



Register Number:

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ST. JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE-27
M.Sc. PHYSICS - I SEMESTER
SEMESTER EXAMINATION: OCTOBER 2019
PH7418-EXPERIMENTAL PHYSICS-I

Time- 2 1/2 hrs

Max Marks-70

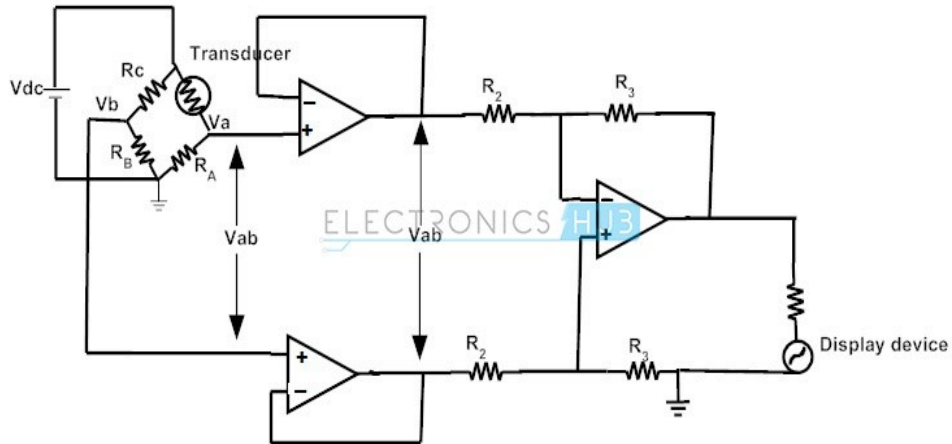
This paper contains 2 parts and 3 printed pages.

Part-A

Answer any **5** questions. Each question carries **10** marks. **(5X10=50)**

1. With a neat diagram explain the working of Link-type load cell for maximum sensitivity in the measured output and show that the applied load is proportional to the output voltage.
2. a) Two Resistance Temperature Detectors have same base resistance of 100Ω but they have different Temperature Coefficients of Resistance. Can they be used interchangeably? Explain.
b) In a Wheatstone bridge network, what are dummy strain gauges used for? Explain.
c) Which sensor should be used in order to detect the vehicles crossing on a toll road? How many sensors would you need in order to classify the type of vehicle passing by?
d) An instrumentation engineer wants to buy a CRO which will help him in analysing his data. In addition to the system being accurate and of good resolution, what are the other important dynamic characteristics of the CRO that he should check before buying? (2+2+2+4)
3. A Cu-Al-Ni alloy shape memory material undergoes a martensite to austenite phase transformation upon heating. Which instrument should an analyst use to identify this transformation so as to know what changes the material has undergone? Explain the working of this instrument in detail. (2+8)
4. Design and show how analog input of 4.2 V is converted into digital output using Flash Analog to Digital Converter. Assume reference voltage to be 8V. Also explain how the change in the reference voltage changes the nature of conversion. (8+2)
5. a) Explain how spintronics is used to produce magnetoresistive effect in Giant Magnetoresistive(GMR) devices.
b) Why is indium antimonide used in making Hall probe for Hall effect sensors? Can these sensors be used for detection of any kind of object? Explain. (7+3)
6. a) Draw and explain the working of a 3-bit negative edge triggered asynchronous UP counter.
b) What is the resolution of a 5-bit Digital-to-Analog converter (DAC)? Explain. (8+2)

7. Using the given instrumentation amplifier circuit where the transducer resistance is denoted by $R_T \pm \Delta R$, explain the working of the given instrumentation amplifier and derive an expression for the output voltage in terms of ΔR .



Part-B

Answer any 4 questions. Each question carries 5 marks.

(4X5=20)

8. a) A 20-turn potentiometer with a calibrated dial (100 divisions per turn) is used as a balance resistor in a Wheatstone bridge. If the potentiometer has a resistance of 20 k Ω and a resolution of 0.05 percent, what is the minimum incremental change in ΔR that can be read from the calibrated dial?

b) A constant voltage Wheatstone bridge circuit is employed with a displacement transducer (potentiometric type) to convert resistance change into output voltage. If the displacement transducer has a total resistance of 2000 Ω and the wiper is moved to the center position due to displacement, then find the output voltage from the bridge circuit. The resistance in the other arms is equal to the total resistance of the displacement transducer and the input DC voltage to the bridge is 8V. (2.5+2.5)

9. A piezoelectric transducer is a voltage source of 10 V with an internal impedance of 10 M Ω . It is connected to a digital oscilloscope with an input impedance of 10 M Ω (i) directly and (ii) using a high impedance buffer amplifier. What voltage will be measured by the oscilloscope in the two cases? Draw circuit diagrams for the two cases and explain.

10. A practical integrator has input resistance of 30 M Ω and feedback resistance and capacitance of 20 M Ω and 0.1 μ F respectively. If a step DC input voltage of +3V is applied as input for $0 \leq t \leq 4$ (seconds), find the output voltage and draw the corresponding input and output waveforms.

11. An 820 Ω resistance known to be accurate to $\pm 10\%$ carries a 10 mA current. The current was measured on the 25 mA range of an analog ammeter that has an accuracy of 2% of full scale. Calculate the power dissipated in the resistor and determine the accuracy of the result.

12. In summer, the rooms inside houses start warming up towards evening instead of noon even though the sun is hottest around noon time. Assuming that walls of the house are made up of concrete where the thickness of the walls is 24 cm and thermal diffusivity of concrete is 0.006 in c.g.s units, find the time taken by the heat wave to penetrate into the

room. If the outside temperature is maximum at 1 pm then at what time will the room be hottest? (Assume that the walls are not radiating heat.)

13. An RTD fabricated from Platinum exhibits a temperature coefficient of resistivity of $0.003902/^{\circ}\text{C}$. If the resistance of the sensor is 100Ω at 0°C then find the resistance at -240°C and 600°C . Comment on your result.