Roll No. ..... Total Pages : 3

321405

May-2026

(Physics) B.Sc. IV SEMESTER

Basic Materials Science (PHU-218-V)

Time : 3 Hours] [Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART–A

1. (a) Define macrostructure of materials. (1.5)

(b) What is meant by point defect? (1.5)

(c) Differentiate between a primitive and a non-primitive unit cell. (1.5)

(d) Determine the nearest neighbor distance in a BCC crystal if the atomic radius is 0.15 nm. (1.5)

(e) Identify the crystal structure having atoms at cube corners and one atom at body center. Calculate the number of atoms per unit cell. (1.5)

(f) Name the four primary bonds. (1.5)

(g) What is nucleation in phase transformation? (1.5)

(h) What is the Burgers vector, and how does it relate to dislocations? (1.5)

(i) What is a solid solution? Give two examples. (1.5)

(j) Define diffusion coefficient. (1.5)

PART–B

2. (a) Explain Bravais lattices and classify crystal systems with suitable examples. (10)

(b) A BCC crystal has atomic radius 0.13 nm. Calculate its lattice parameter. (5)

3. (a) Distinguish between edge and screw dislocations. Explain their role in plastic deformation. (8)

(b) Explain binary phase diagrams and discuss the significance of the eutectic reaction. (7)

4. (a) Explain Schottky and Frenkel defects with suitable examples, and discuss their effects on material properties. (7)

(b) An alloy consists of 50% component A. Using the lever rule, calculate the fraction of α and β phases. (4)

(c) The atomic mass of copper is 63.5 g/mol and its density is 8.96 g/cm^3. Calculate the lattice constant assuming FCC structure. (4)

5. (a) State and derive Fick's First Law of diffusion. Mention its physical significance. (7)

(b) Differentiate between homogeneous and heterogeneous nucleation. (4)

(c) A concentration gradient of 6×10^4 atoms/m^4 exists in a material with diffusion coefficient 2×10^{-11} m^2/s. Calculate the diffusion flux. (4)

6. (a) The atomic weight of iron (Fe) is 55.85 g/mol. and its atomic radius is 0.124 nm. If iron crystallizes in a BCC structure, calculate its density. (Avogadro's number $= 6.022 \times 10^{23}$ atoms/mol). (5)

(b) A material with fine grain size exhibits higher strength but lower ductility compared to the same material with coarse grains. Explain this behavior using grain boundary theory. Predict how diffusion and creep will differ in both materials. Suggest one engineering application for each case. (10)

7. Write short notes :

(a) Hume-Rothery rules and their limitations.

(b) Role of grain boundaries in diffusion.

(c) Complete Solid Miscibility. (15)
