

CBCS Scheme

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15ME/MA32

Third Semester B.E. Degree Examination, June/July 2018 Material Science

Time: 3 hrs.

Max. Marks: 80

Note: Answer FIVE full questions, choosing one full question from each module.

Module-1

- 1 a. Define atomic packing fraction. Calculate the coordination No, atomic radius and APF for a HCP crystal structure. (08 Marks)
- b. The surface of 1020 steel with 0.2% C to be carburized at 927°C. Calculate the time required to increase the carbon content to 0.4% at 1mm below the surface, if the carbon potential at the surface is 1.2% wt. Given $D = 1.28 \times 10^{-11} \text{ m}^2/\text{sec}$. (08 Marks)

Z	0.85	0.9	1.0
erf(z)	0.7707	0.797	0.842

OR

- 2 a. What is stress relaxation? Derive an expression for stress relaxation. (08 Marks)
- b. Define Fatigue. Explain the different types of stress cycles that cause fatigue failure, with sketches. (08 Marks)

Module-2

- 3 a. What is solid solution? Mention the types of solid solution. Explain the factors given by Hume Rothery that govern the formation of solid solution. (08 Marks)
- b. Explain the effect of any 8 alloying elements on the properties of steel. (08 Marks)

OR

- 4 a. Draw the Iron Carbon diagram and label all the points and fields in it. Explain the different phases in it. (08 Marks)
- b. Two metals A and B with melting temperatures 850°C and 1100°C respectively having unlimited liquid solubilities. They form an eutectic solid solution at 600°C and a composition of 35% A and 65%B. The maximum solid solubility of A in B is 10% at Eutectic temperature and 5% at room temperature. The maximum solubility of B in A is 16% at eutectic temperature and 7% at room temperature. Assume liquidus, solidus and solvers lines to be straight.
- i) Draw the phase diagram and label all the regions.
- ii) Determine the NO, relative amount of phases at room temperature for an alloy of 60% A and 40% B. (08 Marks)

Module-3

- 5 a. Draw a TTT diagram for plain carbon steel and label the fields. Show the cooling curve which form 100% marten site on it and explain it. (08 Marks)
- b. Give the detailed classification of heat treatment types. Explain Mastempering and Austempering, with sketches. (08 Marks)

OR

- 6 a. What is age hardening? Explain age hardening of at 0.4% Cu alloy showing the microstructure, with sketch. (08 Marks)
- b. Explain the composition, structure and properties of 4 types of Cast Iron. (08 Marks)

Module-4

- 7 a. State and explain the mechanical and electrical properties of ceramic materials. (08 Marks)
- b. How are plastics classified based on structure and behaviour? Give the advantages and disadvantages of plastic materials. (08 Marks)

OR

- 8 a. What are smart materials? Write short notes on Piezo electric materials and shape memory alloys. (08 Marks)
- b. What is residual life assessment and its importance? Explain any 3 non destructive testing methods used for accessing residual life. (08 Marks)

Module-5

- 9 a. Define composite material. Explain the role of matrix interface and reinforcement in a composite material. (08 Marks)
- b. Explain Resin transfer moulding process, with a neat sketch. State its advantages and disadvantages. (08 Marks)

OR

- 10 a. Under Iso-Strain condition derive an expression for Young's modulus of fiber reinforced composites. List the advantages and applications of composite materials. (08 Marks)
- b. With a neat sketch explain injection moulding process and state its advantages. (08 Marks)

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