Question Paper

Exam Date & Time: 20-Apr-2018 (09:30 AM - 12:30 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES FOURTH SEMESTER B.S. (ENGG) END-SEMESTER THEORY EXAMINATIONS APRIL - 2018 DATE: 20 APRIL 2018 TIME: 9:30AM TO 12:30PM Material Science and Metallurgy [ME 245]

Marks: 100

Duration: 180 mins.

Answer 5 out of 8 questions. Each question carries 10 marks Missing data, if any, may be suitably assumed

1)	A)	Explain briefly the effective number of atoms in FCC and HCP unit cells.	(10)
	B)	What is Miller Indices? Explain the procedure to sketch the miller indices of planes in a cubic cell.	(10)
2)		Sketch the following:	(10)
	A)	i. (201) ii. [210] iii. (111) iv. [111] v. (212)	
	В)	Define free energy and bound energy. Establish a relationship of free energy with temperature with respect to Degree of Super cooling.	(10)
3)	A)	Name any two important types of nucleation. List any 6 differences between them.	(10)
	B)	Explain the application of phase rule applied to single and two phase regions of a single component system.	(10)
4)	A)	What is a solid solution? Explain two types of solid solution.	(10)
	B)	With a neat sketch explain the construction procedure of simple binary phase diagram.	(10)
5)	A)	With any two cooling curves and phase diagram, explain the binary system where the components are completely soluble in liquid and partially soluble in solid state. Name the system and give one example.	(10)
	B)		(10)

Melting temperatures of pure metals 'A' & 'B' are 1000°C and 800°C respectively. The metals 'A' and 'B' are mutually soluble in the liquid state and completely insoluble in the solid state. A liquid phase alloy containing 40% A completely transforms into a mixture of two solid solutions at 600°C. Assuming the curves to be linear, draw phase diagram to scale and label the regions. For 40% B alloy determine the following:

a) Weight percentage of eutectic formed at 400 °C.

b) Weight ratio of the solid phases in the eutectic mixture

- ⁶⁾ Neatly sketch the Fe-C phase diagram and label the regions. On the diagram show any two alloys which solidifies like pure metal.
 - ^{B)} With a part of phase diagram and cooling curves, explain ⁽¹⁰⁾ the phase transformation of hypo eutectoid steel from austenite phase to room temperature phase.
- With part of phase diagram and cooling curves explain
 delta region in Fe-C binary system.
 - ^{B)} Explain the procedural steps for obtaining the TTT diagram. ⁽¹⁰⁾
- ⁸⁾ Construct the TTT diagram for 0.8% carbon steel and super $^{(10)}$ _{A)} impose the cooling curve to obtain martensitic structure.
 - ^{B)} With relevant sketches explain the standard hardenability ⁽¹⁰⁾ test for eutectoid steel.

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(10)