CHENNAI

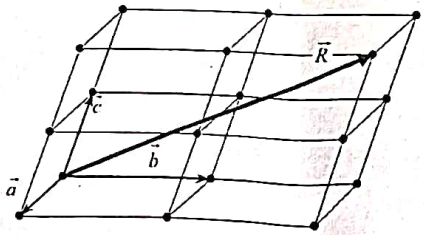
Continuous Assessment Test (CAT) – I AUGUST 2025

Programme	:	B.Tech BVD	Semester	:	FS 2025-26
Course Code & Course Title	:	BEVD101L Electronic Materials	Class Number	:	CH2025260100501
Faculty	:	Dr. Anisha Natarajan	Slot	:	C2+TC2
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
- Only non-programmable calculator without storage is permitted
- Useful constants:
  - Electronic charge: 1.602×10^{-19} C
  - Mass of the electron in free space: 9.10939×10^{-31} kg
  - Avogadro's number: 6.0221×10^{23} mol^{-1}
  - Boltzmann constant: 1.3807 × 10−23 J K^{-1}

Answer all questions

Q. No	Sub Sec.	Description	Marks	CO	BT Level
1.	(a)	Lithium has bcc structure. Its density is 530 kg/m^3 and its atomic mass is 6.94 g/mol. Estimate the atomic radius and edge length of a unit cell in the lithium metal. (5 marks)	10	CO1	K4
	(b)	Find the planar concentrations in Lithium as the number of atoms per nm^2 of the (100), (110), and (111) planes. Which plane has the most concentration of atoms per unit area? (5 marks)			
2	(a)	Consider a plane (hkl) in a crystal lattice. Prove that the reciprocal lattice vector $\overrightarrow{G^*_{hkl}} = h\overrightarrow{a_1^*} + k\overrightarrow{a_2^*} + l\overrightarrow{a_3^*}$ is perpendicular to the plane (hkl). (3 marks)	10	CO1	K3
	(b)	Determine the direction index for the lattice vector $\vec{R}$ shown in Figure 1. Within a cubic unit cell mark the $[\bar{1}\,\bar{1}\,1]$ direction. (3 marks)  Figure 1.			
	(c)	Suppose the real space primitive lattice vectors are $\overrightarrow{a_1} = a\hat{x}$, $\overrightarrow{a_2} = \frac{a}{2}(\hat{x} + \frac{\sqrt{3}}{2}\hat{y})$ and $\overrightarrow{a_3} = \hat{z}$. Determine the lattice vectors in the reciprocal space. (4 marks)			
3.		The resistivity of a piece of silver at room temperature 1.6×10^{-8} Ω m. The density and atomic mass of silver are 10.5g/cm^3 and 107.87 g/mol respectively.	10	CO2	K4

		(a) Estimate the mean free path of the conduction electrons if the mean speed is 10^6 m/s. (5 marks) (b) Calculate the mean free time and the electronic drift velocity in a field of 100 Vm^{-1}. (5 marks)			
4.	(a)	The thermal conductivity of a metal is 123.92 $Wm^{-1}K^{-1}$. Find the electrical conductivity and Wiedemann–Franz– Lorenz coefficient (or Lorentz number) when the metal possesses a mean free time of 10^{-14} sec at 300 K. Conduction electron concentration is $6x10^{28}/m^3$. (6 marks)	10	CO2	K2
	(b)	Design and explain the working of a sensor that can measure the power dissipated in a load by leveraging Hall effect (4 marks)			
5.		Consider a parallel beam of light of wavelength 600 nm and intensity 100 W/m^2. Find the energy and linear momentum of each photon. How many photons cross 1 cm^2 area perpendicular to the beam in 1 second?	10	CO2	K3
********** All the best **********					