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10ME32A/AU32A/MT32/TL32

Third Semester B.E. Degree Examination, Dec.2013/Jan.2014

Material Science and Metallurgy

Time: 3 hrs.

Max. Marks: 100

Note: Answer FIVE full questions, selecting at least TWO questions from each part.

PART – A

1. a. Sketch the unit cell of a HCP crystal structure. Calculate the number of atoms per unit cell. Derive an expression for the density of atomic packing factor. [Given $c = 1.6339$]. (08 Marks)
 b. Explain different types of mechanism of diffusion in solids. (08 Marks)
 c. Aluminum has a FCC structure and an atomic radius of 0.143 nm. Calculate volume of its unit cell in cubic meters. (04 Marks)
2. a. Define engineering stress and strain, and true stress strain. Find out the relationship between true strain and engineering strain. (08 Marks)
 b. A steel rod of 10 mm diameter and 1.5 m length is subjected to an axial tensile load of 1 kN. Determine: i) Stress, ii) Strain and iii) Elongation. Take modulus of elasticity of steel = 205×10^6 kN/m². (06 Marks)
 c. Differentiate between slip and twinning deformation in materials. (06 Marks)
3. a. Define creep with a typical creep curves. Explain different stages of creep. (06 Marks)
 b. Sketch the basic modes of fracture. List the difference between them. (06 Marks)
 c. What is fatigue? Draw the SN curves for steel and aluminum alloys. (08 Marks)
4. a. Explain the homogeneous nucleation. Discuss the significance of critical radius of the nuclei. (08 Marks)
 b. Define solid solution, and explain the different types of solid solution. (06 Marks)
 c. State the Gibb's phase rule and explain with a simple example. (06 Marks)

PART – B

5. a. Draw the iron-carbon equilibrium diagram and label all the fields. Write the different invariant reactions. (10 Marks)
 b. Explain the steps to construct TTT diagram. Draw a sketch of a TTT diagram label all the fields for an eutectoid steel. (10 Marks)
6. a. Define the process of heat treatment and classify the various heat treatment processes. (08 Marks)
 b. Explain carburizing with a neat sketch. (06 Marks)
 c. Define hardenability of a material and list the factors affecting hardenability. (06 Marks)
7. a. Briefly describe the composition, properties and application of medium and high carbon steel. (08 Marks)
 b. Briefly describe the composition, properties and application of grey cast iron. (06 Marks)
 c. Discuss AISI-SAE designation of steel with examples. (06 Marks)
8. a. What is a composite material? How it is classified? Explain briefly. (10 Marks)
 b. With a neat sketch, explain the hand lay up laminating process. (10 Marks)
