



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS / B.TECH(CHE-OLD) / SEM-4 / CHE-403 / 2012**

**2012**

**MATERIAL SCIENCE & 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 for any *ten* of the following :

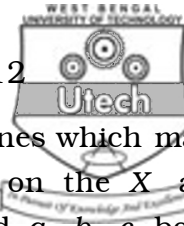
10 × 1 = 10

i) Corrosion resistance of stainless steel is due to

- |              |              |
|--------------|--------------|
| a) Manganese | b) Nickel    |
| c) Carbon    | d) Chromium. |

ii) If the first reflection from an FCC crystal has a Bragg angle  $21.5^\circ$ , then the second reflection will have the angle of

- |                 |                   |
|-----------------|-------------------|
| a) $18.5^\circ$ | b) $25^\circ$     |
| c) $31.2^\circ$ | d) $36.8^\circ$ . |



- iii) The Miller indices of a set of parallel planes which make intercepts in the ratio of  $4a : 3b$  on the X and Y axes and parallel to the Z-axis and  $a, b, c$  being primitive vectors of the lattice are
- a) 2, 3, 1                      b) 3, 4, 0  
c) 4, 3, 0                      d) 3, 0, 4.
- iv) The reaction that on heating one solid phase, yields another solid phase and one liquid phase is called
- a) eutectic                      b) peritectic  
c) eutectoid                      d) peritectoid.
- v) At the equilibrium separation distance for an ion pair interionic force will be
- a) zero                      b) minimum  
c) maximum                      d) any value.
- vi) For rhombohedral crystal structure the relation between the lattice constants  $a, b, c$  and angle  $\alpha, \beta, \gamma$  is
- a)  $a = b = c$  and  $\alpha = \beta = \gamma \neq 90^\circ$   
b)  $a \neq b \neq c$  and  $\alpha = \beta = \gamma = 90^\circ$   
c)  $a = b \neq c$  and  $\alpha = \beta = 90^\circ$   
d)  $a = b = c$  and  $\alpha = \beta = \gamma = 90^\circ$
- vii) How many atoms are there per unit cell in a face centred cubic lattice ?
- a) 2                      b) 3  
c) 4                      d) 6.
- viii) Creep is not exhibited at low temperature by
- a) rubber                      b) acrylics  
c) lead                      d) plastics.



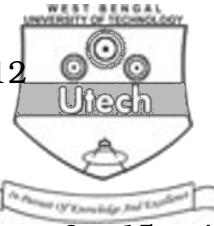
- ix) Martensite start temperature in TTT diagram increases with increasing concentration of
- |             |            |
|-------------|------------|
| a) Carbon   | b) Cobalt  |
| c) Chromium | d) Nickel. |
- x) Dislocation are sometimes called
- |                         |                         |
|-------------------------|-------------------------|
| a) point imperfection   | b) line imperfection    |
| c) surface imperfection | d) volume imperfection. |
- xi) An alloy of aluminium is
- |                    |           |
|--------------------|-----------|
| a) Stainless steel | b) Bronze |
| c) Magnesium       | d) Brass. |
- xii) Carbon content of steel is
- |             |                   |
|-------------|-------------------|
| a) 0.1 – 2% | b) 4 – 6%         |
| c) 2 – 4%   | d) 0.001 – 0.01%. |

### GROUP – B

#### ( Short Answer Type Questions )

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

2. Define atomic packing factor ( APF ). Prove that APF for FCC crystal structure is greater than that of the BCC crystal structure. 2 + 3
3. Write short notes on TTT diagram.
4. Define plastic deformation of a material. Define strength and toughness. 1 + 4
5. Write short notes on slip and twinning mechanism.
6. What is creep ? Describe the mechanism of creep. 1 + 4



**GROUP – C**

**( Long Answer Type Questions )**

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

7. a) What is dislocation in a material ? Explain different types of dislocations observed in the material. 1 + 4  
b) Define edge and screw dislocation. 4  
c) Mention salient points of the metastable iron-carbon equilibrium diagram. 6
8. a) What is the principle of hydrometallurgical process ? Give the various possible steps of hydrometallurgy. 2 + 4  
b) What are the sources of copper ? What are the steps involved in the pyrometallurgical extraction of copper ? Discuss the smelting operation during copper extraction with the help of Cu-Cu<sub>2</sub>S phase diagram. 2 + 3 + 4
9. a) Derive Bragg's law of X-ray diffraction. 5  
b) A KCl crystal which has FCC structure has a density of  $1.98 \times 10^3 \text{ kg/m}^3$ . Its molecular weight is 74.55. Find the distance between the adjacent atoms. 3  
c) Find APF for a HCP crystal structure. 7
10. Describe the continuous casting process of steel making.
11. Draw and label the different sections of a blast furnace plant. Briefly describe their function in production of liquid iron. 7 + 8

