



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 : $10 \times 1 = 10$
 - 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. $3 \times 5 = 15$

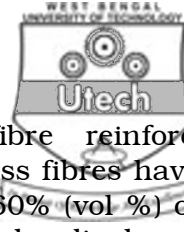
2. Give the classification of engineering material. Draw stress-strain diagram of various engineering material. Discuss about the elastic deformation of engineering material.
 $1 + 2 + 2$
3. Give the definition of creep. Draw the engineering creep curve and give all the creep equations. Discuss various 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. $3 \times 15 = 45$

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 : $K_{IC} = 14 \cdot 5(\text{CVN})^{0.5}$ where K_{IC} and $\frac{1}{2}$ CVN are in units of $\text{MPa-m}^{\frac{1}{2}}$ 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
