

CS/B.TECH/ME/PE/PWE/AUE/ODD SEM/SEM-3/ME-303/2016-17



**MAULANA ABUL KALAM AZAD UNIVERSITY OF  
TECHNOLOGY, WEST BENGAL**  
Paper Code : ME-303  
**ENGINEERING MATERIALS**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own  
words as far as practicable.*

**GROUP - A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any ten of the following : 10 × 1 = 10

- i) The word 'ceramic' meant for
  - a) soft material      b) hard material
  - c) burnt material      d) dry material.
- ii) Which of the following alloying elements is essential in manufacturing HSS ?
  - a) Silicon      b) Tungsten
  - c) Cobalt      d) Nickel.
- iii) Ductility is measured in terms of
  - a) UTS      b) % Elongation
  - c) Yield strength      d) Toughness.
- iv) Globular form of cementite in the structure of steel is obtained through
  - a) Normalizing      b) Malleabilising
  - c) Spheroidizing      d) Carbonizing.

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- v) TTT diagram indicates time and temperature transformation of
  - a) Cementite      b) Pearlite
  - c) Ferrite      d) Austenite.
- vi) Martensite is a super-saturated solution of carbon in
  - a) Alpha iron      b) Beta iron
  - c) Gamma iron      d) Delta iron.
- vii) The ( c/a ) ratio for an ideal HCP crystal is
  - a) 1.366      b) 1.633
  - c) 1.636      d) 1.363.
- viii) In the case of BCC crystal, the distance between two nearest neighbouring atoms is
  - a)  $\sqrt{3} \cdot a/2$       b)  $2a$
  - c)  $2a/\sqrt{3}$       d)  $\sqrt{3} a$ .
- ix) Grain boundary is an example of ..... imperfection.
  - a) Point      b) Volume
  - c) Line      d) Surface.
- x) In case of CRSS of a material shear stress is minimum when the angle between slip plane and tensile force direction is
  - a)  $0^\circ$       b)  $45^\circ$
  - c)  $60^\circ$       d)  $90^\circ$ .
- xi) Which one of the following is an austenite stabilizer ?
  - a) W      b) Au
  - c) Cr      d) Co.
- xii) Mathematical form of phase rule for a two-component binary solid solution is
  - a)  $F = 1 - P$       b)  $F = 4 - P$
  - c)  $F = 3 - P$       d)  $F = 2 - P$ .

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**GROUP - B**

**( Short Answer Type Questions )**

Answer any *three* of the following.  $3 \times 5 = 15$

2. Calculate the atomic packing factor of face centre cubic structure.
3. What is called solid solution ? State the conditions necessary to form substitutional solid solution.
4. Define plain carbon steel and alloy steel. State the demerits of plain carbon steel.  $2 + 3$
5. Determine the Young's modulus of a composite containing 65 volume % of glass fibre ( $E_f = 70 \text{ GN/m}^2$ ) in a matrix of epoxy resin ( $E_m = 3 \text{ GPa}$ ) under isostress condition.
6. Define heat treatment and explain its objectives. State how temper brittleness can be avoided.  $3 + 2$

**GROUP - C**

**( Long Answer Type Questions )**

Answer any *three* of the following.  $3 \times 15 = 45$

7. a) Explain Schottky defect in a lattice. State two reasons for increase of vacancies with respect to their equilibrium concentration in a metal.  $5 + 2$
- b) Discuss about mixed dislocation. Why edge dislocation can climb and it cannot cross-slip ?  $4 + 4$
8. a) Explain with neat sketch the Fe-Fe<sub>3</sub>C phase equilibrium diagram. Write the invariant point reactions of that diagram.  $7 + 6$
- b) Find the degree of freedom with Gibbs' phase Rule at (i) melting temperature of pure iron, and (ii) any point in *hypoeutectic iron* region below 727°C temperature.  $2$

9. a) Define composite material. Write the classification of composite materials.  $2 + 4$
- b) Derive the modulus of elasticity when load applied in transverse direction to the alignment of fiber in the composite material.  $6$
- c) A continuous and aligned glass fiber - reinforced composite consists of 60 volume % of resin having modulus of elasticity 3.4GPa and remaining volume % of glass fibers display 69GPa modulus of elasticity. Calculate the modulus of elasticity of the composite when force is applied in longitudinal direction of fiber alignment.  $3$
10. a) Define true stress and true strain. Show how the true stress and true strain affect the stress-strain behavior of a ductile material and justify it.  $5$
- b) Write the comparison between (i) Brinell hardness testing with Rockwell hardness testing. (ii) Charpy impact testing with Izod impact testing.  $6$
- c) A 12.5 mm diameter bar was subjected to under a load of 2500 kg-force, by which length of the bar transformed from 50 mm to 65 mm ? Calculate the *True stress* on the bar in MPa and ductility in % of reduced cross-sectional area.  $4$
11. a) Draw the Time-Temperature-Transformation diagram of steel. Show the cooling curves indicating the transformation of (i) 50% Bainite + 50% Martensite. (ii) 100% Pearlite in that TTT diagram.  $6 + 2$
- b) Differentiate between (i) Normalizing and Annealing. (ii) Hardening and Tempering.  $6$
- c) What is Austenization ?  $1$