

1059
B.E. (Mechanical Engineering) Second Semester
APH-207: Physics of Materials
(Common with ECE, IT and EEE)

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Part.

x-x-x

- Q. 1 (a) Discuss rotational symmetries of the cube.
- (b) What are different mechanisms of metallic diffusion.
- (c) Differentiate between resilience and toughness.
- (d) Discuss constant load creep behaviour of metals w.r.t. time.
- (e) Differentiate between eutectic and eutectoid transformations with examples. (5×2)

Part A

- Q. 2 (a) Show that an octahedral void in FCC crystal can be filled by sphere having radius not larger than $0.414R$, where R is the radius of the larger sphere involved in the packing of these spheres. (3)
- (b) Monochromatic X-rays of $\lambda = 1.51\text{\AA}$ are incident on a crystal face having an interplaner spacing of 1.61\AA . Find various orders of Bragg's reflections. (3)
- (c) Discuss the structure of $BaTiO_3$. Also find an expression for its packing fraction. (4)
- Q. 3 (a) Discuss various point defects found in ceramics. (3)
- (b) Discuss three factors responsible for promoting non crystallinity in long chain polymers. (3)
- (c) The lattice constant a for copper is 3.61\AA . How many atoms per mm^2 are there in (110) and (111) planes of copper, which has FCC structure. (4)
- Q. 4 (a) Differentiate between elastic, anelastic and viscoelastic behavior of materials. (3)
- (b) A steel bar and an aluminium bar are each under a load of 5000N. If the cross-sectional area of the steel bar is 100 mm^2 , what must be the area of aluminium for the same elastic deformation. Given the young's moduli $E_{Al} = 71\text{ GN/m}^2$, $E_{steel} = 210\text{ GN/m}^2$. (3)
- (c) Nitrogen from a gaseous phase is to be diffused into pure iron at 675°C . If the surface concentration is maintained at 0.2 wt% N, what will be the concentration 2 mm from the surface after 25 h? The diffusion coefficient for nitrogen in iron at 675°C is $1.9 \times 10^{-11}\text{ m}^2/\text{s}$. (4)

Part B

- Q. 5 (a) Give at least three differences between a stable and an unstable crack. (3)
- (b) Discuss the processes that revert a plastically deformed metal to its precold-worked state. (3)
- (c) What is slip? With examples, explain how number of slip systems influence ductility of a metal. (4)
- Q. 6 (a) What are various modes of material failure? Discuss subtle features of each mode. (4)
- (b) Discuss the phase diagram and development of microstructure in lead-tin system. (6)
- Q. 7 (a) Explain the phenomenon of coring. Also cite undesirable consequences of coring. (3)
- (b) Describe the microstructure of fine pearlite, coarse pearlite, spheroidite, bainite and martensite. (3)
- (c) Briefly describe the simplest heat treatment procedure that would be used in converting a 0.76 wt% C steel from one microstructure to the other, as follows: (a) Martensite to spheroidite (b) Spheroidite to martensite (c) Bainite to pearlite (d) Spheroidite to pearlite (4)

x-x-x