REG.NO.: 24BEC0336

VIT
Vellore Institute of Technology

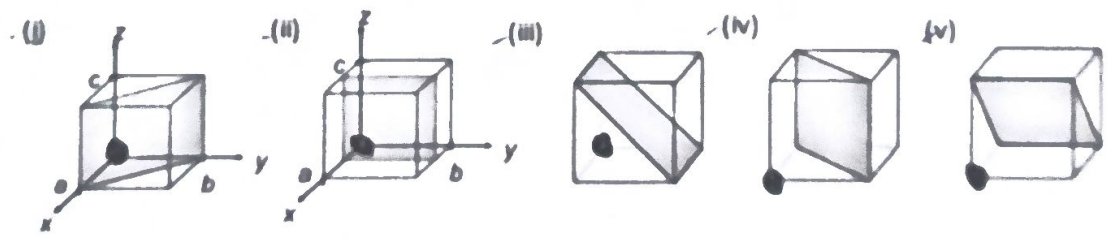
SENSE
CONTINUOUS ASSESSMENT TEST - I
WINTER SEMESTER 2024-2025

SLOT: E2+TE2

Programme Name & Branch	**: B.Tech & ECE**
Course Code and Course Name	**: BECE201L and Electronic Materials and Devices**
Faculty Name(s)	**: RAJA SELLAPPAN, VISHAL GUPTA, CHITTARANJAN NAYAK, ANAND S, NAWAZ SHAFI**
Class Number(s)	**: VL2024250500762, VL2024250500758, VL2024250500749, VL2024250500755**
Date of Examination	**: 31/01/2025**
Exam Duration	**: 90 minutes** **Maximum Marks: 50**

General instruction(s):

- Answer All Questions
- Constants for Silicon: $n_i = 1.5\times10^{10}$ cm-3, Eg =1.1eV, Relative permittivity $\varepsilon_r = 11.8$, kT=0.026 eV at 300K, Boltzman's constant k= 8.66×10^{-5} eV/K, $\varepsilon_0=8.854\times10^{-14}$ F/cm, q=1.6×10^{-19} C, h = 4.136×10^{-15} eV.s, Normalized effective mass for Si $m_n/m_0=0.26$, $m_p/m_0=0.39$, $m_0 = 9.1\times10^{-31}$ kg
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 - Remember, 2 - Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes
  CO1: Comprehend the basics of electronic materials, crystal structure, electrical and thermal conduction in solids
  CO2: Draw and analyze the band diagrams of semiconductor devices

Q. No	Question	M	CO	BL
1.	(a) Discuss the vacancy and substitutional defects in a crystal. (5 M) (b) Identify the Miller indices for the following crystal planes shown in figure below. Use the same co-ordinates as in figure (i) and (ii) for the remaining three figures (iii, iv, and v). The origin is marked as round solid circle. (5 M) 	10	1	2
2.	The electron drift mobility in indium (In) has been measured to be 6 $cm^2 V^{-1} s^{-1}$ and the room temperature (27 °C) resistivity is 8.37×10^{-8} Ω m. Determine (a) concentration of conduction electrons (b) mean free path if the mean velocity of conduction electrons is 1.74×10^{8} cm s^{-1} (c) applied electric field if the drift velocity is 0.1 % of the mean velocity and	10	1	3

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	(d) current through In wire of diameter 1mm.			
3.	Illustrate the following with the help of suitable diagrams and mathematical descriptions. (a) Fermi-Dirac distribution for T1<T2<T3 where T1 = 0 K (5 M) (b) Energy band diagram for intrinsic and extrinsic semiconductors (both N and P type) (5 M)	10	2	2
4.	Compute the following for Si at room temperature. Given $N_C = 2.8 \times 10^{19}$ cm^{-3} and $N_V = 1.04 \times 10^{19}$ cm^{-3}. (a) electron concentration if the Fermi level is 120 meV below the conduction band edge. (5 M) (b) hole concentration if the Fermi level is 150 meV above the valence band edge. (5 M)	10	2	3
5.	Determine the position of the Fermi energy level with respect to the intrinsic Fermi level in silicon at $T = 300$ K (a) if the silicon is doped with boron atoms at a concentration of $N_a = 2 \times 10^{16}$ cm^{-3}. Also, Calculate electron concentration (n_0) and hole concentration (p_0). (5 M) (b) if the silicon is doped with phosphorus atoms at a concentration of $N_d = 2 \times 10^{16}$ cm^{-3}. Also, Calculate electron concentration (n_0) and hole concentration (p_0). (5 M)	10	2	3

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