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M – 7122

Reg. No. :

Name :

Third Semester M.Sc. Degree Examination, March 2022

Physics

Special Paper I

PH 233 M : MATERIALS SCIENCE I

(2020 Admission)

Time : 3 Hours

Max. Marks : 75

PART – A

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

1. Briefly discuss dislocations in crystals.
2. Differentiate weak excitonic confinement and strong excitonic confinement.
3. What are the capabilities that an equipment associated with thermal Chemical vapour deposition (CVD) process should have?
4. Differentiate between heterogeneous and homogeneous nucleation.
5. What you mean by Ellipsometry?
6. How can you express the thickness variation on a coated surface using the variation in deposition?
7. What is the difference between nucleation and crystal growth?
8. What are high vacuum pumps?

(5 × 3 = 15 Marks)

P.T.O.

PART – B

Answer **three** questions. Each carries **15** marks.

9. (a) Give a brief note on types of imperfections in crystals.
(b) Discuss the significance of Line Kröger Vink notation.

OR

10. (a) Derive Fick's second law of Diffusion.
(b) What are the applications of diffusion?
11. (a) Discuss Epitaxy.
(b) Discuss the theories of epitaxial growth.

OR

12. What do you mean by nucleation? Discuss heterogeneous formation of 3D nuclei. Also express the rate of nucleation.
13. (a) With a neat diagram explain Sputter Deposition.
(b) Give a note on common types of sputter sources.

OR

14. (a) How electroplating is done? What are the requisites for successful electroplating?
(b) What are the advantages and disadvantages of electroplating technique?

(3 × 15 = 45 Marks)

PART – C

Answer **any three** questions. Each carries **5** marks.

15. In diffusion of dopant atoms from a continuous source (C_0) into semiconductor wafer was carried out for time t_1 and diffusivity D_1 . This was followed by a second drive in diffusion time t_2 with diffusivity D_2 . Show that the resulting dopant concentration profile is given by $C(x, t) = \frac{2C_0}{\pi} \sqrt{\frac{D_1 t_1}{D_2 t_2}} \exp - \frac{x^2}{4D_2 t_2}$

If the drive in diffusion is essentially that form an instantaneous surface source.

16. A steel rod has uniform concentration of 0.25wt% carbon. One end of the rod is kept in contact with an atmosphere of carbon concentration of 1.20wt%. The rod is heated to 950°C. How long will it take to get a concentration of 0.7% at depth of 0.5 mm? Diffusion coefficient of carbon in steel at 950°C is $1.6 \times 10^{-11} \text{ m}^2/\text{s}$.
17. Using suitable diagram, explain Czochralski method of crystal growth. Mention its advantages and disadvantages.
18. What is the mass percentage of sodium hydroxide in a solution that is made by dissolving 8.00g NaOH in 50.0g H₂O? Will the solution be saturated or unsaturated at 20°C?
19. The vacancy migration energy in copper is 0.8 eV. The self-diffusion coefficient at 700K and 1000K are $3.43 \times 10^{-15} \text{ m}^2/\text{s}$ and $1.65 \times 10^{-11} \text{ m}^2/\text{s}$. Determine vacancy concentration at these two temperatures.
20. Briefly explain two step theory of crystal growth with mathematical support.

(3 × 5 = 15 Marks)
