Question Paper

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTER FOR APPLIED SCIENCES
END SEMESTER THEORY EXAMINATIONS
NOVEMBER 2019
III SEMESTER B.sc. (Applied Sciences) in Engg.
MATERIAL SCIENCE AND METALLURGY [IME 233]

Marks: 100   **Duration: 180 mins.**

Answer 5 out of 8 questions.
Answer ANY FIVE full Questions.
Missing data, if any, may be suitably assumed

1)
  A) Relate lattice parameter in terms of atomic radius for BCC and FCC structures with unit cell sketches. (6)

  B) Explain edge and screw dislocations with neat sketches along with Burger's circuit. (6)

  C) Show the following planes and directions in cubic systems (8)
$$(110), [210], [1\bar{2}1], (\bar{2}10)$$

2)
  A) Explain Hume Rothery rules of governing the formation of substitutional solid solutions. (6)

  B) Explain dendritic growth during solidification of liquid metals with neat sketches. (6)

  C) Highlight the differences between: i)Homogeneous and Heterogeneous nucleation
ii)Frankel and Schottky defects (8)

3)
  A) How do you determine amount and composition of phases using lever rule on a phase diagram? (6)

  B) Write a short note on intermetallic and interstitial compounds with examples. (6)

  C) What are binary phase diagrams? Explain construction of binary phase diagram considering an Isomorphous system (8)

4)
  A) Explain Peritectic and Eutectoid systems with phase diagrams, cooling curves and microstructures. (10)

  B) The metals Lead and Tin are mutually soluble in the liquid state and partly soluble in the solid state. A liquid phase alloy containing 30% Lead completely transforms into a mixture of two solid solutions at 180oC. Maximum solubility of Tin in Lead and Lead in Tin are 20% and 10% respectively at $180^{o}C$, 10% and 5% respectively at $50^{o}C$. Melting (10)

temperatures of Lead and Tin are 330°C and 230°C respectively. Assuming the curves to be linear, draw phase diagram to scale and label the regions. For 20% Lead alloy determine the following: a) Composition of first solid nucleated. b) Temperature where equal proportions of liquid and solid phases exist. c) Composition of last drop of liquid to be precipitated.

5)

A) Neatly sketch the Iron -Carbon phase diagram and label the regions. Calculate eutectoid and pro-eutectiod phases for 1.5%C steel. (10)

B) Referring to Iron- Carbon system explain: i)Ferrite, ii)Austenite iii)Pearlite, iv) Ledeburite, v)Iron Carbide. (10)

6)

A) With relevant sketches explain the standard hardenability test for eutectoid steel. (10)

B) Write the construction procedure of TTT diagram for 0.8% carbon steel and super impose the cooling curves to obtain martensitic and bainitic structures on it. (10)

7)

A) Explain Austempering and Martempering processes. (10)

B) "Tempering follows hardening" justify. Explain low, medium and high temperature tempering processes. (10)

8)

A) Explain composition, properties and applications of various plain carbon steels. (10)

B) What are the characteristics and applications of High Speed Steel, Maraging Steel and Free Machining Steels. (10)

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