

M. Sc (Instrumentation) Examination, 2017

(1st Year, 1st Semester)

Paper-IV(T-104A)

Subject: Vacuum and Cryogenics Instrumentation

Full Marks: 50

Time: 2 Hours

Question- 10 is compulsory. Answer any four questions from Section- I, and answer any two questions from Section-II

Section-I

1. How the vacuum pumps are classified according to their nature of operation? Describe the operation of a sputter ion pump 3+4=7
2. Describe diffusion and permeation processes related to degassing in a vacuum chamber. What materials are to be used to construct a vacuum chamber and associated components for high vacuum applications? 4 + 3 = 7
3. (i) What is the compression ratio of a Rotary mechanical vacuum pump if the ultimate pressure achieved is 15 mTorr. 4
(ii) Can a combination of rotary pumps attain a vacuum level below 10^{-3} Torr? Explain your answer. 3
4. (i) Describe different flow regimes of gases. Expedite the state of flow: Laminar and turbulent. 3+1
Two vacuum conduits having a conductance of 450L/s joined in parallel are connected in series to a pipe having conductance of 500 L/s. What is the conductance of the assembly? 3
5. What is meant by throughput and pumping speed of a pump used to evacuate gas from a system? What are the unit of throughput and pumping speed? What is the relation between them? 3+2+2
6. Draw a vacuum system (a cylindrical stainless steel chamber) to be evacuated by an oil rotary pump, an oil diffusion pump and liquid nitrogen trap complete with different valves. Describe the basic operating principle. 4+3=7

Section-II

7. What is RTD? Describe with a diagram the principle of measurement of temperature by RTD 2+5=7
8. Enumerate briefly the different methods of cold production. 7
9. Liquid Nitrogen boiling at -196°C is stored in a 15 liter spherical container of dia. 32cm. The container is surrounded by a concentric spherical shell of dia. 36cm at a temperature of 30°C and the space between the two spheres is evacuated. The surfaces of the spheres facing each other are silvered and have an emissivity of 0.03. Taking latent heat of vaporization for liquid nitrogen to be 48kcal/kg, find the rate at which the nitrogen evaporates. 7
10. Short notes: (answer any four) 2x4 =8
 - (i) Choice of materials for inner and outer cryogenic vessel.
 - (ii) Peculiarity of liquid Hydrogen.
 - (ii) Permeation process
 - (iv) Difference between physisorption and chemisorption.
 - (v) Ortho - para conversion for liquid hydrogen
 - (iv) Explain superfluidity in liquid helium