Code : 021619

B.Tech 6th Semester Exam., 2019

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 questions (any *seven*) :

$2 \times 7 = 14$

(a) Explain accuracy and precision.

(b) Explain dynamic accuracy and calibration.

(c) Explain reliability, maintainability and repeatability.

(2)

(d) Explain stacks and resource sharing of microprocessor.

(e) Explain torsion shaft and proving rings.

(f) Explain diaphragms using diagrams.

(g) Write merits and demerits of thermocouples.

(h) Write application of strain gauges.

(i) Write working principle of a thermistor.

(j) What are synchros and resolvers?

2. (a) Derive ramp response expression of a second-order system.   4

(b) Discuss bourdon tubes using diagrams.   6

(c) Discuss strain gauges and its operating principle. Give also the types of strain gauges.   4

3. (a) Develop impulse response of a piezoelectric crystal. State the merits, demerits and applications of piezoelectric transducer.   7

(b) A barium titanate piezoelectric pickup has dimensions of 5 mm × 5 mm × 1·5 mm and a voltage sensitivity of 0·015 V m/N. Relative permittivity of the barium titanate is 1200 and modulus of elasticity is 10×10^{10} N/m². Determine (i) output voltage, (ii) charge sensitivity, (iii) charge generated and the capacitance of the pickup. The force applied to the pickup is 12 N. 7

4. (a) What are the basic requirements of a transducer? Explain any transducer based on variable inductance. 6

(b) Discuss construction, working principle and applications of linear variable differential transformer (LVDT). 4

(c) An LVDT is used for measuring the deflection of a bellows. The sensitivity of LVDT is 40 V per mm. The bellows is deflected by 0·125 mm by pressure of $0·8 \times 10^{-6}$N per m². Determine the sensitivity of the LVDT in V per N/m² and the pressure when the voltage output of LVDT is 3·5 V. 4

5. (a) Discuss the capacitive transducers based on any two methods of varying the capacitance of capacitor. 7

(b) A capacitive transducer uses two quartz diaphragms of area 600 mm² separated by a distance of 2·5 mm. A pressure of 8×10^5 N/m², when applied to the top diaphragm, causes a deflection of 0·5 mm. The capacitance is 400×10^{-12} F when no pressure is applied to the diaphragms. Determine the value of capacitance after the application of a pressure of 8×10^5 N/m². 7

6. (a) Explain multiplexing the outputs of sample-holds using block diagram. 6

(b) Discuss programmable gain amplifier along with its diagram. 6

(c) Give the applications of a microprocessor. 2

7. (a) Write applications of signal analysis. 7

(b) Write short notes on the following : 7

   (i) Swept filter analysis

   (ii) Chebysev filter

   (iii) Elliptic filter

8. (a) A capacitive transducer with its plate separation 0·05 mm under static condition has capacitance 5×10^{-12} F. Find the displacement which causes change of capacitance of $0 \cdot 75 \times 10^{-12}$ F.   4

(b) A capacitive transducer uses two quartz diaphragms of area 750 mm^2, separated by distance of 2·5 mm, then capacitance is 400 pF. A pressure of 900 kN/m^2 when applied to top diaphragm, it produces a deflection of 0·5 mm. Find the capacitance after applying pressure.   4

(c) A capacitive transducer is used in pressure measuring instrument which has a spacing of 3·8 mm between its diaphragms. A pressure of 500 kN/m^2 produces average deflection of 0·25 mm of diaphragm of transducer. A transducer which has a capacitance of 280 pF before application of pressure and it is connected to oscillator circuit having a frequency 100 kHz. Find the change in frequency of oscillator after the application of pressure to the transducer.   6

9. (a) An ideal potentiometer having a length of 100 mm and resistance 1000 Ω. Calculate the power dissipation by the potentiometer if the sensitivity of the potentiometer is 0·1 V/mm.   4

(b) A strain gauge having a resistance of 120 Ω and a gauge factor 2 is subjected to a strain of $(60 + 10 \sin 314t) \times 10^{-6}$.

(i) Find the expression for the change in output voltage when the strain gauge is connected in a ballast circuit having a blast resistance of 120 Ω and a voltage 6 V.

(ii) If capacitor is connected in one of the output leads and a true RMS reading voltmeter of infinite impedance is connected across the output terminals. Find the reading of voltmeter.   3+3=6

(c) The output of an LVDT connected to 5 V voltmeter through an amplifier whose amplification factor is 250. An output

2 mV appears across terminal of LVDT
when core moves a distance of 0·5 mm :

 (i) Find sensitivity of LVDT.

 (ii) Sensitivity of whole setup.   4

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