshold voltage (V_T) of MOSFET as 0.5 V. Identify the region of operation. Also, If the drain current (I_D) is specified as 2 mA for V_{GS} = 3 V, then estimate the drain current and transconductance using the appropriate formula for V_{GS} = 5V. **[10]**

10. Suggest a suitable material that has high electrical and thermal conductivity for a semiconductor device along with its working principle and necessity. **[10]**

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