



Register Number :

Date and Session:

ST. JOSEPH'S UNIVERSITY, BANGALORE-27
M.Sc. PHYSICS – I SEMESTER
SEMESTER EXAMINATION – OCTOBER 2023
(Examination conducted in November/December 2023)
PH 7421 : EXPERIMENTAL PHYSICS-I
(For Current and 2022 batches only)

Time: 2 hours

Maximum Marks:50

This question paper contains 2 parts and 2 printed pages.

Part-A

Answer any **FIVE** questions. Each question carries **7** marks. **(7x5=35)**

1. a) Explain the working principle of ultra-high pressure diamond anvil cells.
b) What is tacho-generator? Explain Linear velocity measurement tachometers. (4+3)
2. a) Explain how four probe method is used to determine the resistivity of thin film?
b) What is Magnetoresistance? Explain (4+3)
3. a) Draw the schematic diagram of seismic transducer and explain its operation in acceleration mode.
b) Explain the basic principle of Vibrating Sample Magnetometer along with its construction. (3+4)
4. a) Write a note on Giant Magnetoresistance (GMR) effect.
b) Why are constantan and manganin used in making potentiometers?
c) In capacitive displacement sensors, explain the difference between application of sensors of large and small surface area. (3+2+2)
5. a) What is the need for sample and hold circuit in Data Acquisition Systems?
b) Draw and explain the working of Flash type Analog to Digital converter which gives 3- bit quantisation in the output. (2+5)
6. a) Draw the differentiator circuit using op-amp and derive an expression for its output voltage.
b) Explain the need of a practical differentiator circuit, draw it and hence, explain how are the problems of the former are resolved using the latter. (3+4)
7. a) What is a voltage follower circuit? Explain the need of this circuit in an instrumentation amplifier.
b) Explain how improper choice of transducer in an instrumentation system can affect the output. What aspects of its properties should be looked at while making this choice?
c) Explain how error analysis can be used to determine if two measurements of a physical quantity agree or not. (3+2+2)

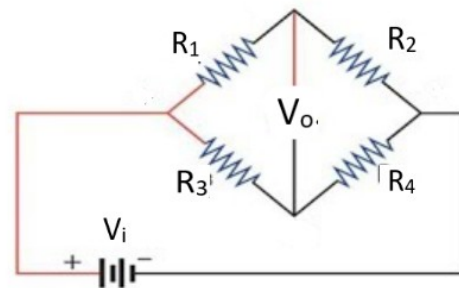
Part-B

Answer any **THREE** questions. Each question carries **5** marks.

(5x3=15)

8. A capacitive transducer with its plate separation 0.05 mm under static condition has a capacitance 5×10^{-12} F. Find the displacement which will cause a change of capacitance of 0.75×10^{-12} F.
9. The magnetization within a bar of some metal alloy is 1.2×10^6 A/m when the H field is 200 A/m. Calculate (a) the magnetic susceptibility χ_m of this alloy, (b) the permeability μ and (c) the magnetic induction B within the alloy. What type(s) of magnetism would you suggest as being displayed by this material (and explain why)?

10. A strain gauge with gauge resistance of 350 Ω and gauge factor of 2.05 is used in arm R_1 of a constant voltage Wheatstone bridge. If the power that can be dissipated across the transducer is limited to 0.25 W and the maximum input power supply V_i is 28 V, then determine the values of R_2 , R_3 , R_4 needed to maximize output voltage V_o . If the gauge is subject to a strain of $1000 \mu\text{inch/inch}$, then determine the output voltage.



11. a) A 5-bit D/A converter produces $V_{OUT} = 0.2$ V for a digital input of 00001. Determine the output voltage for a digital input of 10001.

- b) In the given instrumentation amplifier circuit, the transducer resistance can be denoted by $R_T \pm \Delta R$. The transducer CL605L photocell has minimum dark resistance of 500k Ω for which the bridge is balanced and the resistance at 0.61 meter-candle(lux) is 7.5k Ω . Using the circuit given below,, determine the voltage V_{ab} and the output voltage i) at the dark condition ii) at 0.61 lux. (2+3)

