

B. MECHANICAL 2ND YEAR 1ST SEM. SUPPLE EXAMINATION, 2017**MATERIAL SC. AND ENGG.****Time: Three hours****Full Marks: 100****Answer any FIVE questions**

1a) Define co-ordination number. Show that the minimum relative size (r/R) for the co-ordination number three is 0.155. (2+4)

b). Explain the tetrahedral structure of a diamond unit cell. The lattice parameter for diamond is 3.57\AA , calculate its density and packing efficiency. (4+10)

2a) Explain any two types of diffusion mechanisms. (6)

b) At $900\text{ }^{\circ}\text{C}$, what is the time required to carburize a steel with initial composition of 0.2% carbon to 1% carbon at a depth of 0.2 mm? Assume a constant surface concentration of 1.4% carbon due to carburising atmosphere.

Given: $D_o = 0.7 \times 10^{-4} \frac{\text{m}^2}{\text{s}}$; $Q = 157 \frac{\text{KJ}}{\text{mol}}$; $R = 8.314 \frac{\text{J}}{\text{mol K}}$

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|--------|--------|--------|--------|--------|
| Z | 0.25 | 0.30 | 0.35 | 0.40 |
| erf(Z) | 0.2763 | 0.3268 | 0.3794 | 0.4284 |

(14)

3a) Draw the Fe-Fe₃C equilibrium phase diagram according to scale and label it. (12)

b) How much pro-eutectoid ferrite is there in a slowly cooled 0.6% steel? How much eutectoid ferrite is there in the same steel? (8)

4.a) Derive the expression for composite elastic modulus under iso-strain condition for a fibre reinforced composite material. Also mention the assumptions made to derive the expression. (6+4)

b) For a fibre reinforced composite material, the modulus ratio is 26 and the fibre takes 35% of the cross sectional area. What percentage of the longitudinal load is taken by the fibre? (5)

c) Explain the stress-strain behaviour of a fibre reinforced composite under longitudinal loading. (5)

5a) Explain the 'Energy Band Structure' in solids. Differentiate among conductors, semiconductors and

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(2)

- insulators in the light of energy band structure. What is energy band gap? (4+6+2)
- b) Calculate band gap for a semi-conductor from the following data:
- The conductivity of the semi-conductor at 30°C. = $260 (\Omega\text{m})^{-1}$
- The conductivity of the semi-conductor at 180°C. = $1200 (\Omega\text{m})^{-1}$ (8)
- 6a) What is vulcanization ? If 10 gm of sulphur is added to 100 gm of butadiene rubber, what is the maximum fraction of the cross-link sites that can be connected ? (4+6)
- b) Write down the Mer-structure of the following and mention the uses of them.
- i) PE ii) PS iii) PVC iv) PTFE (10)
- 7a) Describe the process of Recovery, Recrystallization, and Grain Growth. How mechanical properties are affected by the said processes? (10)
- b) Write down the Hume-Rothery rules for solid solubility. (5)
- c) Differentiate between hot working and cold working. (5)
8. Write short notes on the followings (any four): (4X5)
- a) Full annealing in heat treatment
- b) Metallic bond
- c) Diffusion flux
- d) Normalising in heat treatment
- e) Thermosetting plastic
- f) Traditional ceramics
- g) Viscoelastic property of polymers