

[PI-511] [BI-511] TRANSDUCERS DESIGN

END SEMESTER EXAM

Year: F.Y. M. Tech

Branch: Instrumentation & Control

Academic Year: 2013-14

Duration: 03 Hours

Max. Marks: 60

Instructions:-

- 1) Answer **all** questions.
- 2) Neat diagram must be drawn wherever necessary.
- 3) Assume suitable data if necessary.
- 4) Figures to the right indicate full marks.
- 5) Use of only non-programmable calculator is allowed.

Q.1 Solve **All**

- A) For variable head type flow meters, prove that volumetric flow measurement is independent of the fluid being measured.

Design a venture tube which is used for metering of gas flow. The density of gas is 0.52 Kg/m^3 flows through a pipe of diameter 8.0 cm. A U- tube manometer containing mercury is used to measure pressure differential. For a 280 litter/s gas flow, manometer shows 10 cm height difference. (Assume $C_d = 0.9$).

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- B) Explain with neat diagram working principle of Pressure switch.
Design a resistance strain gauge type pressure transducer, with the following specifications:

Maximum pressure to be measured = 2 bars.
Diameter of steel diaphragm = 8 cm.
Size of resistance gauges used = 3mm x 6mm
Resistance of each gauge = 120 Ohm
Gauge factor = 2

Find the thickness of the diaphragm and sensitivity of the transducer.

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- C) Using float type level sensor, show that, if float is hollow ball, the liquid level measurement is decided by length of the float to shaft attachment.

Explain: how do you measure the level if the liquid

- a) Is corrosive
- b) Is explosive
- c) Has suspended particles

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Q.2 Solve any **Five**

- A) A Pressure transducer as shown in fig. 1 has a natural frequency of 30 rad/s, damping ratio of 0.1 and static sensitivity of $1.0 \mu\text{V}/\text{Pa}$. A step pressure input of $8 \times 10^5 \text{ N/m}^2$ is applied. Determine the output of the transducer and plot its output response.

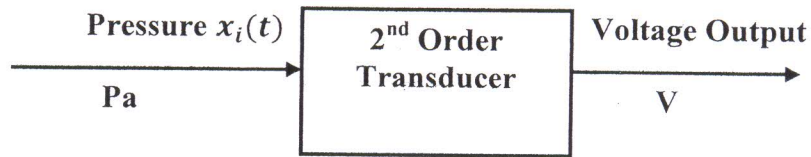


Fig. 1

- B) Discuss important parameters to be considered for selection of sensors particularly for temperature, pressure, flow and level measurement. Develop a matrix indicating types of sensors available for selection. 06
- C) Draw equivalent circuit of LVDT. Explain how supply frequency affects the sensitivity of an LVDT. How it is compensated for. 06
- D) It is required to design a resistance thermometer for an application. The material which is used in design is Nickel wire of 0.002mm diameter. The thermometer resistance at 0°C is to be 100 Ohm. How long the wire should be? The resistivity of nickel $\rho = 8.7 \times 10^{-6} \text{ ohm-cm}$ at 0°C and temperature coefficient of resistance is $0.0068/^\circ\text{C}$. Determine also the value of resistance at steam point. 06
- E) Explain working principal of:
- 1) Bio-sensor used for glucose measurement
 - 2) Level measurement with Guided Wave Radar
 - 3) Non-contact method used for temperature measurement
- 06
- F) Design a strain gauge load cell of cantilever type capable of measuring a force of 5N to an accuracy of 5%. Assume: gauge factor of strain gauges is 2 and battery excitation voltage is 6V. Material of cantilever is mild steel having Young's modulus 210 MPa. 06