U.S.N

P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Third Semester, B. E. - Mechanical Engineering

Semester End Examination; Dec. - 2014

Material Science and Metallurgy

Time: 3 hrs   *Max. Marks: 100*

Note : i) Answer **FIVE** full questions, selecting **ONE** full question from each Unit.

     ii) Assume suitably missing data if any.

Unit - I

1. a. Define the following:

   i) Co-ordination Number   ii) Atomic packing factor   iii) space lattice   10

    iv) Crystal grain   v) Grain boundary

  b. Derive relation between lattice parameter "a" and radius of atom "r" for FCC structure and Show that APF for FCC is equal to 74%.   10

2 a. List the crystal defects and explain screw dislocation with neat sketch.   10

  b. Define diffusion and explain limitation of 1st law of diffusion.   4

  c. Explain the affect of the following factors on diffusion:

   i) Temperature   ii) Atomic radius   iii) crystal structure.   6

Unit - II

3 a. Draw stress and strain curve for mild steel and explain various salient points on the curve.   10

  b. Define true stress and strain and give the corresponding equations.   4

  c. Give the procedure to evaluate stiffness of highly non-linear material.   6

4 a. Sketch and explain the procedure to draw S-N curves with help of Fatigue-testing apparatus.   10

  b. How to prevent fatigue failure of materials which do not exhibit fatigue limit   3

  c. Explain the various stages followed by the material during creep failure.   7

Unit - III

5 a. What is a solid solution and give two examples.   3

  b. Explain governing Rules of alloy formation (Hume Rothery's Rule).   7

  c. Construct a phase diagram for copper-Nickel system melting point of copper is 1080ºC and Nickel is 1450ºC. The table below shows liquidus and solidus temperature for various alloy composition.   10

Alloy Composition	Solidus Temperature	Liquidus temperature
20% Cu	1090°C	1200 °C
40% Cu	1120 °C	1280 °C
60% Cu	1200 °C	1350 °C
80% Cu	1300 °C	1400 °C

Determine the following for an alloy composition of 70% copper and 30% Nickel.

i) Estimate range of temperature for phase transformation.

ii) Presence of liquid phase and solid phase at a temperature of 1200°C.

6 a. Draw Iron-Carbon equilibrium diagram and label different phases present and also explain Invariant reactions.   10

  b. Explain steps involved in construction of TTT diagram for Hypo eutectoid steel.   10

Unit - IV

7 a. Explain full annealing heat treatment process with respect to aim, phase transformations and applications with help of temperature and percentage of carbon diagram..   10

  b. What is surface hardening and explain any one method of surface hardening.   10

8 a. Define hardenability. Explain joming-End-Quench test.   10

  b. Describe age hardening of Al and Cu alloys.   10

Unit - V

9 a. Write short notes on:

    i) Galvanic Cell   ii) Electrode Potentials   20

    iii) Cathodic Protection   iv) Stress corrosion cracking.

10 Write short notes on:

    i) High Carbon steel   ii) Gray cast Iron   20

    iii) Aluminium and its alloys   iv) Copper and its alloys.

∗ ∗ ∗ ∗ ∗