

1(a) Draw the circuit diagram for calibrating a strain gain. Derive the expression for the relation between the output and the strain needed to draw the calibration curve.

The static calibration of a strain gauge bridge is carried out by connecting a standard resistor shunted across one of the arms. If the nominal value of the strain gauge resistance is 100Ω and the gauge factor is 2.0, calculate the shunt resistance needed to obtain equivalent microstrain level of 150.

(b) Discuss the applications of "Logarithmic amplifiers" in instrumentation systems. Explain the working principle of basic logarithmic amplifier using simple diode. Discuss its limitations and the method to improve its characteristics.

(c) Derive the expression for gain of a differential amplifier. Explain how its CMRR is improved by connecting two additional Op-Amps in the input circuit. Draw its diagram and derive the expression for its gain.

A differential amplifier with a common mode input of 500 mV and a difference mode input of 5 mV due to common input and 3 V due to difference mode input. Find CMRR.

(5+5+6)

2. (a) Draw the block diagram of digital to analog converter. Describe its main elements. Compare the features of (i) binary weighted network and (ii) R-2R ladder.

(b) Draw the block diagram of IC ADC 0808 and describe its functioning.

An 8-bit ADC has a conversion time of $50 \mu s$. Find the maximum frequency of an input sine-wave that can be digitized without aperture error. Comment on the result.

(c) Describe the principal of operation of switched capacitor filter. Discuss its characteristics and applications.

(6+5+5)

3(a) Name the different elastic transducers used for pressure measurement. Describe the working of (i) capacitive pressure transducers and (ii) Piezo-electric pressure transducers. Mention their applications.

(b) What is a Load cell? Give the properties of materials chosen for the load cell. Describe the working and applications of Piezo-electric force transducer.

(P.T.O.)

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© A seismic motion transducer has a mass of 100 gm. Its un-damped natural frequency is 15 Hz and damping ratio is 0.7. The relative motion of seismic mass w.r.t. frame of the transducer is converted to voltage by a first order transducer which has static voltage sensitivity of 2.5 V/mm and time constant of 0.01 s. Find the output voltage for an input motion of 0.5 mm at a frequency of 20 Hz. (6+5+5)

4(a) Describe the design concept of torque cells. Explain the method of measurement of torque using (i) Rotary transformer and (ii) telemetry system.

(b) Discuss the necessity of liquid level measurement in process industries. Name the different types liquid level measurement techniques. Draw the diagram and describe the method of measuring the water head of reservoirs using "Pneumatic force balance method".

(c) A sub- marine moves horizontally in the sea and has its axis much below the surface of sea- water. A pilot-tube properly placed just in front of the sub-marine, is connected to the differential pressure gauge. The pressure difference between the pilot and static pressure was found to be 25 KN/m². Find the speed of the submarine if the density of sea water is 1020 kg/m³. (5+6+5)

5(a) Describe the method of level measurement of molten metal in steel industry using "eddy current sensor". Mention its important features.

~~(b)~~ Draw the diagram and describe the principle of operation of "electromagnetic flow meters". Compare its features with ultrasonic flow meters. Discuss their applications.

(c) In a variable capacitance transducer, the diaphragm and housing are made out of a single piece of steel where the diaphragm thickness and diameter are 0.5 mm and 12.5mm respectively. The stationary electrode of 10 mm diameter is separated by a gap of 0.25mm from diaphragm. Calculate the pressure sensitivity. (6+6+4)

6. (a) Describe the important factors that decides the configuration and sub-systems of Data Acquisition Systems (DAS). Draw the diagram of various configurations of (DAS). Discuss their features and applications.

~~(b)~~ What is smart transducer and smart network?

~~(c)~~ What is SCADA? Give an example of its application. (6+5+5)

7. ~~(a)~~ What is Industry Standard Architecture (ISA)? How this standard saves the cost of production?

~~(b)~~ What is transducer Electronic Data Sheet (TEDS)? Explain the formats for TEDS as defined by IEEE 1451.1.

(c) What is calibration and why calibration is required? (6+5+5)