53 (IE 502) TREN

2013

(May)

TRANSDUCER ENGINEERING

Paper : IE 502

Full Marks : 100

Pass Marks : 30

Time : Three hours

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

*Answer **any five** questions.*

1. *(a)* Explain briefly the term "Measurand". 2

(b) Explain the difference between an analog signal and a digital signal. 3

(c) Distinguish between direct and indirect method of measurement. 4

(d) Explain the various stages of the general measurement system. 5

(e) What are random errors ? State the common causes of their occurrence. 4

(f) A meter reads $136 \cdot 6V$ and the true value of the voltage is $136 \cdot 52V$. Determine the static error and the static correction for this instrument. 2

2. (a) A thermometer is calibrated $100^{\circ}C$ to $150^{\circ}C$. The accuracy is specified within $\pm 0 \cdot 25$ per cent of instrument span. What is the maximum static error ? 4

(b) Sketch and explain the response of a first order system when subjected to a ramp input. 6

(c) Describe briefly the following terms : 6

* Deviation
* Variance
* Standard deviation.

(d) Explain briefly the term "Precision Index". 4

3. *(a)* A temperature sensitive transducer when subjected to sudden temperature change takes 10-seconds to reach the equilibrium condition *(five time constants)*. Calculate the time taken by the transducer to read half of the temperature difference. 6

(b) Make a comparison of characteristics of Thermistor and RTD. 5

(c) A piezoelectric material measuring $5mm \times 5mm \times 1 \cdot 5mm$ is used to measure a force. Its voltage sensitivity is $0 \cdot 055 Vm/N$. Calculate the force if the voltage develop is $110V$. 4

(d) State the advantages and disadvantages of capacitive transducer. 5

4. *(a)* The output of a LVDT is connected to a $5V$-voltmeter through an amplifier whose amplification factor is 250. An output of $2mV$ appears across the terminals of LVDT when the core moves through a distance of $0 \cdot 5mm$. If the multimeter has 100–divisions and the scale can be read to $\frac{1}{5}$ of a division, calculate —

(i) Sensitivity of LVDT

(ii) the resolution of the instrument in *mm*. 8

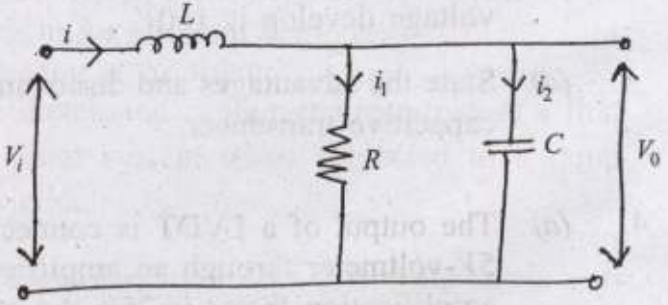
(b) How are the transducers classified ? 5

(c) State the requirements / characteristics of resistance wire strain gauge. 5

(d) Write the characteristics of a First order system. 2

5. (a) Enumerate the main static characteristics of measuring instruments. 6

(b) Find the Transfer Function of the following network : 8



Also state the order of it.

(c) What is an LVDT ? Explain its working principle and applications. 6

6. (a) State the *four* different types of standard test signals used for determination of dynamic characteristics of instruments. 4

(b) Describe briefly the working of Bourdon tube pressure gauge measurement system. 6

(c) Find all the time domain specifications (i.e. — rise time, peak time, peak overshoot, settling time) for a unity f/b control system whose open loop transfer function is given by —

$$G(s)=\frac{25}{s(s+6)}$$ 8

(d) What is the function of a signal manipulating element in a generalized measurement system ? 2

7. Write short notes on : 4×5=20

(i) Variable Inductance Transducer

(ii) Digital transducer

(iii) Fiber optic transducer

(iv) Thermocouple

(v) Calibration.