

25

Ex/ME/T/316/2017(OLD)(S)

**B. MECHANICAL 3<sup>RD</sup> YR 1<sup>ST</sup>. SEM. SUPPLE EXAM. -2017(OLD)  
MATERIALS AND METALLOGRAPHY (OLD)**

Time: Three hours

Full Marks: 100

Answer *any five* questions.

Sketches should be drawn by pencil only.

1. a) Differentiate among a space lattice and a crystal. 0
- b) Copper is FCC and has an atomic diameter of 2.556 Å. Calculate the lattice parameter of copper.
- c) Why FCC metals are in general more ductile than BCC and HCP metals.
- d) The lattice parameter of iron (BCC) is 2.87 Å. Find the number of atoms/cm<sup>2</sup> on the plane (111). 0  
5+5+5+5=20

2. a) Draw the following crystallographic planes in the cubic unit cells

(111), (101), (123)

- b) Derive an equation for finding out the critical size of a nucleus.

[ Turn over

[ 2 ]

- c) Calculate the radius of the largest interstitial void in  $\gamma$ -iron lattice.
- d) Find out atomic packing factor for FCC unit cells.  $6+6+4+4=20$

3. a) From the data given below for  $B_i - C_d$  system, plot the equilibrium diagram to scale and find:

i) Amount of eutectic in 20%  $C_d$  alloy and

ii) Free  $C_d$  in 70%  $C_d$  alloy. Given:

Melting temperature of  $B_i = 271^\circ\text{C}$

Melting temperature of  $C_d = 31^\circ\text{C}$

Eutectic temperature =  $144^\circ\text{C}$

Eutectic composition = 39.7%  $C_d$

b) What is a solid solution?

c) What is coring? Which alloys show cored structures and under what conditions?

$10+5+5=20$

4. a) Draw the iron-iron carbide equilibrium phase diagram according to scale and label it.

b) A 0.4% C hypoeutectoid steel is slowly cooled from  $940^\circ\text{C}$  to a temperature just slightly above  $723^\circ\text{C}$ , calculate

[ 3 ]

- i) the weight percent austenite present in the steel
- ii) the weight percent pro eutectoid ferrite present in the steel.

12+8=20

5. a) Describe the factors which control graphitization in cast iron.

b) Describe the following cast irons:

- i) Malleable cast iron
- ii) Nodular cast iron.

c) Explain why pearlite becomes finer when steel is cooled more rapidly than the equilibrium rate.

5+10+5=20

6. a) Explain the terms recrystallization and grain growth.

b) What is spheroidising ? State its purpose.

c) Differentiate between Annealing and Normalising.

6+7+7=20

7. a) With a neat sketch describe Martempering and Austempering process.

b) What is carburizing? Why it is done? Is it necessary to harden and temper the components after carburizing? If yes, why?

c) Define the critical cooling rate of an eutectoid steel and show the same on a T-T-T diagram.

8+5+7=20

[ Turn over

[ 4 ]

8. Write short notes on: (*any four*)

- i) Metal Ingot structure
- ii) Slip and Twinning
- iii) Hardness and Hardenability
- iv) Eutectic and Eutectoid reaction
- v) High speed steel
- vi) Hume-Rothery rules
- vii) Lever Rule
- Viii) Hotworking and cold working.

---

5x4=20