

Exam.Code:0906

Sub. Code: 33302

2015

B.E. (Mechanical Engineering)

Second Semester

ASP-X03: Physics of Materials

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Part.

x-x-x

I. Attempt any five parts (2 x 5=10)

- (a) Differentiate between primitive and non-primitive unit cells.
- (b) Sketch within a cubic unit cell the following planes:
(i) $(0\bar{2}1)$ (ii) $(11\bar{2})$
- (c) What are elastomers?
- (d) What is the significance of the Hall-Petch equation?
- (e) What is/are the driving force/s behind recovery process of deformed materials?
- (f) Define temper embrittlement and describe the conditions under which it occurs in metallic materials.

Part A

- II. (a) The mutual interaction potential energy of two atoms forming a molecule is given by the expression $U(r) = \frac{-A}{r^m} + \frac{B}{r^n}$. Show that the potential energy of these two atoms is stable configuration is given by $U(r_0) = -\frac{4}{5} \left(\frac{A}{r_0^2} \right)$ for $m=2$ and $n=10$.
(b) Evaluate the planar density of (111) plane in FCC unit cell.
(c) Write a short note on fullerenes.
(4,3,3)
- III. (a) Derive Fick's 2nd law of diffusion. Discuss the factors affecting diffusion process? What are the potential applications of diffusion?
(b) How is carburization of steel accomplished? Why is this process required?
(6,4)
- IV. (a) Sketch the time-strain curve for anelastic behaviour and compare it with the time-strain curve in the Voigt-Kelvin element. What do you deduce from this?
(b) What are elastomers? Why they are able to sustain very large strains?
(7,3)

P.T.O.

(2)

Part B

- V. (a) How do you strengthen a metal using solid solution strengthening and grain size reduction methods?
(b) Give an account of phenomena of fracture and fatigue discussing their features and factors influencing them.
(5,5)
- VI. (a) Neatly sketch the Iron-Carbon phase diagram and explain the various invariant reactions and phases that are present in it.
(b) What is Gibb's phase rule? Discuss its significance.
(7,3)
- VII. (a) Explain the heterogeneous nucleation process using free energy change. Find the critical radius, r^* for heterogeneous nucleation.
(b) Differentiate between TTT and CTT transformation diagrams.
(6,4)

X-X-X