Register Number:
Date:

ST. JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE-27
M.Sc. PHYSICS - IV SEMESTER
SEMESTER EXAMINATION: APRIL 2018
PH0115 – EXPERIMENTAL PHYSICS II

Time- 2 1/2 hrs **Max. Marks-70**

This paper contains 2 printed pages and no parts.

Answer any **7** questions. Each question carries **10** marks. **(7X10=70)**

1. a) Explain why the following materials are used in making specific parts of vacuum system? Also, mention their limitation.
   i) Vacuum valves are made of Brass.
   ii) Windows of viewing parts are made of Quartz.
   iii) Stainless Steel is used in making the vacuum chambers.

   b) What are baffles and why are they used in vacuum systems?

   c) What is oil required in rotary vane pump? (6+2+2)

2. Explain the principle of working of a sputter-ion pump. For operating this pump, the pressure has to be reduced to 10^{-5} Torr, why? Which pumps are used as roughing pump for the sputter ion pump? Explain in detail. (10)

3. With diagram, explain the working of Thermionic ionization gauge. Explain the limitation (both upper and lower) on the pressure range over which it works? (8+2)

4. a) A vacuum pump with pumping speed of 1500 litre/s is connected to the vacuum chamber through a tube. Tubes with following lengths are available i)200 mm with diameter 150 mm ii)300 mm with diameter 300 mm. Which one should be used and why? The conductance of the tube is given as $12.2\frac{r^3}{l}$ where r is diameter of the tube in cm and l is length of the tube in cm and C is measured in litre/s.

   b) Give a complete description of liquefaction of Helium using Joule-Thomson regenerative cooling technique with the help of a neat diagram. You can use the following data to support your description: (4+6)

Helium	Critical Temperature: 5.2K	Temperature of Inversion: 33K	Liquefaction temperature: 4.2K

5. Explain how cooling is produced by adiabatic demagnetisation of a paramagnetic salt. Thermodynamically, obtain an expression for the cooling produced and using this expression justify that it does produces cooling. Will a paramagnetic salt at room temperature show this effect? (3+6+1)

6. a) Compare the performance characteristics of Stirling and GM cryocooler.
   b) Explain the principle and working of Pulse-tube cryocooler in detail. (3+7)

7. a) Draw the schematic diagram and explain the working of a Bath Cryostat.

   b) Calculate the fall in temperature produced by adiabatic throttling process of 1 mole of oxygen when the pressure is reduced by 50 atmospheres. The initial temperature of gas is 27 ^{o} C. For oxygen C_p = 7.03 cal/mole-K, a=1.32 x 10^{12} cm^4-dyne/$mole^2$ and b=31.2 cm^3 /mole, R= 8.31 x 10^{7} erg/mole-K , 1 dyne= 10^{-5} N, 1 litre = 10^{3} cm^3 and 1 atm = 1.013 x 10^{5} N/$m^2$and J= 4.18x10^{7} erg/cal. (6+4)

8. Explain the principle and working of electron beam evaporation with diagram and discuss how it is better than the conventional resistive evaporation technique. (10)

9. Answer the following questions regarding Scanning Electron Microscope(SEM) giving reason for your answer:
   a) What coating type is preferred for carrying out compositional imaging on a conductive specimen?
   b) When analysing the topography of samples, should the accelerating voltage be low or high?
   c) Why is chilled water supplied to the scanning electron microscope?
   d) In SEM, why would resolution decrease in a backscattered electron image with increase in accelerating voltage?
   e) In secondary electron imaging which aspect of the sample will be dominant in determining the appearance of the image? (2+2+2+2+2)

10. a) In Scanning Tunnelling Microscope, the tip-sample separation is 4 to 7 Å where as in the Atomic Force Microscope it is less than 4 Å. Why?
    b) Why are the tips of cantilever in Atomic Force Microscope made up of Silicon or Silicon Nitride?
    c) Explain how the samples are imaged using Magnetic Force Microscope. Why are the tips of cantilever in Magnetic Force Microscope coated with Nickel or Cobalt? (2+2+6)