DMM-1622
M. Sc. (Sem. IV) Examination
April / May - 2016
Physics : PH (M) - 544
(Specialization : Material Science)
(Techniques of Material Science)

Time : 3 Hours] [Total Marks : 70

Instructions :

(1) Fill up strictly the details of signs on your answer book.

Name of the Examination:
M. SC. (SEM. IV)

Name of the Subject:
PHYSICS : PH (M) - 544 (SPE. : MATER. SCI.)

Subject Code No.: 1622
Section No. (1, 2,.....) N

(2) Symbols used have their usual meaning.

(3) Figures to the right indicate full marks.

1 Write any two out of the (a), (b) and (c) below :

(a) Define vacuum. Describe the words difference in vacuum science, vacuum techniques and vacuum technology. What are importance of vacuum in modern science ?

(b) (i) Write brief history of vacuum. What are the units of vacuum connect it with history ?

(ii) The diameter of a molecule is $2 \times 10^{-8}$ cm. If the molecular density $n = 3.0 \times 10^{9}$ and the average velocity of a molecule is $10^5$ cm/sec, calculate the number of collision made by the molecule per unit time and mean free path.

(c) (i) Describe the classification of vacuum according to vacuum ranges.

(ii) Calculate the pump down time for a Vacuum vessels having capacity 2000 liter from atmospheric pressure 1 Torr to $10^{-6}$ Torr having speed 50 liter/second.
Write any two out of the (a), (b) and (c) below:

(a) Write the names component of a vacuum system and give description its. Also draw the schematic diagram of typical high vacuum system.

(b) Why diffusion pumps are known as vapor pumps? Write the principle, construction, operation and using pump fluids in diffusion pump. Also discuss difficulties with diffusion pump.

(c) (i) What are the difference between absolute and indirect gages? Classify them according to their working principles and pressure range.

(ii) Write short note on pirani gauge.

Write any two out of the (a), (b) and (c) below:

(a) (i) Explain the various types of Thin film deposition techniques. Discuss various types of PVD merits and demerits.

(ii) Draw figure and discuss various types resistive sources (Boats) and source material.

(b) What is sputtering processes? Explain with the help of neat diagram Dc glow discharge sputtering processes of thin film deposition.

(c) What is an epitaxial layer growth of thin films and why it is so important in case of multilayer semiconductor films?

Write any two out of the (a), (b) and (c):  

(a) Describe the three main steps of thin film growth process and show that thin film formation of the picture step-by-step growth process takes place via nucleation and coalescence.

(b) (i) Write short notes on quartz crystal thickness monitor.

(ii) A quartz crystal monitor indicates a change in frequency of 1600 Hz when an Aluminium film of density 2.7 gm/cm³ is deposited on its faces. Describe how such a monitor works and determine the film thickness in Å. Assuming the normal conditions for such crystals. If the quartz crystal is 0.4 mm thick and the density of quartz is 2.3 gm/cm³. Estimate the starting frequency of the oscillator.
(c) Which parameters are influence microstructure and topographical details of thin film. Also describe the schematic variation of the grain size of pure metal film as a function for substrate temperature, rate of deposition, film thickness and annealing temperature.

5 Write any two out of the (a), (b) and (c) below:

(a) Write the sources of resistivity in metallic films. Also explain Matthiessens rule and in which case it is easier to measure temperature coefficient than the resistivity.

(b) (i) Explain the quantities sheet resistance and temperature coefficient of resistance of thin films.
(ii) Calculate the sheet resistance of a square of thin film resistor material with the following properties: bulk resistivity = $10^{-1}$ Ohm-cm and film thickness = 20 μm.

(c) Write structural characterization of thin films in brief. State advantages or disadvantages of TEM over XRD techniques.