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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 faction. 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 $D = 1.28 \times 10^{-11}$ m^2/sec. **(08 Marks)**

Z	0.85	0.9	1.0
enf(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 Rolhery 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 Youngs 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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