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Question Paper Code : 90857

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Third/Fourth Semester

Mechanical Engineering

ME 8491 – ENGINEERING METALLURGY

(Common to: Automobile Engineering/Manufacturing Engineering/Mechanical and Automation Engineering/Production Engineering)

(Regulations 2017)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write down the differences between substitutional and interstitial solid solutions.

2. What are the factors that govern the formation of the substitutional solid solution?

3. Continuous cooling transformation curves are of industrial importance when compared to the Isothermal transformation diagram. Give reasons.

4. Is nitriding suitable for plain carbon steels or alloy steels? Justify your answer.

5. Distinguish between alpha and beta stabilizers

6. What are the ways by which the sensitization problem can overcome in stainless steels?

7. In What way thermo plastics differ from thermosetting plastics?

8. What are the functions of matrix phase in a composite material?

9. What is the influence of grain size on the yield strength of an alloy?

10. Why is the strength of brittle materials are much lower than predicted by theoretical calculations?

PART B — (5 × 13 = 65 marks)

11. (a) Discuss in detail the formation of pearlite from austenite with a neat schematic diagram.

Or

(b) How are the liquidus and solidus lines plotted in an Isomorphous phase diagram? Explain them with an example and draw the neat phase diagram.

12. (a) Describe the precipitation sequence in Al-4%Cu alloy upon subjecting the alloy to precipitation hardening

Or

(b) For a eutectoid steel, describe an isothermal heat treatment that would be required to produce a specimen having a hardness of 93 HRB.

13. (a) (i) What are Super alloys? (3)

(ii) Discuss in detail the mechanism involved in the super alloys that makes the alloy suitable for high temperature applications. (10)

Or

(b) (i) How are Cast irons classified based on the fractured surface and phase constituents? (3)

(ii) Explain the method of production of Malleable cast iron. (10)

14. (a) With the help of suitable examples, compare and contrast the processes of addition polymerization and condensation polymerization.

Or

(b) (i) How does the amount of crystallinity in a thermoplastic affect its density and tensile strength? (4)

(ii) Write short notes on the following: (3 × 3 = 9)

(1) Tungsten carbide

(2) Cermets

(3) Boron nitride

15. (a) What are the deformation mechanisms that are encountered in metallic materials? Discuss any one of the deformation mechanism in detail.

Or

(b) (i) Coarse grain structure has higher creep strength when compared to fine grain structure. Justify the statement. (4)

(ii) Describe any two creep mechanism in detail. (9)

PART C — (1 × 15 = 15 marks)

16. (a) (i) An Fe-C alloy of eutectoid composition (0.76 wt% C) is subjected to equilibrium cooling from austenitic region to room temperature. Discuss on the microstructural changes that take place during cooling. (8)

(ii) Draw an illustrative eutectic phase diagram and write down the eutectic reaction (with respect to the figure). What is a typical microstructure obtained, when a eutectic composition is slowly cooled? (7)

Or

(b) Two metals A & B have melting points 750° C and 500° C respectively. They form an eutectic at 75% B which melts at 400° C. Their solubilities at eutectic temperature are, 20%B in A and 10%A in B and at 0°C, 5% B in A and 10% A in B. From the above information, draw the equilibrium diagram for the system clearly labelling all the phases present. From the diagram, determine what structures would be obtained in slowly cooled alloys of the following compositions 10%B, 40%B, 75%B and 95%B and explain the microstructural changes on slow cooling.

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