2024
TRANSDUCERS AND SIGNAL CONDITIONING
Full Marks : 100

Time : Three hours

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

*Answer question number **1** and any **four** from the rest.*

1. a) Fill in the blanks   1 x 10=10

     i. Carbon Microphone is a …………………….. transducer.

     ii. An example of active transducer is…………………..

     iii. An example of inverse transducer is. …………………………..

     iv. In capacitive transducer, capacitance is …………………………

        proportional to the permittivity of the medium.

     v. Photovoltaic detectors are ……………………… transducers.

     vi. Hall effect transducers are used for the measurement of ……………

     vii. When temperature increases, the resistance of NTC

        thermistors…………………

     viii. The unit of inductance is …………………

     ix. LVDT is used for measurement of…………………………

     x. Young's modulus is the ratio of …………….. to…………….

   b) Determine the input and output variable for the following: 1x10=10

      Strain gauge, potentiometric accelerometer, RTD, synchro, piezoelectric transducer, LDR , LVDT, carbon microphone, capacitive transducer, photodiode.

2. a) How transducers are classified? Explain with suitable examples.   8

   b) A strain gauge is bonded to a steel beam 0.2m long and has a cross   6
      sectional area of 8cm². Young's modulus for steel is 100 GN/m². The strain gauge has an unstrained resistance of 240Ω and a gauge factor of 2. When a load is applied, the resistance of gauge changes by 0.02Ω. Calculate the change in length of steel beam.

   c) Explain potentiometric accelerometer using a suitable diagram.   6

3. a) Describe the construction and working of a synchro.   10

b) Describe the working of a capacitive transducer using a suitable diagram. 10

4 a) What is piezoelectric effect? Name some common piezoelectric materials. Derive the relation for output voltage in a piezoelectric transducer. 10

b) A piezoelectric transducer having thickness of 4mm and voltage sensitivity of 0.055 V-m/N is subjected to a pressure of 100 N/m². Calculate the voltage output. 4

c) Describe the working of an ultrasonic transducer with the help of a suitable diagram. 6

5 a) Differentiate the following: 5x2=10

(i) RTD and thermistor.

(ii) Bonded and unbonded type of strain gauge.

b) The resistance vs temperature reading of RTD is given below. Determine the linear approximate relation between 30°C and 50°C. 5

Temperature (°C)	Resistance (Ω)
25	100
30	101.2
35	102.7
40	103.9
45	105
50	107.3
55	108.6
60	109.8

c) Draw the signal conditioning circuit for RTD and explain its working. 5

6 a) Describe the working of a Hall effect transducer using a suitable diagram. 7

b) How shaft encoder can be used for position measurement? Explain its working using a suitable diagram. 8

c) Differentiate between photoconductive detectors and photovoltaic detectors. 5

7 Explain the operation of the following with relevant mathematical expressions: 10x2=20

a) Inductive transducers.

b) Differential capacitive transducers.