Subject: Materials Science   Subject Code: PE/ES/B/T/222

Time: 3 Hr   Full Marks: 70

Part-I

1. **Chose the correct Answer of the following Questions (Any TEN)   1x10=10**

i.   Repeatable entity of a crystal structure is known as
   (a) Crystal   (b) Lattice   (c) Unit cell   (d) Miller indices

ii.   α-Iron has body-centered cubic crystal structure. How many Fe atoms are in each unit cell?
   (a) 6   (b) 4   (c) 8·   (d) 2

iii.   Atomic packing factor is
   (a) Distance between two adjacent atoms   (b) Volume fraction of atoms in cell
   (c) Projected area fraction of atoms on a plane   (d) None

iv.   Usually materials with _____ crystal structure, can be easily deformed in room temperature
   (a) FCC   (b) BCC   (c) HCP   (d) SC

v.   Dislocation is a _____ defect
   (a) Surface   (b) Point   (c) Line   (d) Volume

vi.   Most often machine components subjected to repeated load, are failed by
   (a) Buckling   (b) Creep   (c) Fatigue   (d) All

vii.   Time dependent yield is known as
   (a) Fracture   (b) Fatigue   (c) Buckling   (d) Creep

viii.   Creep rate in Secondary stage _____.
   (a) Decreases   (b) Roughly Steady   (c) Increases   (d) Sharply Increases

ix.   In a single-component condensed system, if degree of freedom is zero, maximum number of phases that can co-exist _____.
   (a) 0   (b) 1   (c) 2   (d) 3

x.   A liquid phase produces two solid phases during _____ reaction up on cooling.
   (a) Eutectic   (b) Eutectoid   (c) Peritectic   (d) Peritectoid

xi.   Weight percentage of Carbon present in Eutectoid steel
   (a) 0.008   (b) 0.08   (c) 0.8   (d) 1.8

xii.   Liquid- Solid-1 + Solid-2. This type of reaction is known as _____ reaction.
   (a) Peritectic   (b) Eutectic   (c) Peritectoid   (d) Eutectoid

Part-II

Answer the following Questions (Any FOUR)   4X10=40

2. (i) Which types of bond(s) is/are present in the following materials?
   (a) Metal, (b) Ceramic and (c) Polymer.
   (ii) What are the Miller Indices of the following points: (2, 3, 5); (-2, 1, 3).
   (iii) Show the (110) plane and [110] direction in a simple cubic system with neat sketch.
   (iv) What is dislocation? How it can be measured?   3+2+2+3

3. (i) How Resiliance and Toughness of a material can be measured from tension test?
   (ii) Calculate the Packing Fraction of FCC crystal system.
   (iii) What is Frenkel defect and schottky defect?   2+4+4

4. (i) What is DBT temperature?
   (ii) Which Hardness measuring method should be used for a large sized component?
   (iii) Explain, why tension test is not applicable for determining young modulus for small sample? Which test is preferable?
   (iv) Explain the Fracture Mechanism for Ductile Material (with neat sketch).   2+1+3+4

5. (i) A Tensile test was conducted on a mild steel specimen to Find out: (i) Yield Stress (σ_y),
   (ii) Ultimate Tensile stress (UTS) (σ_u), (iii) Fracture Stress (σ_f), (iv) Percentage of Elongation, (v) Young Modulus (E), (vi) Modulus of Resilience. The required data from the test are as follows :
   Initial Dimensions: Diameter: 12.5mm, Gauge length: 50mm.
   Final Dimensions: Diameter: 8mm, Gauge length: 62.5mm.
   Load at Yield point: 4500 kg, Maximum load: 7500, Fracture load: 5000kg.
   At a certain point within elastic limit, load 1200kg, Δl= 0.035mm.
   (ii) Why Izod and Charpy test is performed? What is the difference between these two tests?
   (iii) Differentiate between cold and hot working?   5+3+2

6. (i) Write down the ranges of Carbon (%) present in (a) Hypoeutectoid steel, (b) Hypoeutectic cast iron.
   (ii) What is Pearlite and Bainite?
   (iii) Why maximum 6.67% Carbon is dissolved in Iron- Carbon system?
   (iv) Write down the Hume Rothery Rule. Where it is the used?   2+2+2+4

7. (i) Draw the Stress-Strain Diagram of Mild Steel material and illustrate the following points:
   (a) Elastic Limit, (b) upper yield point, (c) lower yield point (d) ultimate tensile stress
   (ii) Differentiate between screw and edge dislocation.
   (iii) What is Annealing process? What are the types of Annealing?   4+2+4

8. (i) What is the Degree of Freedom (F) for two component (C) system? Only Temperature is variable in the system and three phases is present in the system?
   (ii) What is Tempering process? Write its importance.
   (iii) Why Fatigue Fracture occurred in materials? What are the precautions to avoid fatigue? What is high cycle fatigue and what is low cycle fatigue?   2+3+5

Part-III

Answer the following Questions (Any TWO)   2X10=20

9. (i) What is Curie temperature? What are the Curie Temperatures of (a) Co and (b) Ni?
(ii) Give definition with example of each type material: (a) Para-Magnetic, (b) Anti Ferro-Magnetic, (c) Ferri-Magnetic.   4+6

10. (i) What is Magnetic hysteresis?
(ii)What is difference among Hard Magnet, Soft magnet and Semi Hard Magnet?
(iii) Which properties should be taken care for design the following components of Ultra-supercritical coal generation system: (a) Superheater (b) Rotating buckets. Also mention the preferred material for above components.   3+3+4

11. (i) Write down the Mechanical Properties of CNT.
(ii) Explain the procedure of production of CNT with sketch for Chemical Vapor Deposition
(iii) Write down the limitations of Nanotubes.   3+5+2

12. (i) What is Nanofluid? How Nanofluid can be used in Automobile industry?
(ii) Write down the uses of Nanofluid in industry for Heat Transfer applications.
(iii) Write down the Difference between SWCNT and MWCNT.   3+4+3