

6. (a) Explain the working principle and construction of a diffusion pump. **10**
(b) Sketch the sputtering magnetron target. **5**
7. Explain the working principle, advantages and applications of the following thin film deposition techniques : **15**
- (a) Chemical Vapour Deposition (CVD)
(b) Pulsed Laser Deposition (PLD)
(c) Molecular Beam Epitaxy (MBE)



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M. Sc. (Physics) (Fourth Semester)

Vacuum Science and Thin Film Technology

(PHP-224-V)

Time : 3 Hours]

[Maximum Marks : 75

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

Part A

1. (a) Calculate the mean free path of gas molecules if molecular diameter $d = 3 \times 10^{-10}$ m and pressure $P = 10^{-3}$ Torr at room temperature. **1.5**

- (b) A vacuum pump has a pumping speed of 200 L/s and gas load of 0.02 Torr.L/s. Calculate the operating pressure. **1.5**
- (c) Name any *two* types of vacuum pumps. **1.5**
- (d) Define pumping speed in vacuum systems. **1.5**
- (e) What is meant by leak detection in vacuum systems ? **1.5**
- (f) Write the unit of leakage in vacuum system. **1.5**
- (g) During thermal evaporation, a film thickness of 200 nm is deposited in 100 s. Calculate the deposition rate. **1.5**
- (h) Write the name of oil use in diffusion pump. **1.5**
- (i) What is Physisorption ? **1.5**
- (j) A thin film grows to 500 nm thickness in 10 minutes. Calculate the growth rate in nm/s. **1.5**

Part B

2. (a) Explain the kinetic theory of gases and derive the expression for mean free path. **10**
- (b) What is the importance of vacuum in thin film technology ? **5**
3. (a) Write a short note on Spray pyrolysis. **5**
- (b) In sputtering deposition 3×10^{16} atoms/cm² are deposited. If atomic density is 10^{23} atoms/cm³, calculate the film thickness. **10**
4. Explain the principle, construction, working and applications of the following vacuum gauges : **15**
- (a) Pirani gauge
- (b) Penning gauge
- (c) Ionization gauge.
5. (a) Define nucleation in thin film growth. **5**
- (b) Explain thermal evaporation and electron beam evaporation techniques for thin film deposition. **10**