7. (a) Explain briefly the types of errors encountered in a transducer. 7

(b) What do you mean by semiconductor strain gauges? 7

8. (a) What is linear variable differential transformer (LVDT)? List the advantages and disadvantages of LVDT. 7

(b) The output of an LVDT is connected to a 10 A ammeter through an amplifier whose amplification factor is 200. An output of 3 mA appears across the terminals of LVDT when the core moves through a distance of 0·75 mm. Calculate the sensitivity of LVDT and that of the whole setup. The milliammeter scale has 100 divisions. The scale can be read to 1/10 of a division. Determine the resolution of the instrument in mm. 7

9. What do you mean by data acquisition systems (DASs)? Explain with the help of block diagram, single-channel and multi-channel DAS. 14

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B.Tech 6th Semester Exam., 2016

INSTRUMENTATION AND MEASUREMENT

Time : 3 hours   Full Marks : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are **NINE** questions in this paper.

(iii) Attempt **FIVE** questions in all.

(iv) Question No. **1** is compulsory.   akubihar.com

1. Write True or False (any seven) :   2×7=14

(a) The equivalent binary number of decimal number 27 is 11011.

(b) The equivalent decimal number of binary number 101011 is 43.

(c) The temperature measured by a thermocouple is primary measurement.

(d) Environmental errors may be due to change in wind velocity.

(e) A second-order underdamped system has a damping factor of 0·8. It is subjected to a sinusoidal input of unit amplitude. It has resonant peak of 92%.

(Turn Ove

(f) A first-order thermometer has a time constant of 50 seconds. It is subjected to a sinusoidal input cycling at 0·002 Hz. The time lag of the instrument is 50 seconds.

(g) A set of readings has a wide range and therefore it has low precision.

(h) LVDT is a capacitive transducer.

(i) The most suitable device for measuring temperature of a furnace is optical pyrometer.

(j) Strain gauge cannot be used to measure pressure.

2. (a) Discuss the factors relating the selection of instruments. 5

(b) Describe briefly the main functions of the instruments with suitable examples. 9

3. (a) What are the main static characteristics of measuring instruments? Discuss the terms – accuracy, errors and correction. 9

(b) A pressure indicator showed a reading as 42 bar on a scale range of 0–50 bar. If the true value was 41·4 bar, determine (i) static error, (ii) static correction and (iii) relative static error. 5

(Continued)

4. The temperature of a furnace is found to vary sinusoidally between 520° C and 580° C with a periodic time of 50 seconds. A thermocouple system with a time constant of 10 seconds is employed to measure the furnace temperature. Determine—

(a) the maximum and minimum values that will be indicated by the thermocouple;

(b) the phase shift and the corresponding time lag between the temperature signals and the thermocouple input signals. 14

5. Discuss zero-, first- and second-order systems with suitable examples. 14

6. By using a micrometer screw, the following readings were taken of a certain physical length :

1·34, 1·38, 1·56, 1·47, 1·42, 1·44, 1·53, 1·48, 1·40 and 1·59 mm

Assuming that only random errors are present, calculate the following : 14

(a) Arithmetic mean

(b) Average deviation

(c) Standard deviation

(d) Variance

(Turn Over)

Code : 021619

B.Tech 6th Semester Exam., 2018

INSTRUMENTATION AND MEASUREMENT

Time : 3 hours   Full Marks : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are **NINE** questions in this paper.

(iii) Attempt **FIVE** questions in all.

(iv) Question No. **1** is compulsory.

1. Answer the following as directed [attempt any seven from (a) to (j)] :   2×7=14

   State whether the following is True or False :

   (a) Platinum RTDs have a negative temperature coefficient (NTC).

   (b) Thermocouple is a passive transducer.

   (c) A PMMC type instrument has high sensitivity.

   (d) The most suitable device to measure temperature inside a boiler furnace is optical pyrometer.

   (e) Amplifiers used for signal conditioning must have high input impedance and low output impedance.

(2)

Select the correct answer :

(f) The smallest change in a measured quantity to which an instrument will respond is

   (i) accuracy

   (ii) sensitivity

   (iii) resolution

   (iv) precision

(g) A crystal oscillator is used in digital circuits for clock signal generation because of its

   (i) low cost   akubihar.com

   (ii) simple circuitry

   (iii) high-frequency stability

(h) Complete set of logic gates known as universal gates is

   (i) NOT, OR and AND gates

   (ii) XNOR, NOR and AND gates

   (iii) NOR and NAND gates

(i) Piezoelectric crystal is generally used for the measurement of

   (i) flow

   (ii) velocity

   (iii) acceleration

   (iv) temperature

(j) A load cell is an electromechanical device which is widely used for measurement of

   (i) temperature

   (ii) static force

   (iii) dynamic force

   (iv) Both *(ii)* and *(iii)*

2. *(a)* Giving the basic block diagram of a measuring/instrumentation system, explain the function of its each important block or component. 7

   (b) Six measurements of a quantity were obtained as 12·35, 12·71, 12·48, 10·24, 12·63 and 12·58. Calculate—

   (i) arithmetic mean;

   (ii) standard deviation;

   (iii) probable error in percent of the readings. 7

3. *(a)* Give broad classification of instruments from construction point of view along with examples. akubihar.com 7

   (b) A voltmeter has a sensitivity of 15 kΩ/ V and it reads 80 V on a 100 V scale when connected across an unknown resistor. The current through the resistor is 2 mA. Calculate the % error due to loading effect. 7

4. *(a)* What do you understand by LVDT? Write its application. Detail its working principle and operation with suitable diagrams. 7

   (b) An LVDT has a maximum core motion of $\pm 1\cdot 6$ cm with linearity of $\pm 0\cdot 3\%$ over that range. The transfer function is 24·5 mV/mm. If used to track work-piece motion from $-1\cdot 1$ cm to $+1\cdot 3$ cm. what is the expected output voltage range? What is the uncertainty in position detection due to non-linearity of the LVDT? 7

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5. *(a)* What is a strain gauge(SG)? Discuss different applications of SG in instrumentation. 7

   (b) A strain gauge has a gauge factor of 4 and nominal resistance of 120 Ω. The SG is attached to a beam that stretches from 25 cm to 25·2 cm. Find the % change in its resistance. Also find its resistance after strain is applied. 7

6. Describe the working of a differential capacitive transducer along with its merits and limitations. 14

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7. (a) Convert the decimal number $6031 \cdot 25_{10}$ into hexadecimal number.   7

(b) Explain the following with suitable diagrams :   7

     (i) Flip-flop

     (ii) Multiplexer

     (iii) Ripple counter

8. Draw and explain a temperature measuring data acquisition system (DAS) with the details of each component.   14

9. Write short notes on any *four* of the following : $3\frac{1}{2} \times 4 = 14$

   (a) Advantages of electrical transducers

   (b) Loading effect of instruments

   (c) Classification of transducers

   (d) Piezoelectric effect and materials

   (e) Step response of a first-order system

   (f) Types of strain gauges

   (g) Selection of instruments

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