

B.TECH/AEIE/4TH SEM/AEIE 2202/2018
SENSORS AND TRANSDUCERS
(AEIE 2202)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

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

Group - A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Thermopile is made from a combination of
(a) thermocouples (b) thermowells (c) RTDs (d) thermistors.
 - (ii) Potentiometer transducers are used for the measurement of
(a) pressure (b) displacement (c) humidity (d) both (a) and (b).
 - (iii) The Iron-Constantan thermocouple is typed as
(a) T (b) J (c) K (d) R.
 - (iv) Which of the following acts as detector in optical sensor?
(a) Light emitting diode (b) Photo diode
(c) Transistor (d) All of the above.
 - (v) Piezoelectric transducer is a/an
(a) passive transducer (b) active transducer
(c) inverse transducer (d) both (b) and (c).
 - (vi) The transducer that converts an input signal into an output signal, which is a discrete function of time, is known as _____ transducer.
(a) active (b) analog (c) digital (d) pulse.
 - (vii) The sensitivity factor of a semiconductor strain gauge is normally of the order of
(a) 1-1.5 (b) 1.5-2 (c) 10-50 (d) 100.
 - (viii) Number of coils in an LVDT is
(a) 2 (b) 3 (c) 4 (d) 1.

- (ix) Capacitive transducers are normally employed for _____ measurements.
(a) static (b) dynamic (c) transient (d) both static and dynamic.
- (x) Inductive proximity sensors can be effective only when the objects are made of ____ materials.
(a) ferro magnetic (b) diamagnetic
(c) paramagnetic (d) all of the above.

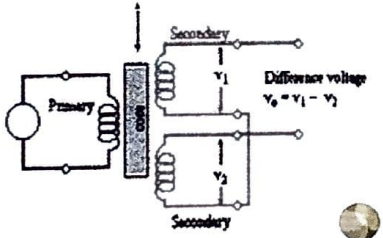
Group - B

- 2. (a) A voltmeter with a finite internal resistance is connected across the output terminals of a linear potentiometer. Find an expression for error generated in this system relative to an ideal voltmeter.
- (b) In a linear potentiometer, linearity and sensitivity are two conflicting characteristics—justify. Write the specifications of a linear potentiometer.

6 + (4 + 2) = 12

- 3. (a) A strain gauge of gauge factor 1.2 has its nominal resistance of 120 Ω at zero strain condition. A 200 KΩ is connected across the gauge. Find the equivalent virtual strain as observed from the combination.

- (b) The operation of a LVDT depends on the mutual inductance of coils. In the adjoining figure, insert dots to the coils to realize a differential output.
What is an off-set voltage in a LVDT? What are the reasons of having such an offset voltage. Explain the function of a phase-sensitive detector.



4 + (2 + 1 + 2 + 3) = 12

Group - C

- 4. (a) What is a piezoelectric transducer? Draw its equivalent circuit. Derive an expression for the output voltage by making suitable assumptions.
- (b) A heavy machine is running with some abnormal vibration. How can a Piezo Electric Transducer be used to measure that vibration?

2 + (2 + 4) + 4 = 12

- 5. (a) An industrial load draws 500 A of current. Can a Hall sensor be used for the measurement of such magnitude of current? Explain briefly with a neat sketch.
- (b) A costly tachometer-based RPM (Rotation per minute) sensor of a rotating motor is malfunctioning. An engineer wants to replace that with a low cost speed sensor. He goes to the engineering store and finds an inductive proximity switch. Show a scheme for measurement of RPM of the motor using the proximity sensor.

6 + 6 = 12

Group - D

- 6. (a) The distance between the temperature sensing and measuring points is around 800 meters. What type of RTD configuration will be suitable? Explain with a neat and labelled diagram.
- (b) What is the difference between compensating cable and extension cable? Draw and explain a scheme for temperature compensation while using a thermocouple as a sensor.

(1 + 4) + (2 + 5) = 12

- 7. (a) How would you segregate the industrial thermocouples, RTDs and Thermistors from a given set of temperature sensors? With a neat sketch, show the arrangement and working of an optical radiation pyrometer.
- (b) A platinum thermometer has a resistance of 1000 ohm at 0°C. Find the resistance at 65°C if the platinum has a resistance temperature coefficient of 0.00392/°C.

(3 + 5) + 4 = 12

Group - D

- 8. (a) What is a photo-multiplier tube? Explain with a suitable sketch, the use of a photodetector for the measurement of angular speed.
- (b) With a suitable labelled diagram, explain the use of an ultrasonic sensor to measure the velocity of a flowing liquid.

(2 + 4) + 6 = 12

- 9. Write short notes on any two of the followings:
i) Geiger Counters
ii) Inductive proximity
iii) Semiconductor type temperature sensors
iv) Level measurement using ultrasonic sensor.
v) Thermistors

6 + 6 = 12