

MANIPAL INSTITUTE OF TECHNOLOGY MANIPAL

III SEMESTER B.TECH. (MECHANICAL / I & P ENGINEERING) END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: MATERIAL SCIENCE AND METALLURGY [MME 2104]

REVISED CREDIT SYSTEM (11/ 12/ 2016)

Time: 3 Hours

MAX. MARKS: 50

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Instructions to Candidates:

✤ Answer ALL the questions.

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- Missing data may be suitably assumed.
- **1A.** State and explain the conditions favorable for the formation of different type of solid solutions.
- **1B.** Show that the packing factor of an ideal HCP structure is 0.74. Also write the coordination number for HCP unit cell.
- **1C.** Why bainite and martensite phases are not observed in Iron carbon phase diagram? Explain about how these phases are formed in steel.
- 2A. Neatly sketch labelled Iron-Cementite phase diagram. Write the structure and name the solid solution nucleus formed during the solidification of 3% Carbon –Iron alloy on equilibrium cooling.
- **2B.** Explain: i) Tempering ii) Nitriding (iii) Flame hardening treatments

2C. Explain the following:

- i) Solid to solid state transformation reactions are always heterogeneous in nature.
- ii) Solidification will not take place without degree of super cooling.
- 3A. Explain the procedural steps for drawing the binary phase diagram where the components show complete liquid and solid solubility and also draw the labeled diagram for the same.
- 3B. Sketch neatly the Isothermal Transformation diagram for Eutectoid steel. Label all the salient features on it. Superimpose on it a cooling curve to obtain conventional hardened structure.

- **3C.** Name the cubic unit cell with maximum packing factor. Also mention the coordination number and effective number of atoms in it.
- 4A. The melting temperatures of pure metals A & B are respectively 1000°C and 800°C. An alloy of 30% A solidifies isothermally at 500°C. A & B are having complete liquid and partial solid solubilities. The maximum solubility of B in A is 20% and that of A in B is 10%. The solubility of B in A at 100°C is 10% and solubility of A in B at 100°C is 5%. Name and draw the phase diagram for the above binary alloy system to a suitable scale assuming all solubility lines to be linear.

For an alloy of 40% A, draw the schematic cooling curve and determine the following:

- (i) The temperature at which the alloy has equal proportions of liquid and solid phases.
- (ii) Weight of the eutectic mixture formed in the 3 Kg alloy sample.

4B.	Explain with a neat sketch, the procedure to plot the hardenability curves for eutectoid steel in End Quench Test.	4
4C.	What are Miller Indices? Sketch the following: i) (2 0 5) ii) [5 0 4]	2
5A.	With the part of phase diagram and any two cooling curves briefly explain the phase transformation of steel from austenite to room temperature phases on cooling.	4
5B.	With the help of temperature and time curve explain the homogeneous solidification process in pure metals emphasizing the steps involved in the process.	4
5C.	Write short notes on:	2

i) Plain carbon steel ii) Brass

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