Exam.Code:0906
Sub. Code: 33302

2055
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

Q 1. Attempt any five parts. **(2×5=10)**

(a) What do you understand by a space lattice?

(b) Discuss non stoichiometric defects with example.

(c) Discuss how diffusion takes place at the atomic level.

(d) Discuss one atomic phenomenon leading to anelasticity in metals?

(e) What is Mathiessen's rule?

(f) Explain the origin of magnetic moment in materials?

(g) Why lenses are coated with thin layers of magnesium fluoride?

(h) Why five fold symmetry is prohibited in crystals?

(i) What are the different types of luminescence observed in materials?

Part A

Q 2. (a) The attractive force between ions with unlike charges is $\frac{e^2}{4\pi\epsilon_0 r^2}$, while the repulsive force is $\frac{ce^2}{r^n}$, where r is the distance between the ions, c and n are constants. Obtain an expression for the equilibrium distance r_0 between the ions in terms of c and n. Also show that the energy required to separate the ions to an infinite distance apart is $E = \frac{e^2}{4\pi\epsilon_0 r_0}\left(1 - \frac{1}{n-1}\right)$. **(4)**

(b) Magnesium (Atomic weight 24.3g/mol) has an HCP crystal structure, a c/a ratio of 1.624, and a density of $1.74\,g/cm^3$. Compute the atomic radius for Mg. **(3)**

(c) What do you understand by reflection symmetry. Draw all planes of reflection symmetry in a cube. **(3)**

Q 3. (a) Discuss the structure, properties and applications of various polymorphic forms of carbon. **(4)**

(b) For a certain BCC crystal the (110) planes have a separation of 1.81A^o. These (110) planes are incident with X-rays of wavelength 1.54A^o. How many orders of Bragg's reflection will be there. **(3)**

(c) What is a dislocation? Discuss the differences between edge and screw dislocations. **(3)**

Q 4. (a) Discuss the structure of Hexagonal Close-Packed unit cell and obtain its packing fraction. **(4)**

(b) Explain Fick's first and second laws of diffusion. **(3)**

(c) The diffusion coefficients for Iron in Nickel at 1273K and 1473K are $9.4 \times 10^{-16} m^2/s$ and $2.4 \times 10^{-14} m^2/s$ respectively.

(i) Determine the values of D_o and the activation energy Q_d.

(ii) What is the magnitude of D at 1100°C. **(3)**

Part B

Q 5. (a) Analyze the complete stress-strain curve for a material up to the point of fracture, and provide an account of the mechanical properties that can be determined from it. **(5)**

(b) Discuss different methods used to increase the strength of metals, explaining the underlying physical principles for each. **(5)**

Q 6. (a) Discuss various factors that contribute towards electrical resistivity in (i) metals and (ii) semiconductors. **(4)**

(b) What is polarizability. Discuss different kinds of polarizations observed in a dielectric material. **(3)**

(c) Briefly explain the nature and atomic origin of diamagnetism, paramagnetism and ferromagnetism. **(3)**

Q 7. (a) Sketch and explain the BH curve (magnetic flux density vs. magnetic field strength) for diamagnetic and paramagnetic materials. How is it different from the BH curve for ferromagnetic materials? **(4)**

(b) What determines the characteristic colors of (i)metals and (ii)transparent nonmetals. **(3)**

(c) Discuss how the optical properties are exploited to realise lasing action of Ruby laser. **(3)**

x-x-x