(viii) Delta iron occurs at temperature of
(a) room temperature (b) above melting point
(c) between 1400^0C to1539^0C (d) between 910^0C to 1400^0C.

(ix) Which of the following constituents of steel is softest and least strong?
(a) austenite (b) perlite
(c) ferrite (d) cementite.

(x) The hardness of martensite in a steel is a function of
(a) C content (b) cooling rate
(c) Ni content (d) nose location.

Group - B

2. (a) What do you mean by "Miller Indices"? Explain the procedure for finding Miller Indices.

(b) Obtain the Miller Indices of a plane whose intercepts are 'a', 'b/2' and 3c on x, y and z axes respectively in a simple cubic unit cell.

6 + 6 = 12

3. (a) What do you understand by the term "point defects"? Name their types with the corresponding sketches.

(b) Mention the differences between the slip and twinning mechanism for plastic deformation of metals.

6 + 6 = 12

Group - C

4. (a) Define and explain Annealing process and state its objectives.

(b) What are the characteristic properties of tool steel.

6 + 6 = 12

5. (a) Write short notes on perlite, ledeburite and cementite.

(b) Name any two ferrous alloys mentioning their compositions, properties and applications.

6 + 6 = 12

Group - D

6. (a) Define fatigue and creep.

(b) A tensile stress is to be applied along the long axis of a cylindrical brass rod of 10 mm diameter. Determine the magnitude of the load necessary to produce a 2.4×10^{-3} mm change in diameter assuming that the deformation is entirely elastic. For brass the value for Poisson's ratio is 0.34, and the modulus of elasticity is 97GPa.

4 + 8 = 12

7. (a) Mention various factors that affect the mechanical properties of a metal.

(b) The following observations were made during a tensile test on a mild steel specimen 40mm in diameter and 200 mm long:
Elongation with 40 KN load (within limit of proportionality) δl=0.0304 mm,
Yield point load = 161 KN,
Maximum load = 242 KN,
Length of specimen at fracture = 249 mm
Determine (a) young's modulus of elasticity (b) yield point stress (c) ultimate stress and (d) percentage elongation.

6 + 6 = 12

Group - E

8. (a) Define polymerization. Differentiate between the two different types of polymerization.

(b) What are the general properties to be considered while polymeric materials are to be used?

6 + 6 = 12

9. (a) Define composite. What are the differences between alloy and composite?

(b) How corrosion can be prevented?

6 + 6 = 12

ENGINEERING MATERIALS
(MECH 2104)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The atomic diameter of an FCC crystal (lattice parameter "a") is
(a) $a\sqrt{2}/2$ (b) $a\sqrt{2}/4$ (c) $a\sqrt{3}/4$ (d) $a/2$.

(ii) Strain hardening improves
(a) static tensile strength (b) steady state creep rate
(c) fatigue life (d) none of these.

(iii) Gibbs phase rule for condensed state reaction under constant pressure is
(a) F+P = C+2 (b) F+C = P+2
(c) F+P = C+1 (d) F+1 = C+P.

(iv) If the radius of an atom in a simple cube crystal is 'r', the body diagonal of the unit cell is
(a) $r\sqrt{3}$ (b) $2r\sqrt{3}$ (c) $4r/\sqrt{3}$ (d) $3r/4$.

(v) Thermal expansion of materials arises from
(a) strong bonds (b) weak bonds
(c) thermal vibrations (d) asymmetry of potential energy.

(vi) Hydrogen bonds are stronger than
(a) vander waals bonds (b) metallic bonds
(c) ionic bonds (d) covalent bonds.

(vii) The packing efficiency of a simple cubic crystal with an interstitial atom exactly fitting at the body centre is
(a) 0.52 (b) 0.68 (c) 0.73 (d) 0.91.