Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(AUE)(O)/SEM-5/AUE-503/2012-13

2012

MATERIAL SCIENCE AND TECHNOLOGY

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 of the following : 10 × 1 = 10

   i) An elastic or viscoelastic deformation mainly occur in the

      a) Ceramic material b) Polymer material

      c) Composite material d) Nano-material.

   ii) Which type of material is used in space shuttle nose cone tiles application during reentry ?

      a) Polymer matrix composite

      b) Metal matrix composite

      c) Ceramic matrix composite

      d) Ceramic material.

iii) What is the value of fracture toughness for ceramic material ?

a) 1 to 5 MPa-$m^{\frac{1}{2}}$ b) 5 to 17 Mpa-$m^{\frac{1}{2}}$

c) 17 to 19 MPa-$m^{\frac{1}{2}}$ d) – 1 to – 8 MPa-$m^{\frac{1}{2}}$.

iv) What is the value of Young's modulus for Steel ?

a) 20 GPa b) 110 GPa

c) 97 GPa d) 304 GPa.

v) In which material cup and cone type fracture occur ?

a) Ductile material b) Brittle material

c) Nano-material d) None of these.

vi) Steel having more than 0·8% carbon is called

a) Hypo-eutectic steel b) Hyper-eutectoid steel

c) Hypo-eutectoid steel d) Hyper-eutectic steel.

vii) Main objective for addition of Tungsten in steel is to get

a) Good machinability

b) High temperature strength

c) Corrosion resistance

d) Grain refinement.

viii) For Hardening by quenching the rate of cooling should be ..... critical cooling rate.

a) half of b) more than

c) less than d) none of these.

ix) Which is the hardest out of the following ?

a) Austenite b) Pearlite

c) Ferrite d) Cementite.

x) Which of the following is not true in case of white cast iron ?

a) Whitish in colour b) It is strong

c) It is hard d) It is brittle.

e) It is malleable

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Give the classification of engineering material. Draw stress-strain diagram of various engineering material. Discuss about the elastic deformation of engineering material. 1 + 2 + 2

3. Give the definition of creep. Draw the engineering creep curve and give all the creep equations. Discuss various steps about creep in the engineering material. 1 + 2 + 2

4. Define the term "corrosion of metals". Write down the surface treatments done to prevent corrosion of steel. 2 + 3

5. Write down the materials used to manufacture the automobile crank shaft, cylinder head, pistons, transmission gears, engine valve and briefly justify the reasons. 5

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

6. a) Give definition of composite material. Give the classification of composite material. What are the functions of matrix and reinforced in composite material ?

b) Discuss about the fabrication techniques of composite material.

c) A continuous and aligned glass fibre reinforced composite consists of 40% (vol %) of glass fibres having a modulus of elasticity of 69 GPa and 60% (vol %) of a polyester resin that, when hardened, displays a modulus of 3·4 GPa. Compute the modulus of elasticity of this composite. 1 + 2 + 2 + 6 + 4

7. a) Give the definition of fracture and fracture toughness. Give all the equations with diagram about distribution of stress in vicinity of crack tip.

b) Discuss about the fracture mechanism and draw all the samples or specimen figures in the impact fracture toughness test.

c) The fracture toughness of a steel bears relation with CVN as follows : $K_{IC} = 14 \cdot 5(\text{CVN})^{0 \cdot 5}$ where K_{IC} and CVN are in units of MPa-m$^{\frac{1}{2}}$ and joule respectively. Reduction in sulphur content from 0·05 to 0·005% in medium carbon steel improves the Charpy impact energy from 45 to 100 joule. What would be the percentage improvement in fracture toughness of the material ? 3 + 2 + 3 + 2 + 5

8. Draw the Iron-Carbon equilibrium diagram and mark all the phases. Differentiate between Iron-Carbon equilibrium diagram and TTT-diagram. Write down the steps involved to prepare a TTT-diagram of a steel. 5 + 5 + 5

9. What is heat-treatment process ? Write down the classification of both volume and surface heat-treatment processes. What is the objective of annealing ? Draw the heat-treatment cycle diagram for Iso-thermal annealing of steel. 2 + 8 + 3 + 2