

This question paper contains 3 printed pages.

3260

Your Roll No.

B. Tech. (M) / I

J

Paper V—METALLURGY

(EME-105)

Time : 3 hours

Maximum Marks : 70

*(Write your Roll No. on the top immediately
on receipt of this question paper.)*

Attempt any five questions.

All questions carry equal marks.

Assume any suitable data, if needed.

1. (a) Iron changes from BCC to FCC at 910°C . At this temperature the atomic radii of the iron atoms in the two structures are 1.258 \AA and 1.292 \AA respectively. (a) What is the percent of volume change as the structure changes? (b) What is the percentage of change in linear dimension C? What is the density of the iron in BCC structure and FCC structure if the atomic weight of iron is 55.845? Assume that the Avogadro's number (N_A) is 6.023×10^{23} atoms/mol. 7
- (b) Explain the arrangement of atoms in BCC, FCC and HCP lattices. Calculate the size of interstitial atoms in terms of lattice parameters which can be easily accommodated in FCC and BCC structure. 7

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2. (a) Discuss the effect of structure on the mechanical properties of the materials. 7
- (b) Explain the defects in crystals with suitable sketches. 7
3. (a) (i) Consider a single crystal of BCC iron oriented such that a tensile stress is applied along $[010]$ direction.
- (ii) Compute the resolved shear stress along a (110) plane and in a $[\bar{1}11]$ direction, when a tensile stress of 50 Mpa is applied.
- (iii) If a slip occurs on a (110) plane and in a $[\bar{1}11]$ direction, and the critical resolved shear stress is 30 Mpa, calculate the magnitude of the applied tensile stress necessary to initiate yielding. 7
- (b) Write a detailed note on Ductile fracture and Brittle fracture. 7
4. Draw Iron-Iron carbide phase diagram. Explain the microstructure with the help of a diagram and the mechanical characteristics of each of the following micro-constituents found in steels:
- Coarse pearlite, ferrite, bainite and tempered martensite. Explain the correspondence between each micro-structure and resulting mechanical characteristics. 14

5. What are the effects of impurities in plain carbon steels? Discuss the purpose and influence of the alloying elements in steels. Give an account of the composition, heat treatment, properties and uses of a typical wear resisting steel. 14
6. Discuss the purpose and effects produced by heat treatment in metals and alloys. Explain in brief.
- (i) Surface hardening
 - (ii) Age hardening
 - (iii) Quench hardening. 14
7. (a) Discuss the steps involved in the production of a component by Powder Metallurgy. What are the applications, advantages and limitations of this technique? 7
- (b) Distinguish between Brasses and Bronzes. Write the composition, properties and uses of various types of Bronzes. 7
8. Define corrosion. Explain how corrosion could be prevented in iron and steel. Explain surface treatment of steels. 14