



Continuous Assessment Test -I (CAT-I) Winter Semester (2022-23)

Course Name & code : Material Science and Engineering/BCHE206L
Programme Name & Branch : B. Tech (Chemical)

Class Number : VL2022230501326
Slot : B2/TB2

Faculty Name : Shankar Raman Dhanushkodi, PhD
Exam Duration : 90 minutes

Maximum Marks : 50

General instruction(s): Answer All questions

Any other specific instruction: Answer all questions

Question					Marks	CO	BL									
1	Calculate the size of the critical radius and the number of atoms in the critical nucleus when solid copper forms by homogeneous nucleation. Comment on the size of the nucleus and assumptions we made while deriving the equation for the radius of the nucleus. You can make necessary assumptions. $\Delta T = 240^{\circ}\text{C}$; $T_m = 1500\text{ K}$; $\Delta H_f = 1628\text{ J/cm}^3$; $\sigma_{sl} = 180 \times 10^{-7}\text{ J/cm}^2$	10	3	3												
	(a) Draw the phase boundaries at the invariant line for the following items : (i) Eutectic and (ii) Peritectoid reactions (5 Marks) (b) Design metric for fabricating a cylindrical rod Length = 370 mm Diameter = 10 mm Condition to be met: If the rod is subjected to tensile load - it should not experience neither plastic deformation nor an elongation of more than 0.9 mm when the applied load is 25 000 N Select one of the metal or alloys listed below as a possible candidate? Justify your decision using stress-strain behaviour. (5 Marks) <table><thead><tr><th>Material</th><th>Modulus of elasticity (GPa)</th><th>Yield Strength (Mpa)</th><th>Tensile Strength (Mpa)</th></tr></thead><tbody><tr><td>Copper</td><td>110</td><td>250</td><td>290</td></tr><tr><td>Steel alloy</td><td>207</td><td>450</td><td>550</td></tr></tbody></table>	Material	Modulus of elasticity (GPa)	Yield Strength (Mpa)	Tensile Strength (Mpa)	Copper	110	250	290	Steel alloy	207	450	550	10	4	2
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Copper	110	250	290													
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	Consider a parallel-plate capacitor having an area of $4 \times 10^{-4}\text{ m}^2$ and a plate separation of $18 \times 10^{-3}\text{ m}$ across which a potential of 10 V is applied. If a material having a dielectric constant of 5.5 is positioned within the region between the plates, $\epsilon_0 = 8.85 \times 10^{-12}\text{ F/m}$ Compute the following: (a) capacitance	10	4	3												

	(b) magnitude of the charge stored on each plate (c) dielectric displacement (d) polarization			
4	(a) A hypothetical A-B alloy of composition 65 wt% B ; 35 wt% A at some temperature is found to consist of mass fractions of 0.5 for both α and β phases. If the composition of the β phase is 80 wt% B ; 10 wt% A, what is the composition of the α phase? (b) Explain the phenomena of CCT and TTT in phase diagram with an appropriate example.	10	3	4
5	Compute the following: (a) magnetic susceptibility, (b) permeability, and (c) magnetic flux density within this material, and (d) Determine type(s) of magnetism that has been displayed by this material? Details: The magnetization of the alloy is 3×10^5 A/m Field $H = 48$ A/m.	10	4	2