VIT

Vellore Institute of Technology

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

School of Electronics Engineering

Winter Semester 2023-24 (CAT-I)

Course Code	:	BEVD101L	**Duration**	:	90 Minutes.
Course Name	:	Electronic Materials	**Slot**	:	B1+TB1
Faculty Name	:	Harish Kittur	**Max. Marks**	:	50

Instructions: Answer all the questions. Use standard values of the physical constants.

	Question	**Marks**
Q1	Gold has the FCC crystal structure, a density of 19.3 g cm^{-3}, and an atomic mass of 196.97 g mol^{-1}. What is the atomic concentration n, lattice parameter a, and atomic radius of gold?	4+3+3
Q2	The primitive translation vectors of the hexagonal space lattice may be taken as: $\mathbf{a}_1 = (3^{1/2}a/2)\mathbf{a}_x + (a/2)\mathbf{a}_y$; $\mathbf{a}_2 = -(3^{1/2}a/2)\mathbf{a}_x + (a/2)\mathbf{a}_y$; $\mathbf{a}_3 = c\mathbf{a}_z$. a) Find the volume of primitive cell in terms of the lattice constants: a and c b) Find the primitive translations of the reciprocal lattice (i.e., the reciprocal lattice vectors) and show that the lattice is its own reciprocal, but with a rotation of the axes	4+6
Q3	The electron drift mobility in silver has been measured to be 54 $cm^2 V^{-1} s^{-1}$ at 27 °C. The atomic mass and density of Ag are given as 107.87 amu or g mol^{-1} and 10.50 g cm^{-3}, respectively. Given the Wiedemann-Franz constant, $C_{WFL} = 2.44 \times 10^{-8}$ $W\Omega K^{-2}$ *a.)* Assuming that each Ag atom contributes one conduction electron, calculate the resistivity of Ag at 27 °C. Compare this value with the measured value of 1.6×10^{-8} Ωm at the same temperature and suggest reasons for the difference. *b.)* Calculate the thermal conductivity of silver at 27 °C.	6+4
Q4	A doped silicon sample has electron concentration 5 x 10^{15} cm^{-3} and hole concentration 4.5 x 10^4 cm^{-3}. The electron and hole mobility in the sample are 1350 $cm^2V^{-1}s^{-1}$ and 450 $cm^2V^{-1}s^{-1}$ respectively. The sample length is 2 cm and cross-section area is 0.02 cm^2. Calculate the sample: a) conductivity and resistivity, b) the Hall coefficient, and c) the Hall voltage E_y when a voltage of 2V is applied along the length of the sample. The voltage is applied along the x-direction and a magnetic field of B_z = 100 mT is applied along the z-direction.	4+3+3
Q5	Consider a crystal having a simple cubic lattice with a lattice constant a = 0.5 nm. X-ray diffraction is to be performed on the set of planes having Miller indices (1,0,0), (1,1,0) and (1,1,1). a) Calculate the total number of angles at which diffraction peaks will be observed. Kindly do not count the cases where θ = 0° or θ = 90°. b) Calculate the minimum and the maximum angles at which diffractions peaks can be observed.	6+4

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