Question Paper

Exam Date & Time: 26-Dec-2022 (09:30 AM - 12:30 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES END SEMESTER THEORY EXAMINATION - DECEMBER 2022 III SEMESTER B.Sc (Applied Sciences) in Engg.

MATERIAL SCIENCE AND METALLURGY [IME 233 - S2]

Marks: 50

Duration: 180 mins.

Answer all the questions.

Missing data, if any, may be suitably assumed

1)	A)	What do you mean by space lattice and unit cell? Sketch HCP unit cell and find atomic packing factor.	(5)
	B)	How do you obtain miller indices for directions? Explain with examples	(2)
	C)	Name the different point defects and explain them with neat sketches.	(3)
2)	A)	What is nucleation? Explain homogeneous and heterogeneous nucleation highlighting differences.	(4)
	B)	Highlight the importance of super cooling in solidification.	(2)
	C)	Write short notes on: i) Modified Gibb's phase rule ii) Laws governing formation of substitutional solid solution.	(4)
3)	A)	Explain the construction procedure of binary Isomorphous system. Explain the application of lever rule in it.	(5)
	В)	Write phase diagrams following eutectic systems and explain: i) Completely soluble in liquid state and insoluble in solid state ii) Completely soluble in liquid state and partially soluble in solid state	(5)
4)	A)	Two metals A and B have their melting points at 1000°C and 900°C respectively. An alloy pair A and B forms a eutectic at 600°C for composition 40% B. A and B have unlimited mutual liquid solubility. Their solid solubilities are as follows: 5% B in A at 600°C and 5% B in A at 0°C ,4% A in B at 600°C and 4% A in B at 0°C Assume the liquidus, solidus and solvus lines to be straight. No solid-state reactions or any intermediate phase changes occur in the series. i)Draw the phase diagram for the series and label all salient temperatures, compositions and regions ii) Find	(5)

the freezing range and room temperature structure of an alloy of composition 30%A with respect to the number, type, amount and composition of the phases iii) Amount of eutectic and pro eutectic phases for 30%A alloy at room temperature iv) Temperature where equal proportions of liquid and solid phases exists for 30%A alloy. v)Composition of the first nucleus of 30%B alloy.

- ^{B)} Neatly sketch the Fe-C phase and label the regions. Calculate (5) proeutectoid ferrite and pearlite in 0.6% C steel.
- ⁵⁾ Write the construction procedure of the TTT diagram for 0.8% carbon steel ⁽⁴⁾ and superimpose the cooling curves of
 - ^{A)} i) Annealing

ii) Normalizing

iii) Hardening in it.

- B) List the various types of cast irons and explain their characteristics briefly. ⁽²⁾
- C) Explain the following surface hardening techniques with necessary (4) sketches: i) Flame hardening ii) Induction hardening.

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