[Total No. of Questions - 9] [Total No. of Printed Pages - 3] (2125)

15122

B. Tech 4th Semester Examination

Material Science & Engineering (OS)

ME-4006

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five questions in all, select one question from each sections A, B, C , D. Section E (Question 9) is compulsory. Use of steam tables is permitted and assume any suitable data if not given.

SECTION - A

1. (a) Calculate the volume of an FCC unit cell in terms of atomic radius R. Show that the atomic packing factor of FCC unit cell is more than that of BCC. (10)

   (b) Define: Metallic bonding, covalent bonding; Orthorhombic and tetragonal crystal structures with examples in each case. (5)

   (c) Calculate the linear atomic density in [110] direction in atoms per meter in Cu-lattice (a_0=0.36nm). (5)

2. (a) What are point, line and surface defects? Explain each with examples and suitable sketch. (10)

   (b) Differentiate between Frenkel pairs and Shottkey defects. (5)

   (c) Explain why interstitial atoms such as C in Fe, can diffuse more rapidly, compared to vacancies. (5)

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SECTION - B

3. (a) Draw and explain $FeFe_3C$ phase diagram. Indicate the carbon percentage range of steel. (10)

   (b) Define peritectic reaction. Explain with suitable phase diagram. (10)

4. (a) Explain any one type of surface hardening with sketches. (10)

   (b) Differentiate between the normalizing and annealing with sketches. (10)

SECTION - C

5. (a) What is strain hardening? Name one application where it is advantageous and on application where it is problematic. (8)

   (b) Differentiate between true and engineering stress-strain curve. Indicate the elastic zone, plastic zone and yield point in a stress-strain curve of mild steel. (6)

   (c) Explain why twinning is associated with homogenous shear though atoms are displaced by equal distance in slip. (6)

6. (a) Give the composition and uses of various cast-irons. (8)

   (b) Give the list of various copper alloys. Write short note on copper alloys. (6)

   (c) What are the various effects of alloying elements on steels? (6)

SECTION - D

7. (a) Explain why the phenomenon of creep of metals is so closely related to diffusion. Can you explain the creep behavior of ceramics and polymers? Outline mechanistic dissimilarity, if any. (10)

   (b) What is Griffith's theory of brittle fracture? Explain and give the equation for critical stress for crack propagation. (10)

8. (a) Show a characteristics creep curve and describe three stages in creep deformation. (10)

   (b) What is fatigue? Draw the SN curves for (i) a material that displays a fatigue limit (ii) Explain how fatigue life can be enhanced. (10)

SECTION - E

9. (i) What is angle between [100] and [101] direction of cubic crystal?

   (ii) Define Burger's vector.

   (iii) What are superalloys? Give examples.

   (iv) What is cup & cone fracture?

   (v) What is tempering?

   (vi) What is an eutectic reaction and eutectoid reaction?

   (vii) What is Bauschinger effect?

   (viii) Draw the binary phase diagram of Al_2O_3-Cr_2O_3 clearly showing the tie line.

   (ix) At high temperature, the mechanical strength is high or low? Give answer with proper reasoning.

   (x) What is difference between annealing twins and deformation twins? (10×2=20)