Ref. No. Ex/SC/PHY/UG/DSE/TH/04/A2/2022

B. Sc. Physics Examination, 2022

(3rd Year, 2nd Semester)

Subject : Principles of Instrumentation and Measurements

Time : Two hours | Full Marks : 40

(Use Separate Answer Sheet for Each Group)

Group A

Answer any four questions

1. (a) What are the advantages and limitations of Bourdon tube pressure gauge? (3)

(b) Explain the role of compensating bulb in Pirani gauge. (2)

2. (a) If CO_2 at room temperature and at 200 atm. is suddenly released to 1 atm. Then find the final temperature? (2)

(b) What is regenerative cooling? With diagram explain the experimental arrangement of regenerative cooling. (1 + 2)

3. (a) Define Joule-Thomson coefficient. Show that in Porous-plug experiment enthalpy is constant. (1 + 2)

(b) Find the expression of Joule-Thomson coefficient for Van der Waals gases. (2)

4. (a) Convert 1 atm. pressure into gauge pressure, torr, Pascal and millibar. (2)

(b) With proper diagram write the working principle of multi-stage oil diffusion pump? (3)

5. (a) Write the working principle of helium vapour pressure thermometer. (3)

(b) Calculate the cooling produced by adiabatic demagnetization of a paramagnetic salt as the magnetic field is reduced from 10000 oersted to 0 oersted at initial temperature of 2 K. (Given: Curie constant per gm. Mol per c.c. = 0.042 erg degree/gm oersted^{-2} and specific heat at constant magnetic field = 0.42 Joule gm^{-1} degree^{-1}. (2)

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Group B

Answer any four questions

1. (a) Name different torques that act on a moving system of a moving coil galvanometer and the variables on which these torques depend on? Then write the equation of motion of the moving system for any deflection θ and given instant t. (2+1)

(b) The coil of a moving coil galvanometer moves in a constant field of 0.2 Wb/m^2. The moment of Inertia of its moving parts 0.2 X 10^{-6} kg-m^2, and the spring constant is 30 X 10^{-6} Nm/rad. When a current of 10 mA is passed through the galvanometer it shows a deflection of $5\pi/6$ rad. Calculate the deflection constant of the system. (2)

2. (a) Ballistic galvanometer are not operated in dead-beat condition. Explain in brief. (2)

(b) Let the expression for deflection of a ballistic galvanometer at any instant is given as

$\theta = AQexp\left(-\frac{K_d}{2I}t\right)\sin\left(\frac{k}{I}t\right)$ where Q is charge flowing, A is a constant, k is spring constant, I is moment of inertia and K_d is damping constant. Plot the θ-time graph. Obtain the expression for angular amplitude of the first swing in terms of the above defined parameters. (1+2)

3. (a) Plot the deflecting angle w.r.t. the measuring current when measured by dynamometer type ammeter. (1)

(b) With proper drawing and labeling describe how a radial iron vane type instrument works in both a.c. and d.c. Why hysteresis effects cause error in such type of instrument? (3+1)

4. (a) Explain with required calculations how Kelvin's double bridge can accurately measure low resistance even when lead resistance is present. (3)

(b) What do you mean by phase voltage and line voltage in a three phase connection? Obtain the relation between them for Star (Y) configuration. (1+1)

5. (a) What is the main disadvantage of using Maxwell Bridge for measuring inductance of an unknown inductor.-Explain your answer in brief. (2)

(b) Draw Hay's Bridge. Obtain the unknown resistance and inductance of an unknown inductor using it, where at balance condition R_1=5100Ω, C_1=2μF, R_2=7900Ω and R_3=790Ω. (3)