Question Paper

Exam Date & Time: 29-Nov-2019 (02:00 PM - 05:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
END SEMESTER THEORY EXAMINATION NOVEMBER/DECEMBER 2019
IV SEMESTER B.S. (ENGG)
Material Science and Metallurgy [ME 245]

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

Answer 5 out of 8 questions.

Missing data, if any, may be suitably assumed.

1)	A)	Draw the neat sketch of and BCC unit cell and show for a BCC unit cell atomic packing factor is 0.68.	(8)
	B)	How do you determine miller indices for planes and directions?	(6)
	C)	What is burgers vector? Draw the burger's circuit on edge and screw dislocations.	(6)
2)	A)	With necessary sketches explain the mechanism of solidification of metals and alloys.	(10)
	B)	Explain homogeneous and heterogeneous nucleation with necessary sketches. Highlight the differences.	(10)
3)	A)	Write the application of Lever Rule on Isomorphous and Eutectic phase diagrams.	(10)
	B)	What are solid solutions? Explain different types of solid solutions.	(10)
4)	A)	Explain the construction procedure of phase diagram of binary Isomorphous system.	(10)
	B)	Write schematic phase diagrams, reactions, cooling curves and microstructure at salient locations for Eutectic , Eutectoid , Peritectic invariant systems.	(10)
5)	A)	Metals A and B are mutually soluble in the liquid state and partly soluble in the solid state. A liquid phase alloy containing approximately 40% B completely transforms into a mixture of two solid solutions at 500^{o}C. Maximum solubility of B in A and A in B are 10% and 20% respectively at 500^{o}C, 5% and 10% respectively at 100^{o}C. Melting temperatures of metal A and metal B are 800^{o}C and 1000^{o}C respectively. Assuming the solubility curves to be linear, draw phase diagram to scale and label the regions. For	(10)

60% B alloy determine the following:
a) Weight percentage of the eutectic mixture formed.
b) Composition of the liquid phase at eutectic temperature.
c) Composition of first solid nucleated.
d) Temperature where equal proportions of liquid and solid phases exists.
e) Composition of last drop of liquid to be precipitated.

B) Neatly sketch Iron-Cementite phase diagram and mark the phases. Explain cooling sequence of 1.2%C steel with all salient points and microstructures. (10)

6) Sketch neatly TTT diagram for 0.8% carbon steel. Superimpose cooling curves of following heat treatments in it: (10)

A)
i) Annealing,
ii) Normalizing,
iii) Hardening,
iv) Austempering,
v) Martempering.

B) Explain Jominy end quench test to determine the hardenability of 1080 steel. (10)

7) Explain the theory of surface hardening treatment. Also explain Flame Hardening and Induction Hardening treatment. (10)

A)

B) Explain Low, Medium and high temperature tempering processes. (10)

8) Write short note on: (10)

A)
i) Low, Medium and High carbon steels
ii)Grey cast iron, White cast iron and Malleable iron

B) Explain the effects of following alloying elements properties of steels: Aluminium, Boron, Chromium, Manganese, Tungsten. (10)

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