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CAI-602/T&SC/6th Sem/2013/M

TRANSDUCER AND SIGNAL CONDITIONING

Full Marks – 70

Pass Marks – 28

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No.1 and any six from the rest.

1. (a) Choose the correct answer : $1 \times 6 = 6$

(i) The transducers that convert the input signal into the output signal, which is a discrete function of time known as

- (a) Active transducers
- (b) Analog transducers
- (c) Digital transducers
- (d) Pulse transducers.

[Turn over

(ii) Strain gauge, LVDT and thermocouple are examples of

- (a) Active transducers
- (b) Passive transducers
- (c) Analog transducers
- (d) Primary transducers.

(iii) Piezo-electric transducers are

- (a) Passive transducers
- (b) Inverse transducers
- (c) Digital transducers
- (d) Pulse transducers.

(iv) The resistance of LDR ——— when exposed to radiant energy.

- (a) Remains unaltered
- (b) Increases
- (c) Reaches maximum
- (d) Decreases.

- (v) In a LVDT, the two secondary voltages
- (a) are independent of the core position
 - (b) vary unequally depending on the core position
 - (c) vary equally depending on the core position
 - (d) None of these.

(vi) Which of the following is a digital transducer ?

- (a) Strain gauge
- (b) Encoder
- (c) Thermistor
- (d) LVDT.

(b) Fill in the blanks : 1×4=4

- (i) The principle of operation of _____ is based on the variation of mutual inductance.

- (ii) _____ is an example of photo emissive cell.
 - (iii) A transducer that converts measurand into the form of pulse is called _____ transducer.
 - (iv) Barium titanate and lead titanate are examples of _____ substances.
2. (a) Define a transducer. Distinguish between a passive transducer and an active transducer giving one example in each case. 5
- (b) Explain the basic principle of Hall effect and how this effect can be used to make a transducer. 5
3. (a) Name any four common piezoelectric materials. 2
- (b) Describe the construction and working of D.C. tachometer generator with suitable diagram. Also mention their advantages and disadvantages. 8

4. (a) What is accelerometer ? Explain the construction and working of LVDT type accelerometer. 6
- (b) A 2.5 mm thick quartz piezoelectric crystal having a voltage intensity of 0.055 Vm/N is subjected to a pressure of 1.4 MN/m². If the permittivity of quartz is 40.6×10^{-12} F/m, calculate
- (i) Voltage output
- (ii) Charge sensitivity of the crystal. 4
5. (a) What is a data acquisition system ? Explain briefly the procedure of analog-to-digital (A/D) conversion. 6
- (b) Draw diagrams to show how LVDTs can be used with bellows and bourdon tubes for measurement of pressure. Give their advantages and disadvantages. 4
6. Explain the different principles of working of capacitive transducers. Give the applications of capacitive transducers. 10

7. (a) What are thermistors ? Draw the resistivity vs. temperature characteristics and also describe their working and applications. 6
- (b) Explain the construction and working of phototransistors. 4
8. (a) Design a 4-bit weighted resistor type DAC where full scale o/p voltage is $-5V$. The logic levels are $1 = +5V$ and $0 = 0V$. What is the output voltage when the input is 1101 ? 7
- (b) What is a multiplexer ? Explain. 3
9. (a) Explain how an unknown temperature can be measured using a thermocouple transducer. 4
- (b) Find the strain that results from a tensile force of 1000 N applied to a 10m long aluminium bar having cross sectional area of $4 \times 10^{-4} \text{ m}^2$. The modulus of elasticity of aluminium is 69 GN/m². 3
- (c) An accelerometer has a seismic mass of 0.05 kg and a spring constant of $3 \times 10^3 \text{ N/m}$. Maximum mass displacement is $\pm 0.02 \text{ m}$ (before the mass hits the stop). Calculate the maximum measurable acceleration. 3

10. Write short notes on any *two* : $2 \times 5 = 10$

- (a) Voltage-to-frequency converters.
- (b) Successive approximation method of A/D conversion.
- (c) Encoder and Decoder.