1058

B.E., Second Semester

AS-208: Material Science (Common)

(May-2014)

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, selecting atleast two questions from each Section.

x-x-x

SECTION A

Question I

(a) The potential energy of interaction between two atoms forming a molecule is given by the expression $U(r) = -\dfrac{a}{r^m} + \dfrac{b}{r^n}$. Starting from this expression, show that the cohesive energy of the molecule can be expressed as $U_{min} = -\dfrac{a}{r_0^m}\left(1 - \dfrac{m}{n}\right)$. (4)

(b) Discuss the arrangement of atoms in different allotropes of carbon. (6)

Question II

(a) What are elastomeric materials. How do you understand this property microscopically. (5)

(b) A diffraction pattern of a cubic crystal of lattice parameter a = 3.16Å is obtained with a monochromatic x-rays of wavelength 1.54Å. The first four on this pattern were observed to have the respective values of 20.3°, 29.2°, 36.7° and 43.6°. Determine the inter-planer spacing and Miller indices of the reflecting planes. (5)

Question III

(a) Give an account of diffusion and its applications. (5)

(b) Discuss various strengthening mechanisms employed in metals subsequent to their plastic deformation. (5)

Question IV

(a) What do you understand by the term fracture. What are two different kinds of fractures and list their fingerprints. (5)

(b) Using spring dashpot model, discuss various properties associated with visco-elastic materials. (5)

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SECTION B

Question V

(a) What is thermionic emission. How does free electron theory explains it. (4)

(b) The Hall coefficient and electrical conductivity of zinc specimen is +0.3 and $1.69 \, \Omega^{-1} m^{-1}$ respectively. What is the charge carrier density and mobility of charge carriers. What do you conclude about nature of charge carriers. (3)

(c) What do you understand by the term effective mass of electron. Give its physical significance. (3)

Question VI

(a) Give a brief account of piezoelectricity and ferroelectricity. (5)

(b) How do you understand the allowed and forbidden energy bands in a linear solid using Kronig-Penny Model. (5)

Question VII

(a) Discuss the Langevin's theory of diamagnetic materials. (5)

(b) Discuss BCS theory of superconductivity. What are various characteristics of superconducting material revealed from this theory. (5)

Question VIII

(a) Derive the expression for conductivity of an extrinsic semiconductor material. (5)

(b) Discuss any two techniques of preparation of nanomaterials. (5)

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