



Register Number:

DATE:

**ST. JOSEPH'S COLLEGE (AUTONOMOUS),
BANGALORE-27**

M.Sc. PHYSICS – IV SEMESTER

SEMESTER EXAMINATION – APRIL 2017

PH 0115 : EXPERIMENTAL PHYSICS

Time: 2.5 hours

Maximum Marks:70

This paper contains no parts and 2 printed pages.

Answer any 7 questions. Each question carries 10 marks.

(7X10=70)

First question is compulsory.

- a) Determine the fall in temperature of a paramagnetic salt produced by adiabatic demagnetisation when the sample initially magnetised with field B of 20,000 Gauss at temperature of 1K is demagnetised. C_B (at 1K) is 0.4 cal/g/K and Curie constant is $0.01 \text{ erg-K/g}/(\text{Oersted})^2$.

b) If the volumetric flow rate of gas is 1000 l/s at a pressure of 10^{-3} Torr, then calculate the throughput of gas.

c) Find the Reynolds number if a gas of viscosity 0.4 Ns/m^2 and relative density of 900 kg/m^3 flows through a 20mm pipe with a velocity of 2.5m/s? If the mean free path of gas is 5.1×10^{-3} cm. Calculate the Knudsen number. In which regime of gas flow is the system. Is this the regime in which the main vacuum pump works? (3+2+5)
- A paramagnetic salt obeying Curie's law is placed in a magnetic field. Obtain an expression for its final temperature in terms of Curie's constant showing that adiabatic demagnetisation of this salt will always produce cooling. (8+2)
- a) Helium II is called a superfluid. Which property of liquid Helium II supports and defies this nature? How is the dual nature explained?

b) Why does lead serve as a better regenerator material below 20K compared to copper? Explain. Why is the temperature range of cryo-refrigerators which use conventional regenerator materials limited to above 10K? Which regenerator materials are typically used in the second stage of cryo-refrigerators for further cooling to lower temperatures? Explain. (5+5)
- a) What is the difference between regenerative and recuperative heat exchangers? Give an example of each type.

- b) Explain the ideal Stirling cycle cryo-refrigerator using the PV diagram. Also, discuss the design requirements of piston and displacer based on their precise functions in this cycle. (3+7)
5. What is the difference between cryo-refrigerator and cryostat? Explain the design and working of a continuous flow cryostat. What are the advantages of this cryostat over bath cryostat? (2+7+1)
6. Explain the working of thermocouple gauge. How is Pirani gauge different from thermocouple gauge? Which out of the two is better? Give reasons in support of your answer. (5+3+2)
7. a) Explain all the design requirements of the rotor blades for efficient working of turbo molecular pump. How does the velocity of rotor blades affect the pumping speed of the pump?
b) Compare the characteristics of an oil diffusion pump and turbomolecular pump. Is there any similarity between the two pumps? (5+5)
8. a) Explain the principle of electron beam evaporation with diagram and discuss how it is better than the conventional thermal evaporation technique.
b) What are the advantages of sputtering over evaporation in thin film deposition? (7+3)
9. a) Explain how force spectroscopy is done using Atomic Force Microscope.
b) What is the principle of working of Scanning Tunnelling Microscope? Explain the two modes of operation? Which mode is better? (4+6)
10. a) What is the function of condenser lens and objective lens in Scanning Electron Microscope(SEM)?
b) Give a detailed description of the detector system used in SEM explaining how the various detectors work? What information about the sample does each detector give? Why do we need different detectors? (2+8)