(vi) In a potentiometer, high value of resistance of potentiometer leads to
(a) high value of sensitivity (b) low value of sensitivity
(c) low value of non-linearity (d) low value of error.

(vii) Two strain gauges are used to measure strain in a continuous beam. One gauge is mounted on top having principle axis parallel to cantilever strain axis and the other at the bottom having principle axis perpendicular to that of the cantilever strain axis. The two strain gauge form two consecutive arms of a voltage sensitive Whetstone bridge. This bridge configuration is called
(a) a quarter bridge (b) a null bridge
(c) a half bridge (d) a full bridge.

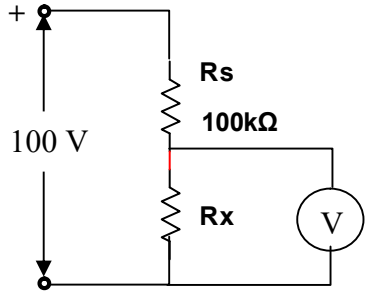
(viii) Two secondaries of an LVDT have wrongly been connected in phase. The input–output relationship would be
(a) linear with +ve slope (b) linear with -ve slope
(c) V shaped curve (d) a constant output.

(ix) Chromel Alumel thermocouple is typed as
(a) J-type (b) T-type (c) K-type (d) E-type.

(x) Photo multiplier tube consists of
(a) 1 photo-emissive cathode and 2 dynodes
(b) 2 photo-emissive cathode and 2 dynodes
(c) 2 photo-emissive cathode and 1 dynode
(d) 1 photo-emissive cathode and 1 dynodes.

Group – B

2. (a) The voltmeter shown in the following figure has a sensitivity of 500 Ω/V and a full scale of 100 V. When connected in the circuit as shown, the meter reads 20 V. Then find the value of R_x.



(b) State the causes of residual voltage appeared in LVDT.

(c) How can you apply a capacitive transducer for moisture measurement – explain?

5 + 3 + 4 = 12

3. (a) Find the half bridge sensitivity for strain gauge signal conditioning unit.

(b) Is it necessary any temperature compensation for half bridge configuration? Justify your answer.

(c) Design a transducer for torque measurement using strain gauge.

5 + 2 + 5 = 12

Group – C

4. (a) Define inverse piezoelectric effect. Derive the relationship between charge sensitivity and the voltage sensitivity.

(b) A piezoelectric transducer is directly connected through a cable to an electronic voltmeter. The minimum operating frequency of measurement is 1000Hz. If the connecting cable length is doubled, calculate the new minimum operating frequency of measurement.

(c) What do you mean by piezoelectric bimorph? Whether a series type or parallel type piezoelectric bimorph be used for a microphone? Justify your answer.

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

5. (a) Define Hall Effect. Derive the expression for the output voltage of the Hall sensor.

(b) How can a Hall sensor be used for the measurement of current of the order of several amperes?

(c) How magneto-strictive transducer can be applied to measure torque? Explain with suitable schematic diagram.

(1 + 4) + 4 + 3 = 12

Group – D

6. (a) Why is temperature compensation necessary for a thermocouple? Briefly describe any one industrially applicable process of temperature compensation. A reaction vessel is divided into three sections at different temperatures. How would you measure the average temperature of the vessel?

(b) The distance between the temperature sensing and measuring points is around 600 meters. What type of RTD configuration will be suitable? Explain with a neat and labelled diagram.

(2 + 4 + 2) + 4 = 12

7. (a) How would you segregate the industrial thermocouples, RTDs and Thermistors from a given set of temperature sensors? What is pt-1000?

   (b) With a neat sketch show the arrangement and working of an optical radiation pyrometer. A platinum thermometer has a resistance of 100Ω at 25°C. Find the resistance at 65°C if the platinum has a resistance temperature coefficient of 0.00392/°C.

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

Group – E

8. (a) What is a photodetector? Explain with a suitable sketch, the use of a photodetector for the measurement of angular speed.

   (b) Explain in brief, the working of an ultrasonic sensor. With a suitable diagram, explain the use of a ultrasonic sensor to measure the velocity of a flowing liquid.

(2 + 4) + (2 + 4) = 12

9. Write short notes on any two of the followings:
   (i) Scintillation counter
   (ii) Photovoltaic cell
   (iii) Semiconductor type temperature sensors
   (iv) Smart sensors.

(6 × 2) = 12

B.TECH/AEIE/4TH SEM/AEIE 2202/2017

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) A transducer has an output impedance of 1 MΩ and a load resistance of 1kΩ, the transducer behaves as
   (a) constant current source (b) constant voltage source
   (c) constant power source (d) constant impedance source.

   (ii) For signal conditioning of the piezo-electric type transducer we require
   (a) a differential amplifier (b) an instrumentation amplifier
   (c) a charge amplifier (d) a transconductance amplifier.

   (iii) Inductive proximity sensors can be effective only when the objects are of _____ materials.
   (a) ferro magnetic (b) paramagnetic
   (c) diamagnetic (d) all of the above.

   (iv) Which of the following forms of temperature sensor produces a large change in its resistance with temperature, but is very non-linear?
   (a) A pn junction sensor
   (b) A platinum resistance thermometer
   (c) Thermistor
   (d) Total radiation pyrometer.

   (v) In a transducer, the observed output deviates from the correct value by a constant factor, the resulting error is called
   (a) Zero error (b) Sensitivity error
   (c) Hysteresis error (d) Nonconformity error.