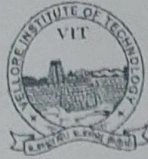


Reg. No.:

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		<p>(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 $N_D = 10^{15}\text{cm}^{-3}$. [5 Marks]</p> <p>(b) Assume that, in an N-type gallium arsenide semiconductor at temperature $T=300\text{K}$, the electron concentration varies linearly from 1×10^{18} to $7 \times 10^{17}\text{cm}^{-3}$ over a distance of 0.10 cm. Calculate the total current density if an electric field $E = 10\text{V/cm}$ is applied along the length of the silicon piece. The electron diffusion coefficient is $D_n = 225\text{cm}^2/\text{s}$ [5 Marks]</p>	10
2		<p>"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".</p> <p>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 $5 \times 10^{18}\text{cm}^{-3}$. 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 ($x = 90\text{nm}$).</p> <p>Assume the intrinsic carrier concentration is $1.5 \times 10^{10}\text{cm}^{-3}$, $T = 300\text{K}$, Mobility of electrons = $500\text{cm}^2/\text{V-s}$ and hole carrier life time = 10^{-10}s.</p>	10

3	<p>An ideal silicon PN junction diode at $T = 300\text{ K}$ 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 $V_{bi} = 0.74\text{ V}$. Determine the value of the following:</p> <p>(a) N_A and N_D [4 marks]</p> <p>(b) Width of the Space Charge Region [3 marks]</p> <p>(c) E_{max} [3 marks]</p> <p>Note : $\epsilon_r = 11.7$, $\epsilon_0 = 8.854 \times 10^{-12}\text{ F/m}$</p>	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 $A = 10^{-4}\text{ cm}^2$ to operate at $T = 300\text{ K}$ such that the total diode current is $I = 10\text{ mA}$ at a forward voltage of $V_a = 0.65\text{ V}$. The ratio of electron current to total current is to be 0.70. Use the semiconductor parameters as $D_n = 25\text{ cm}^2/\text{s}$, $D_p = 10\text{ cm}^2/\text{s}$, $\tau_{n0} = \tau_{p0} = 5 \times 10^{-7}\text{ s}$, $n_i = 1.5 \times 10^{10}\text{ cm}^{-3}$	10
Total Marks		[50]

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