Reg. No.:

Name :

VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

Continuous Assessment Test – II – May 2023

Programme	:	B.Tech (ECE/ECM)	Semester	:	Winter 2022-23
Course	:	Electronic Materials and Devices	Code	:	BECE201L
Faculty	:	Dr. Ashish Kumar Dr. Chandrasekaran N Dr. Rahul Narasimhan Dr. Anith Nelleri Dr. Deepak Punetha Dr. Mangal Das	Slot	:	E2+TE2
			Class Nbr(s)	:	CH2022232300106 CH2022232300107 CH2022232300108 CH2022232300109 CH2022232300110 CH2022232300111
Time	:	90 Minutes	Max. Marks	:	50

Answer ALL the questions

Q.No.	Sub. Sec.	Question Description	Marks
1		(a) A 2 cm long silicon piece at temperature 300K, with cross-sectional area $0.1cm^2$, is used to measure the electron mobility. What is the electron mobility if 90Ω of resistance is measured and the doping level is known to be $N_D = 10^{15}\ cm^{-3}$. **[5 Marks]** (b) Assume that, in an N-type gallium arsenide semiconductor at temperature T=300K, the electron concentration varies linearly from 1×10^{18} to $7\times10^{17}\ cm^{-3}$ over a distance of 0.10 cm. Calculate the total current density if an electric field $E = 10V/cm$ is applied along the length of the silicon piece. The electron diffusion coefficient is $D_n = 225cm^2/s$ [5 Marks]	10
2		"It is known that for a P-type semiconductor, the fermi level (E_F) is nearer to the valence band of the semiconductor. When a very high concentration of electrons is injected near the origin of the P type semiconductor, the P-type semiconductor tends to become an N-type semiconductor near the origin". Consider a P-type semiconductor with acceptor concentration of 10^{17} atoms/cm^{-3} at equilibrium, when electrons are injected into a very long P-type silicon semiconductor at the origin, the steady state excess electron concentration at the origin (x = 0) is 5×10^{18} cm^{-3}. Find the steady state separation between the fermi level (E_F) and the intrinsic level (E_i) at origin x = 0 and at a distance of 90 nm from the origin (x = 90 nm). Assume the intrinsic carrier concentration is 1.5×10^{10} cm^{-3}, T = 300K, Mobility of electrons = 500 cm^2/V-s and hole carrier life time = 10^{-10}s.	10

3		An ideal silicon PN junction diode at T = 300 K is uniformly doped on both sides of the metallurgical junction. It is found that under zero bias, the doping concentration is $N_A = 10\ N_D$ and the built-in potential barrier is $V_{bi} = 0.74$ V. Determine the value of the following: (a) N_A and N_D **[4 marks]** (b) Width of the Space Charge Region **[3 marks]** (c) $\lvert E_{max} \rvert$ **[3 marks]** $Note: \epsilon_r = 11.7, \epsilon_0 = 8.854 \times 10^{-12}\ F/m$	***10***
4		Discuss how a metal-semiconductor junction works instead of a semiconductor–semiconductor junction in conventional diodes. Compare the advantages of each of these above junctions with the help of energy band diagrams and mention some of their uses.	**10**
5		Design a silicon PN junction diode of area $A = 10^{-4}$ cm^2 to operate at T = 300 K such that the total diode current is I = 10 mA at a forward voltage of $V_a = 0.65$ V. The ratio of electron current to total current is to be 0.70. Use the semiconductor parameters as $D_n = 25$ cm^2/s, $D_p = 10$ cm^2/s , $\tau_{n0} = \tau_{p0} = 5 \times 10^{-7}\ s,\ n_i = 1.5\ \times 10^{10} cm^{-3}$	**10**
		Total Marks	**[50]**

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