Exam.Code:0906
Sub. Code: 6212

2063

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

1 (i) Explain why ionically bonded solids are denser than the covalently bonded solids. (2)

(ii) Differentiate between thermoplastics and thermosets. (2)

(iii) Explain steady state diffusion with an example. (2)

(iv) Why HCP metals are brittle in comparison to BCC and FCC metals. (2)

(v) Explain the difference between congruent and non-congruent transformations. (2)

Part A

2 (i) The potential energy function for the force between two atoms in a diatomic molecule is given by $U(x) = \frac{a}{x^{12}} - \frac{b}{x^6}$, where a and b are constants and x is the distance between the atoms. Determine the bond energy in terms of a and b. (4)

(ii) Give at least two differences between a) single crystal and polycrystalline material b) Tetrahedral and octahedral void. (3)

(iii) Determine the packing factor of Cesium Iodide (structurally similar to CsCl), if the radii of the cation and anion are 0.172nm and 0.227nm respectively. (3)

3 (i) In a diamond crystal, sketch the $[\bar{1}11]$ direction and find its linear density, given the lattice constant for diamond is 0.357nm. (4)

(ii) What are the various kinds of 1-dimensional and 2-dimensional defects that may be present in a crystal. (3)

(iii) Monochromatic X-rays of $\lambda = 1.51A^o$ are incident on a crystal face having an interplaner spacing of 1.61A°. Find various orders of Bragg's reflections. (3)

4 (i) At what temperature would a specimen of γ-iron have to be carburized for 2 h to produce the same diffusion result as at 900°C for 15 h. (4)

(ii) What do you understand by viscoelasticity? Discuss few applications of viscoelastic materials. (3)

(iii) How relaxation processes in materials lead to anelastic behaviour. Discuss with an example. (3)

Part B

5 (i) Discuss various microscopic phenomena that take place inside a cold worked metal, when it is heated to recover the pre-cold worked metal. (4)

(ii) A steel alloy (Elastic constant 207 GPa) to be used for a spring application must have a modulus of resilience of at least 2.07 MPa. What must be its minimum yield strength? (3)

(iii) Describe at least three methods to improve the yield strength of a pure metal. (3)

6 (i) What are the two modes of fracture? Elaborate the differences between them. (4)

(ii) What is an SN curve? Describe the manner in which tests are performed to generate SN curve. (3)

(iii) Explain the following terms: (a) terminal solid solution, (b) intermediate solid solution, and (c) intermetallic compound. (3)

7 (i) How is the microstructure of a Pb-Sn alloy of composition 40% of Sn different from the Pb-Sn alloy of composition 80% of Sn, as these are cooled from the liquid phase region to the room temperature. (4)

(ii) What is meant by the critical cooling rate? Explain with reference to the CCT diagram of a Iron-carbon alloy of Eutectoid composition. (3)

(iii) What is Martensitic transformation in an Iron-Carbon alloy. Discuss the mechanical properties of Martensite and suggest a method to improve these. (3)

[illegible] a good communicator? (10)

P.T.O.