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10ME42A/AU42A

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018

Material Science and Metallurgy

Time: 3 hrs.

Max. Marks:100

- Note: 1. Answer FIVE full questions, selecting at least TWO questions from each part.**
2. Draw neat sketch wherever necessary.

PART – A

- 1 a. With sketch, explain the following: (i) Body centered cubic (ii) Face centered cubic and (iii) Hexagonal close packed structure. (08 Marks)
- b. Differentiate between line and screw dislocation. (06 Marks)
- c. The diffusivity of copper atoms in FCC copper lattice is $8.0 \times 10^{-21} \text{ m}^2/\text{sec}$ at 400°C and $6.0 \times 10^{-15} \text{ m}^2/\text{s}$ at 800°C . Calculate the activation energy in J/mole for diffusion of copper atoms in FCC copper lattice. Consider $R = 8.314 \text{ J/mole}$. (06 Marks)
- 2 a. Draw the conventional stress-strain diagram for ductile material under tensile load and explain the different properties of the material. (08 Marks)
- b. Derive an expression for the critical resolved shear stress for slip in a single crystal. (06 Marks)
- c. What is strain hardening? Explain the reasons for the same. (06 Marks)
- 3 a. What are the two major types of fractures of metals? Differentiate between them. (08 Marks)
- b. Draw S-N diagram showing the fatigue limit and explain briefly. (06 Marks)
- c. How would you conduct a test to assess the fatigue life of a material? Explain briefly. (06 Marks)
- 4 a. Derive critical radius of homogeneous nucleation. (08 Marks)
- b. Explain with sketch nucleation and growth of dendrites. (06 Marks)
- c. List and explain different types of substitutional solid solutions. (06 Marks)

PART – B

- 5 a. Sketch and explain the equilibrium diagram, when two components A and B are completely soluble in liquid state and partially soluble in solid state. Also mention an example. (08 Marks)
- b. Draw "Iron-Iron carbide" phase diagram and show the region where the following reactions take place (i) Eutectic (ii) Peritectic and (iii) Eutectoid. Explain the structural changes taking place at 0.6% carbon. (12 Marks)
- 6 a. With the help of TTT diagram and super imposed cooling curves and the heat treatment ranges represented on the relevant portion of the iron carbon equilibrium diagram, explain (i) Process annealing and (ii) Quench hardening. Clearly state the process, changes in micro structure and changes in properties. (08 Marks)
- b. Explain the effect of carbon on the shape of the TTT diagram and the hardenability of the steel. (06 Marks)
- c. Explain the process of flame hardening. (06 Marks)
- 7 a. Mention at least three different types of cast iron. How do they differ with respect to composition and structure? (08 Marks)
- b. Write composition, properties and uses of, (i) Stainless steel (ii) High speed steel and (iii) Brass. (08 Marks)
- c. Write a note on Al-Si alloys. (04 Marks)
- 8 a. Explain the following composite material with examples: (i) Agglomerated composites and (ii) Reinforced composites. (08 Marks)
- b. List the different methods of manufacturing fiber reinforced plastic. Explain any two of them. (08 Marks)
- c. Explain the advantages and limitations of composite materials in practice. (04 Marks)

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Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
 2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.