

Roll No.

Total Pages : 3

CMDQ/D-23

5125

MATERIAL SCIENCE–I

Paper–PHY–304–C

Time allowed : 3 Hours]

[Maximum Marks : 60

Note : Attempt **five** questions in all, selecting **one** question from each unit. Question No. **1** is compulsory. All questions carry equal marks.

Compulsory Question

1. Attempt all questions: 4×3=12
- (i) What is Frank's rule? Use it to prove whether the following dislocation dissociation reaction is possible or not?
- $$\frac{a_0}{6} [\bar{1}2\bar{1}] + \frac{a_0}{6} [1\bar{1}2] \rightarrow \frac{a_0}{6} [011]$$
- (ii) What is the most preferred backscattering angle in RBS? Justify your answer.
- (iii) What are hyper and hypo eutectoid?
- (iv) What is an elastic deformation? Explain. How it is related to damping capacity of materials?

UNIT–I

2. (a) What are planar defects? Discuss in detail various types of planar defects present in crystals. Why grain boundaries are non-equilibrium defects? 7

- (b) What are dislocations? How these dislocations glide from one plane to another in crystals? Explain. 5

3. (a) In a certain crystal the Burgers vector for an edge dislocation is 2.5×10^{-10} m. Calculate the force per unit length on the dislocation when a shear stress of 350 Nm^{-2} is applied. 4

- (b) What are point defects? Discuss about various types of point defects present in crystals using a schematic diagram. 4

- (c) What are Frank and Read sources? Explain. 4

UNIT–II

4. (a) Discuss the atomic mechanism of elastic deformation and explain anisotropy of Young's modulus. 6

- (b) What do you understand by strengthening? Explain the phenomenon of work hardening and solution hardening. 6

5. (a) What do you understand by fracture in materials? Discuss Griffith theory of brittle fracture. 8

- (b) What do you understand by Schmid's law? Explain. Also discuss the significance of Schmid factor. 4

UNIT–III

6. (a) What is an equilibrium phase diagram? Draw and discuss equilibrium phase diagram for complete miscibility system. 5

- (b) What are ceramics? Discuss giving suitable examples. 3
- (c) What is martensitic transformation? How it is different from nucleation and growth mechanism? 4
- 7. (a) Draw equilibrium phase diagram for Fe-C system and discuss the two important phase transformation reactions occurring in this system. 7
- (b) What are the essential conditions for complete solid miscibility? On the basis of these conditions determine whether Cu and Au are completely miscible or not. 5

UNIT-IV

- 8. (a) What is Ion implantation? Discuss the basic components of an ion implantation system giving a suitable diagram. 6
- (b) Discuss in detail the principle of SIMS technique. 3
- (c) What is radiation damage? Discuss. 3
- 9. (a) Discuss in detail the principle of RBS? What is the significance of kinematic factor in RBS? Using RBS technique is it possible to distinguish between the isotopes of silver. Give reason for your answer. 5
- (b) Discuss the principle of ERDA and show that ratio E_2 (energy of recoiling ion) / E_0 (energy of the incident ion) depends on the two masses and the recoil angle? 7