

Roll No.

Total Pages : 3

BT-3/D-18

33108

MATERIAL SCIENCE

Paper : ME-209(N)

Time : Three Hours]

[Maximum Marks : 75

Note : Attempt *five* questions in all, selecting at least *one* question from each unit. Assume any missing data.

UNIT-I

1. (a) Define Atomic Packing Factor. Calculate the APF for an ideally packed HCP unit cell. 6
- (b) Classify the crystal defects. Explain point defect with neat sketches. 7
- (c) Calculate the rate of diffusion of Iron at 700°C. Take $A = 4.9 \times 10^{-5} \text{ m}^2/\text{s}$, $E = 153.2 \text{ kJ/mol}$. 2
2. (a) Explain the yield point phenomenon in materials in terms of dislocations. 6
- (b) On what crystallographic planes and in what direction slip most is likely to occur in *bcc*, *fcc*, and *hcp* metals. 9

UNIT-II

3. (a) Explain in brief different types of solid solutions with sketches. 4
- (b) State Lever rule and Gibbs phase rule. Also explain Hume-Rothery rules for formation of solid solutions. 5

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- (c) Two metals A and B have their melting points at 600°C and 400°C respectively. These metals do not form any compound or intermetallic phase. The maximum solubility in each other is 4% which remains the same until 0°C. An eutectic reaction occurs at 300°C for 65% A.

- (i) Draw phase diagram and label all the phases and fields.
- (ii) Find the temperature at which 20% A and 80% B starts and ends solidification.
- (iii) Find the temperature at which the same alloy contains 50% liquid and 50% solid. 6

4. (a) How does tempering is different from mar-tempering? What is M_s and M_f temperatures? Why is sub-zero cooling applied in some tool steels? 4
- (b) Explain Flame hardening with neat sketch. 4
- (c) Discuss different stages of age-hardening treatment in Aluminium alloys. <http://www.kuonline.in> 5
- (d) What is the difference between hardness and hardenability? 2

UNIT-III

5. (a) What are ceramics? What is the range of thermal expansions coefficients in ceramics? Explain why ceramics have low coefficient of thermal expansions. 5

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- (b) What are polymers? Describe briefly the terms 'Saturated polymer' and 'Unsaturated polymer'. 8
- (c) State the industrial applications of Composite. 2
6. Write short note on the following :
- (a) Piezoelectric materials.
- (b) Liquid crystals.
- (c) Opto-electric materials. 15

UNIT-IV

7. (a) Discuss the mechanism of fatigue failure. Describe the characteristics of fatigue failures. 7
- (b) Describe the procedure for fatigue testing on testing machine with the help of neat diagram. 8
8. Write short notes on the following :
- (a) Transmission electron microscopy.
- (b) Atomic absorption spectroscopy. 15
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