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. - 2015
Material Science and Metallurgy

Time: 3 hrs   Max. Marks: 100

Note: i) *Answer any **FIVE** full questions, selecting **ONE** full question from each **unit**.*
ii) *Assume suitably missing data if required.*

UNIT - I

1 a. Explain following terms,

   i) Unit cell   ii) Space lattice   iii) Co-ordination number   10

   iv) Atomic packing factor   v) Diffusion.

  b. Derive an expression for non steady state diffusion.   6

  c. A plate of iron is exposed to a carburizing atmosphere on one side and a decarburizing
     atmosphere on the other side at 800ºC. The diffusion is steady state and diffusion coefficient is
     of 3×10^{-11} m^2/s at this temperature. Calculate the diffusion flux of carbon through the plate if   4
     the concentrations of carbon at positions of 5 and 10 mm beneath the carburizing surface are
     1.2 and 0.8 kg/m^3, respectively.

2 a. Show that Atomic packing factor for FCC is 0.74.   8

  b. Aluminium has FCC structure and an atomic radius of 0.143 nm. Calculate the volume of its
     unit cell in meters.   4

  c. Steel initially has a uniform carbon concentration of 0.25 wt% and is to be treated at 950ºC. If
     the concentration of carbon at surface is suddenly brought to and maintained at 1.2 wt%, how
     long will it take to achieve a carbon content of 0.80 wt% at a position 0.5 mm below surface?
     The diffusion coefficient for carbon in iron at this temperature is 1.6×10^{-11} m^2/s.

     Table show Error function values   8

Z	erf (z)
0.35	0.3794
0.40	0.4284

UNIT - II

3 a. Draw stress – strain diagram for ductile material and explain the salient points.   8

  b. Define fracture toughness and give corresponding equation.   4

  c. With help of neat S – N diagram explain its significance.   8

4 a.	Draw stress – strain diagrams for both ductile and brittle material and discuss the differences.	8
b.	List factors affecting fatigue life.	4
c.	Explain various stages of creep with help of neat diagram.	8

UNIT - III

5 a.	What are solid solutions? Discuss factors governing formation of solid solution.	8
b.	Draw Iron carbon equilibrium diagram and label various phases present, temperatures and percentages of carbon on it. Also give the invariant reactions.	12
6. a.	Explain the following terms, i) Phase ii) Component iii) Liquidus iv) Solidus	8
b.	Explain the steps involved in construction of TTT diagrams for plain carbon steel.	12

UNIT - IV

7 a.	With help of phase diagram explain spheroidizing annealing process.	10
b.	With help of neat sketch explain method of obtaining Hardenability curves for steels.	10
8 a.	Mention the purpose, explain the process and give the applications of mastempering with help of phase diagram.	10
b.	Explain Age hardening of AL – CU alloys with help of phase diagram.	10

UNIT - V

9 a.	Explain cathodic protection with help of neat sketch.	8
b.	Explain the following briefly, i) Polarization ii) Passivation	8
c.	List various methods of corrosion prevention methods and explain briefly any one.	4
10 a.	Enumerate terms of the steel designation "SAE 1040".	4
b.	Give the classification of plain carbon steel and mention its applications.	6
c.	Explain copper alloys with respect to composition, properties and applications.	10

∗ ∗ ∗ ∗