20/03/24

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Reg. No. : .....

Name : .....

Third Semester M.Sc. Degree Examination, February 2024

Physics

Special Paper 1

PH 233 M : MATERIALS SCIENCE I

(2020 Admission onwards)

Time : 3 Hours

Max. Marks : 75

SECTION – A

Answer any **five** questions. Each question carries **3** marks.

1. What are single crystals? Give an example of single crystal.
2. Distinguish between Frenkel and Schottky defects.
3. Give the cause for formation of grain boundaries.
4. Write a note on the steps involved in the Czochralski process.
5. Briefly comment on the symmetry elements in crystals.
6. Give an account on spray pyrolysis technique.
7. What are point defects?
8. Discuss the significance of nucleation process.

(5 × 3 = 15 Marks)

P.T.O.

SECTION – B

Answer **all** questions. Each question carries **15** marks.

9. (a) Explain the process of diffusion in solids.
   (b) Briefly explain the temperature dependence of diffusion coefficient.

OR

10. (a) Discuss the functional classification of materials with suitable examples.
    (b) Explain strong excitonic confinement.

11. (a) Explain the classical theory of nucleation.
    (b) Discuss homogeneous formation of 3D nuclei.

OR

12. (a) Discuss the kinetics of growth of thin films.
    (b) Brief the mechanism and control for nanostructures in 0 and 1 dimensions.

13. (a) With a neat diagram, explain molecular beam epitaxy.
    (b) What are the applications of molecular beam epitaxy?

OR

14. (a) Explain plasma enhanced chemical vapor deposition (CVD) process.
    (b) With a neat diagram, explain plasma enhanced chemical vapor deposition (PECVD) reactors.

(3 × 15 = 45 Marks)

SECTION – C

Answer any **three** of the following questions. Each question carries **5** marks.

15. Using the temperature Vs solute concentration graph, explain supersaturation.

16. Solve Fick's second law $\frac{\partial C}{\partial t} = D\frac{\partial^2 C}{\partial x^2}$ using suitable conditions.

17. Show schematic diagram of different stages of film growth.

18. If Boron is diffused into a slice of pure silicon at 1100°C for 2h, what is the depth below the surface at which concentration is 10^7 atoms/cm^3, if surface concentration is 10^{18} atoms/cm^3. Diffusion coefficient of boron into silicon is 4×10^{-3} cm^2/s and $erf(1.2) = 0.9$.

19. A steel rod has uniform concentration of 0.25 wt% carbon. One end of the rod is kept in contact with an atmosphere of carbon concentration of 1.20 wt%. The rod is heated to 950°C. What will be the concentration of carbon at a depth of 0.50 mm after a time interval of 7h? Diffusion coefficient of carbon in steel at 950°C is 1.6×10^{-11} m^2/s.

20. Using suitable diagram, explain Bridgmann method of crystal growth. Mention its advantages and disadvantages.

(3 × 5 = 15 Marks)