Register Number :
Date and Session:

ST. JOSEPH'S UNIVERSITY, BANGALORE-27
M.Sc. PHYSICS – I SEMESTER
SEMESTER EXAMINATION – OCTOBER 2022
(Examination conducted in December 2022)
PH 7421 : EXPERIMENTAL PHYSICS

Time: 2 hours **Maximum Marks:50**

This question paper contains NO parts and 3 printed pages.

Answer any **FIVE** questions. Each question carries **10** marks. **(5x10=50)**

1. a) If the transducer containing resistive sensing element is connected to the instrumentation system using lead wires then what errors can possibly be introduced in the measurements? How can it be corrected?

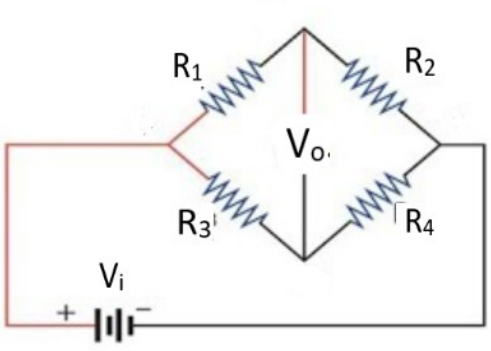
   b) When light of a particular intensity illuminates a photo-resistor, the illuminated resistance R_L is 1500Ω. The sensitivity of this illuminated resistance to the variations in the intensity of light 'I'(mW/cm^2) is (-200) Ω-cm^2/mW. The photo-resistor is included as an active arm in an initially balanced Wheatstone bridge circuit powered by a 9V battery to make a sensitive measurement of resistance change. What will be the output voltage for a change in the intensity of light of 0.1mW/cm^2? (5+5)

2. a) What are the factors that need to be considered while selecting a transducer for an instrumentation system?

   b) What is the principle of working of an LVDT (Linear Variable Differential Transformer)?

   b) A simple Wheatstone bridge circuit is used to determine the unknown resistance of an RTD connected in the circuit as R_1. If upon the initial null balancing of the bridge, R_3 is 132.3 Ω and now if R_3 and R_4 are interchanged, then the null balance is achieved when R_3 is 165.3 Ω, then what is the value of unknown resistance R_1(in Ω)?

   (2+3+5)

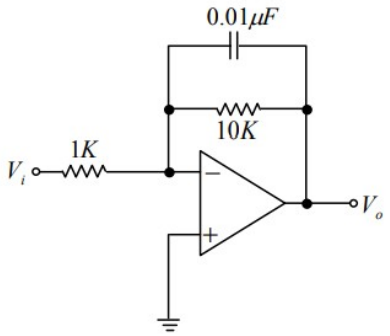


3. a) What is the basic principle of Strain Gauges? Explain different types of strain gauges.

   b) Write a note on moving coil velocity transducers.
   c) Calculate the gauge factor of a strain gauge, if the value of resistance is 152 Ω which changes by 5 Ω for a strain of 5000 μ . (5+3+2)

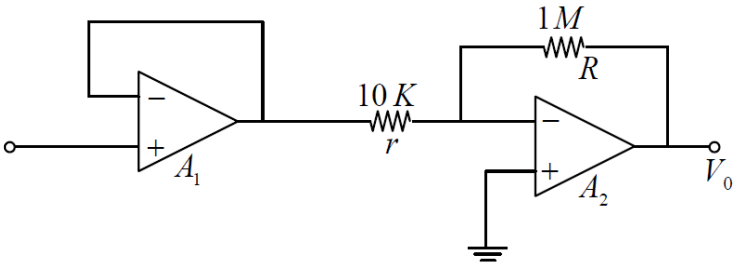
4. a) Explain why open-loop op-amp configurations are not used in linear applications. For what kind of applications can they be used? Explain any one such application.

b) In the op-amp circuit as shown in the figure, if an ac input V_i is applied at 10 Hz (assume this as value of ω) then with all the elements active at this frequency, how much is the gain? OR (Identify the circuit and calculate the output voltage).



c) In the circuit given below comprising of two op-amps A_1 and A_2 , explain the purpose of connecting A1. Given that the input ac signal source to this circuit has an impedance of 50 kΩ.

(5+3+2)



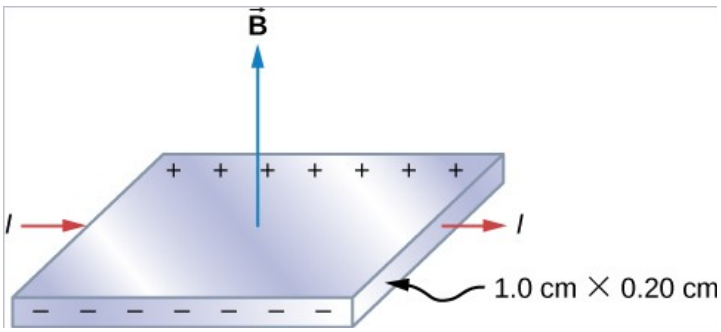
5. a) Explain the Forbe's method used to measure the thermal conductivity of a good conductor.

   b)The main span of a bridge is 1275 m long at its coldest. The bridge is exposed to temperatures ranging from–15°C to 40°C. What is its change in length between these temperatures? Assume that the bridge is made entirely of steel. Given that linear coefficient of thermal expansion of steel is $\alpha = 9 \times 10^{-6} / ^{o}C$ (7+3)

6. a) Explain the basic principle of Vibrating Sample Magnetometer along with its construction.

   b) Explain the basic principle used in 'Search Coil' for measuring the magnetic field.

   c) Figure shows a silver ribbon whose cross section is 1.0 cm by 0.20 cm. The ribbon carries a current of 100 A from left to right, and it lies in a uniform magnetic field of magnitude 1.5 T. Using a density value of n=5.9×10^{28} electrons per cubic meter for silver, find the Hall potential between the edges of the ribbon. (5+2+3)



7. a) Explain the working of successive approximation Analog to Digital converter (ADC) using the block diagram given below. You can use 6.4 V as the input voltage for the explanation.

   b) Find the step size and percent resolution of a 6 bit DAC which gives a maximum output of 3.15V.

   (7+3)