Reg. No.

# A Constituent Institute of Manipal University, Manipal

# III SEMESTER B.TECH (MECHANICAL/IP ENGG.) END SEMESTER EXAMINATIONS, NOV/DEC 2017

## SUBJECT: MATERIAL SCIENCE & METALLURGY – MME 2104

#### Time: 3 Hours

MAX. MARKS: 50

2

5

3

### Instructions to Candidates:

- ✤ Answer ALL the questions.
- Missing data may be suitably assumed.
- ✤ Use Graph sheets if required.
- 1 (A) Neatly sketch labelled Fe-Carbon equilibrium diagram. Name the alloy nucleus formed and write its crystal structure during the solidification of 2.5% carbon cast 5 iron on equilibrium cooling.
- 1 (B) With a part of phase diagram and cooling curve explain the phase transformation of hypoeutectoid steel from austenite to room temperature structure.3
- 1 (C) Write short notes on White cast iron and Free machining steel.
- 2 (A) The approximate melting temperatures of pure metals A & B are respectively 1800°C and 1200°C. An alloy of 40%A solidifies isothermally at 900°C. A & B are having complete liquid and partial solid solubilities. The maximum solubility of B in A is 15% and that of A in B is 10% at 900°C. The solubility of B in A is 10% and solubility of A in B is 5% at 500°C. Name the binary alloy system and draw the phase diagram to a suitable scale assuming all solubility lines to be linear. For an alloy of 30% B, 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 5kg alloy sample.
- 2 (B) With temperature versus time curve briefly explain the steps involved in 3 homogeneous phase transformation process from liquid to solid phase.
- 2 (C) Differentiate hardening and normalizing treatments with respect to purpose, resulting 2 structure, cooling rate and heat treatment temperature range.
- 3 (A) What is hardenability? With relevant sketches explain the End Quench test for hardenability.5
- 3 (B) Show the following Miller Indices. i) [104] ii) (412) iii) (230)
- 3 (C) "Imperfections in metal is not always deficiency for performance. It may be boon in some occasions." Explain the statement.

4 (A)	Briefly write the construction procedure of TTT diagram for eutectoid steel and sketch the labelled diagram. On the diagram superimpose critical cooling rate (CCR).	5
4 (B)	Sketch neatly BCC and FCC unit cells and mention the coordination number and	2
	packing factor in both unit cells. Why FCC metal is more ductile? Explain.	3
4 (C)	Define Gibb's phase rule and show that degrees of freedom is zero during the	
	peritectic reaction.	2
5 (A)	Explain the following	
	i) Brass ii) Flame Hardening iii) Nitriding	5
5 (B)	With phase diagram and any one cooling curve, explain the binary system where the	
	components show complete liquid and solid solubilities. Name the system.	3
5 (C)	Differentiate between interstitial and substitutional solid solutions. Give one example	
	to each category.	2