VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)
CHENNAI

Reg. Number:	24BVD10007

Continuous Assessment Test (CAT) – I AUGUST 2025

Programme	:	B.Tech (VLSI Design and Technology)	Semester	:	Fall Semester 2025-26
Course Code & Course Title	:	BEVD201L & Physics of Semiconductor Devices	Class Number	:	CH2025260100503
Faculty	:	Dr. Bibhuti Bhusan Pradhan	Slot	:	E2+TE2
Duration	:	90 minutes	Max. Mark		50

General Instructions:

- Write only your registration number on the question paper in the box provided and do not write other information
- Use statistical tables supplied from the exam cell as necessary
- Use graph sheets supplied from the exam cell as necessary
- Only non-programmable calculator without storage is permitted

Answer all questions

Q. No	Sub Sec.	Description	Marks	CO	BT Level
1	a.	Differentiate between direct and indirect band gap semiconductors with the help of the energy–momentum (E–K) diagram [2M]. Explain the role of photons and phonons in electron transitions across the energy gap in both types of materials [2M]. How does this difference influence their applications in optoelectronic devices such as LEDs and solar cells[3M]?	7	1	L2
	b.	Explain the significance of Miller indices in crystallography. How do they help in identifying crystal planes and directions [2M]? Illustrate with the planes (100), (110), and (111) in a cubic unit cell [6M].	8	1	L1
2		The intrinsic resistivity of germanium at room temperature is 0.47Ω-m. The electron and hole mobilities at room temperature are 0.43 and 0.23 m^2/V-s respectively. Calculate the concentration of electrons in the intrinsic semiconductor. Also calculate the drift velocity of the charge carriers for a field of 10kV/m [10M].	10	1	L3
3	a.	Define the built-in potential voltage and describe how it maintains thermal equilibrium [4M]. In this regard, explain in detail on the space charge width variation with respect to applied bias [4M].	8	2	L2
	b.	A silicon pn junction in thermal equilibrium at T = 300 K is doped such that $E_F - E_{Fi}$ =0.365 eV in the n region and $E_{Fi} - E_F$ =0.330 eV in the p region. (a) Sketch the energy-band diagram for the pn junction. (b) Find the impurity doping concentration in each region. (c) Determine V_{bi}. Consider the Intrinsic carrier concentration of silicon at 300 K is $1.5\times10^{10}cm^{-3}$ [7M]	7	2	L3
4	a.	A certain metal forms a rectifying contact when deposited on lightly doped n-type silicon but forms a non-rectifying contact when deposited on heavily doped n-type silicon. (a) Identify and explain the nature of both contacts [2 M]. (b) With the help of energy band diagrams, explain the physical reason behind this behaviour [3M].	5	2	L2
	b.	A tunnel diode exhibits a peak current of 4 mA at a peak voltage of 0.07 V and a valley current of 0.9 mA at 0.35 V. Calculate the dynamic resistance in	5	2	L3

		the negative resistance region [2M]. Also, explain the significance of this region in the working of the tunnel diode [3M].			

Charge of electron, $e = 1.602 \times 10^{-19}$ C

Mass of electron, $m_e = 9.109 \times 10^{-31}$ kg

Boltzmann constant, $k = 1.381 \times 10^{-23}$ J/K

Mobility of electron and holes in Germanium is 3800 and 1800 cm^2 /V-s

**********All the best **********