VIT

Vellore Institute of Technology

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

SCHOOL OF MECHANICAL ENGINEERING

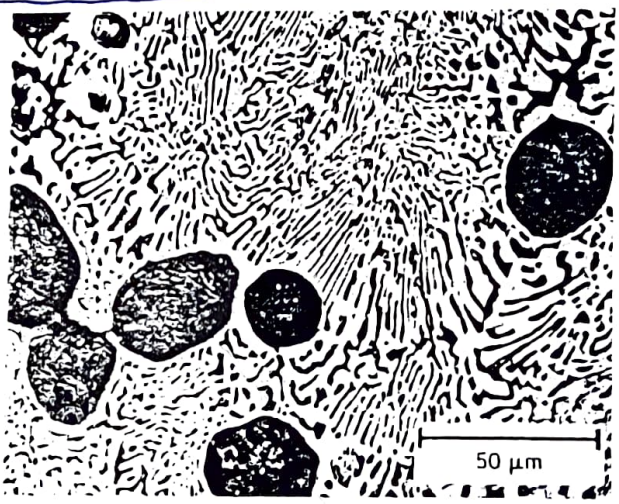
CONTINUOUS ASSESSMENT TEST – II

SLOT:B2+TB2

FALL SEMESTER 2022-2023

Programme Name & Branch : B-Tech, Mechanical Engineering
Course Code :BMEE209L
Course Name :Materials Science and Engineering
Faculty Name(s) :Dr. A. Raja Annamalai, Dr. Rijesh M, Dr. M S Sreekanth, Dr. Md.Faseeullakhan, Dr. Ashish
Class Number(s) :VL2022230100545/536/547/560/562
Duration:90min. **Max. Marks:50**

General instruction(s): Answer All questions

Q.No	Question	Marks
1.	Determine the undercooling temperature for homogeneous nucleation if the number of atoms in the critical nucleus for Iron (Fe) is 734. Given: The melting temperature of Fe is 1538°C, heat of fusion 1737 J/cm^3, solid-liquid interfacial energy 204 x 10^{-7} J/cm^2, and lattice parameter for Fe 2.85 Å.	10
2.	A microstructure of a Pb-Sn alloy is shown below. The dark constituent is a lead-rich solid α, and the light constituent is a tin-rich solid β. Specify the nature of the alloy. The weight fraction of the proeutectic phase is 0.21. Determine the composition of the alloy. 	10
3.	For hypo-eutectoid steel of 0.3 wt% carbon, calculate the following: (i) The amount of austenite and proeutectoid phase, just above the eutectoid temperature (ii) The amount of ferrite and cementite just below the eutectoid temperature. Draw the microstructure of this steel just above the eutectoid temperature and at room temperature. Explain the microstructural evolution and origin of a hypoeutectoid pearlite.	10

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SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST- II

SLOT: B1+ TB1

FALL SEMESTER 2022-2023

Programme Name & Branch : B. Tech - Mechanical Engineering
Course Code : BMEE 2091
Course Name : Materials Science & Engineering
Faculty Name(s) : Prof(s). SITARAM DASH, M. S. SREEKANTH, MD. FASEEULLAKHAN, YAZAR K. U.
Class Number(s) : VL2022230100537/561/540/543
Duration: 90 min.

Max. Marks: 50

General instruction(s): *All questions are compulsory. Please read the questions carefully before answering. Each sub-question carries 5 marks.*

Q. No	Question	Marks
1.	**[a]** Differentiate between homogeneous and heterogeneous nucleation that accompanies a solidification process. Provide a suitable example for heterogeneous nucleation. **[b]** Calculate the radius of the critical nucleus that proceeds to form crystalline Nickel during a solidification event. Use the following data in calculation of critical radius and state significance of this critical size. Latent Heat of Fusion for Nickel: 2756 J/cm^3 Solid-Liquid Interfacial Energy: 255 X 10^{-7} J/cm^2 Typical Value for Undercooling: 480 °C Freezing Temperature for Molten Nickel: 1453°C	10
2.	**[a]** State and explain Ficks first and second law of diffusion. Explain significance of various terms in expression $D = D_o \exp\left(-\frac{E_a}{k_B T}\right)$ **[b]** Obtain an expression for ratio of Diffusion coefficients at 800 K and 500 K i.e. D(800K)/ D(500K). Justify the inequality: $D_{800K} \neq D_{500K}$	10
3.	**[a]**State Hume-Rothery rules and spell out criteria for formation of substitutional solid solutions. Based on this state whether completely miscible solid solution will be formed in case of Copper-Titanium system. Atomic size of Copper: 0.1278 nm and that of Titanium is 0.147 nm. **[b]** A Copper(50%)-Nickel(50%) alloy is subjected to slow as well as sudden cooling from a temperature of 1500°C to room temperature. Compare and contrast the room temperature micro structures that evolve in each case.	10
4.	**[a]** Draw the crystal structures of α-Ferrite and γ-Austenite phases in Fe- Fe_3C system. State reasons for higher carbon solubility in γ-Austenite phase as compared to α-Ferrite **[b]** Differentiate between eutectic and eutectoid transformations in partially miscible binary systems. State reasons for lamellar architecture that forms in such processes. Comment on the mechanical strength of such alloys.	10
5.	**[a]** Compare the microstructure of hypo-eutectoid, eutectoid and hyper eutectoid steels. Comment upon evolution of various phases and microstructures. Arrange them in order of their mechanical strength. **[b]** A hypo-eutectoid steel with 0.4 wt% carbon content is cooled below the Eutectoid Temperature. Calculate the fraction of pro eutectoid ferrite, pearlite and cementite phases.	10