



Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH(ICE-NEW)/SEM-4/EI(IC)-401/2012

2012

SENSORS AND TRANSDUCERS

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

10 × 1 = 10

i) The gauge factor is defined as

- a) $(\Delta L/L) / (\Delta R/R)$ b) $(\Delta R/R) / (\Delta L/L)$
c) $(\Delta R/R) / (\Delta D/D)$ d) $(\Delta R/R) / (\Delta \rho/\rho)$

ii) Inductive type Transducer is

- a) Potentiometer b) Strain Gauge
c) Tachometer d) LVDT.



- iii) Semiconductor type Temperature sensor is
- a) RTD
 - b) Thermistor
 - c) Thermometer
 - d) Pyrometer.
- iv) The output of current of transducer is
- a) 0 – 20 mA
 - b) 4 - 20 mA
 - c) 3 – 20 mA
 - d) none of these.
- v) Quartz and Rochelle salt belong to
- a) natural group of piezo-electric materials
 - b) synthetic group of piezo-electric materials
 - c) both of these
 - d) none of these.
- vi) The gauge factor of semiconductor strain gauge is in the range of
- a) 2 to 10
 - b) 10 to 50
 - c) more than 100
 - d) 50 to 100.
- vii) Load cell converts
- a) voltage to force
 - b) pressure to current
 - c) light intensity to voltage
 - d) force to voltage.



viii) Thermocouple is

- a) Passive transducer
- b) Active transducer
- c) both active and passive transducers
- d) Output transducers.

ix) Which of the following is an inverse transducer ?

- a) LVDT
- b) Piezoelectric crystal
- c) Load cell
- d) Radiation Pyrometer.

x) In optical pyrometers temperature is measured by

- a) the thermoelectric effect
- b) photoelectric effect
- c) comparison of brightness of the source with that of standard source
- d) none of these.



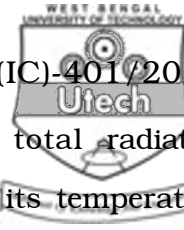
- xi) Dummy strain gauge is used to
- a) increase the efficiency
 - b) increase the range
 - c) compensate for temperature changes
 - d) make the bridge self-balancing.
- xii) Piezoelectric transducer is
- a) passive transducer
 - b) active transducer
 - c) inverse transducer
 - d) both (b) & (c).

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. How can strain developed on a strain gauge be measured by using full bridge configuration ? Derive the sensitivity relation between quarter bridge, half bridge and full bridge configuration of strain gauge measurement. $2 + 3$
3. Explain the difference between primary sensors and secondary sensors.



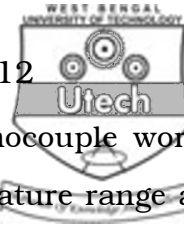
4. Describe the principle of operation of total radiation pyrometer with suitable diagram along with its temperature measuring range.
5. Draw the suitable diagram of capacitor microphone and discuss its principle of operation.
6. What is the hall effect ? Describe the working principle, construction and application of hall effect transducer. 2 + 3

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Derive the expression for error of a resistance potentiometer when connected across a load of finite resistance. Draw typical curves to show the variations of errors with input displacement for different values of load resistance.
- b) Distinguish between photovoltaic and photo-emission cells.
- c) A capacitive transducer uses two quartz diaphragms of area 750 mm^2 separated by a distance of 3.5 mm. A pressure of 900 kN/m^2 when applied to the top diaphragm produces a deflection of 0.6 mm. The capacitance of 370 pF when no pressure is applied to the diaphragms. Find the value of capacitance after the application of a pressure of 900 kN/m^2 . 7 + 4 + 4



8. a) State the principle on which the thermocouple works. Mention the name along with its temperature range and composition of two commonly used thermocouple.
- b) Why is the cold junction compensation necessary for thermocouple ? What is the technique of cold junction compensation ?
- c) Name two IC type temperature sensors. Explain any of them with circuit diagram. $5 + 5 + 5$
9. a) How can the capacitive transducer be used to measure the level of non-conducting liquid ? What special arrangement should be done while measuring conducting fluid ?
- b) Explain the working principle of 3-wire RTD with proper circuit diagram. Also mention its advantage over 2-wire RTD. $(5 + 5) + (4 + 1)$
10. a) Draw the schematic diagram of an LVDT and explain its electromechanical transfer characteristics.
- b) Show an arrangement to extract the amplitude as well as the phase information contained in the *ac* output of an LVDT.
- c) Describe the basic principle of a Hall device and show how it can be used as a magnetic field sensor.

$5 + 5 + 5$



11. Write short notes on any *three* of the following : 3 × 5

- a) Ultrasonic Sensor
- b) Smart sensor
- c) LDR
- d) Rosettes
- e) Villari effect for magnetic sensors
- f) Stroboscope.

