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Question Paper Code: 41363

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2016

Third Semester

Instrumentation and Control Engineering

14UIC303 - SENSORS AND TRANSDUCERS

(Common to Electronics and Instrumentation Engineering)

(Regulation 2014)

Duration: Three hours   Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Strain gauge, LVDT and thermocouple are examples of

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

2. Two capacitances, $C_1 = (150 \pm 2.4)\ \mu F$ and $C_2 = (120 \pm 1.5)\ \mu F$, are in parallel. What is the limiting error of the resultant capacitance C?

    (a) $0.9\ \mu F$ (b) $1.9\ \mu F$ (c) $3.9\ \mu F$ (d) $4.8\ \mu F$

3. A strain gauge is a passive transducer and is employed for converting

    (a) pressure into a change of resistance
    (b) force into a displacement
    (c) pressure into displacement
    (d) mechanical displacement into a change of resistance

4. Resolution of a transducer depends on

    (a) length of wire   (b) diameter of wire
    (c) material of wire   (d) excitation voltage

5. Sensitivity factor of a strain gauge is normally of the order of

    (a) 1.5 - 2.0   (b) 1 - 1.5   (c) 0.5 – 1   (d) 5 - 10

6. Which of the following is a digital transducer

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

7. Self generating type transducers are _____ transducers

    (a) Active   (b) Passive   (c) Inverse   (d) Secondary

8. Piezo electric crystal can produce an emf

    (a) When external mechanical force is applied to it
    (b) When radiant energy stimulates the crystal
    (c) When external magnetic field is applied
    (d) When the junction of two such crystals are heated

9. An inverse transducer is a device which converts

    (a) electrical energy into thermal energy
    (b) electrical energy into light energy
    (c) electrical quantity into mechanical quantity
    (d) an electrical quantity into a non-electrical quantity

10. Which of the following can be measured with the help of piezo electric crystal?

    (a) Sound   (b) Velocity   (c) Force   (d) Pressure

PART - B (5 x 2 = 10 Marks)

11. Distinguish passive and active transducers and give an example of each.

12. A thermometer has a time constant of 3.5 *s*. it is quickly taken from a temperature 0^0C to a water bath having a temperature 100^0C. What temperature will be indicated after 1.5 *s*?

13. What is Helipot? Write its salient features.

14. List the various factors affecting the propagation of light through optical sensors.

15. Define the term 'Relative humidity'.

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PART - C (5 x 16 = 80 Marks)

16. (a) Discuss in detail the different types of errors occurring in measuring instruments and explain how to minimize them. (16)

Or

(b) (i) A test temperature is measured 100 times with variations in apparatus and procedures. After applying the corrections, the readings are:

Temperature ^{0}C	397	398	399	400	401	402	403	404	405
Frequency of occurrence	1	3	12	23	37	16	4	2	2

Calculate: Arithmetic mean, mean deviation, standard deviation, probable error of one reading, probable error of the mean, standard deviation of the mean, standard deviation of the standard deviation. (10)

(ii) Discuss the various classifications of transducers with examples. (6)

17. (a) (i) Discuss the following static characteristics of a transducer. Resolution, Linearity, Hysteresis and Dead zone. (8)

(ii) With a neat diagram, derive the expression for the generalized transfer function of a second order transducer. (8)

Or

(b) Derive the expression for unit step and ramp response of first order transducer. Plot their responses. Also discuss about the steady state error in both the cases. (16)

18. (a) (i) With neat sketches, describe the constructional details of a resistance potential divider and derive the expression for its output voltage when connected across a meter of finite impedance. (8)

(ii) A linear resistance potentiometer is 50 *mm* long and is uniformly wound with a wire having a resistance of 10,000 *Ω*. Under normal conditions the slider is at the center of the potentiometer. Find the linear displacement when the resistance of the potentiometer as measured by a Wheatstone bridge for two cases is: (i) 3850 *Ω* (ii) 7560 *Ω*. Are the two displacements in the same direction? (8)

Or

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(b) With neat sketches and expressions, describe the constructional details and operation of different types of hot wire anemometer. (16)

19. (a) Discuss the principle of operation, construction, equivalent circuit and application of Piezoelectric transducer. (16)

Or

(b) With neat sketches, extend your thoughts on the constructional details and operation of the following transducers.

    (i) Fiber optic transducer (8)

    (ii) SQUID sensor (8)

20. (a) With neat sketches and expressions, illustrate the constructional details and operation of seismic accelerometer. (16)

Or

(b) (i) Briefly discuss about the operation of resistive type hygrometer. (8)

    (ii) With neat sketches and expressions, describe the operation of LM 335 IC temperature sensor. (8)

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