(vii)   Photo conductive cell consists of a thin film of
   (a) Quartz   (b) Lithium sulphate
   (c) Barium titanate   (d) Selenium.

(viii) The resistance of LDR _____ when exposed to radiant energy.
   (a) remains unaltered   (b) increases
   (c) reaches maximum   (d) decreases.

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

(x)   Magneto elastic type transducer works on _____with applied stress
   (a) change of permeability   (b) change of dimensions
   (c) change of charge distribution   (d) all of these.

Group - B

2. (a)   Explain the working principle of LVDT. Draw an electronic circuit interfaced with LVDT that can provide core-direction sensitive output.

   (b)   The Fig.1 represents an arrangement of a potentiometric sensor whose specifications are given as20 KΩ and 0.025W.
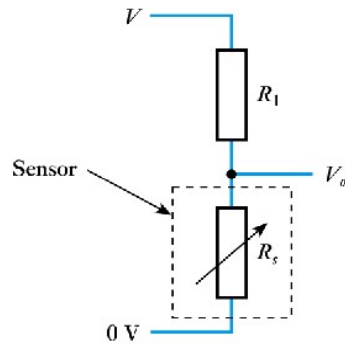   If V=15 Volts DC, find the current flowing through the resistor R1.

Fig.1

(4+4) + 4 = 12

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

   (b)   A variable capacitance angular velocity pick-up is made up with two concentrically mounted parallel semicircular plates with a small

separation between them. A DC voltage (V) is connected across the capacitance sensor. Derive the nature of the current drawn by the capacitance when the movable plate is displaced with a constant angular velocity. Assume r is the radius of each plate.
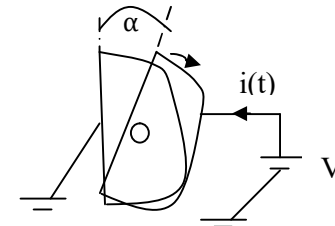
6 + 6 = 12

Group - C

4. (a)   What is a thermocouple? What is meant by cold junction compensation? Why is it necessary? A thermocouple with reference junction temperature at 20°C gives an output of 5 mV. If the thermocouple sensitivity is 50μV/°C, then calculate the measured temperature.

   (b)   Explain with a neat schematic diagram the operation of a radiation.
   (1+2+2+2) + 5 = 12

5. (a)   Draw an equivalent electrical circuit of a thermopile. Explain with a suitable electrical circuit how one can measure an average temperature of a reaction column using thermocouples.

   (b)   Explain the operation of a 3-wire RTD using a suitable circuit diagram. Why is 4-wire RTD better that 3-wire RTD?
   (2+4) + (4+2) = 12

Group – D

6. (a)   Describe the principle of operation of Hall-effect sensor. How can it be used in displacement sensing?

   (b)   Draw the equivalent circuit of a piezo-electric crystal. Show the step response of a piezo-electric crystal.
   (3+3) + (2+4) = 12

7. (a) A piezo- electric transducer is directly connected to an OP-AMP through a cable. The minimum operating frequency is 1000 Hz. If the connecting cable is doubled, then find the new operating frequency.

   (b) Evaluate the transfer function of a piezoelectric transducer and draw its frequency response.

   $$4 + (4+4) = 12$$

Group - E

8. (a) The responsivity of a photodiode is 0.9 A/W. Find the value of R to obtain an output voltage V_{out} of (-1)V from an Op-Amp for an incident optical power of 1 mW. The Op-Amp is powered by a dual source of ±5 V.
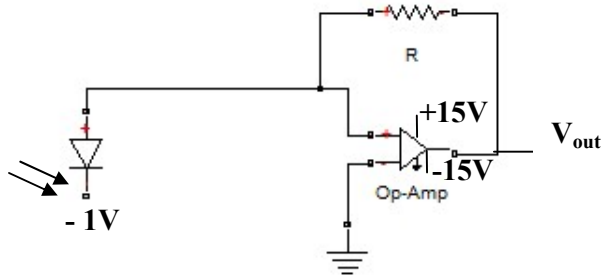
   (b) What are Bimorph and Multimorph? Draw and explain the operation of a photoelectric proximity sensor.

   $$4 + (4+4) = 12$$

9. (a) Explain magnetostrictive phenomenon. Draw and explain a scheme to measure the vibration of an object.

   (b) Write short notes on any one of the following:
   a) Geiger Counters
   b) Photovoltaic cell
   c) Photodiode

   $$(2+4) + 6 = 12$$

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 alternatives for the following:　　　$10 \times 1 = 10$

   (i) The transducer that converts the input signal into the output signal, which is a discrete function of time, is known as _____ transducer.
   (a) Active　　(b) Analog　　(c) Digital　　(d) Pulse.

   (ii) The principle of operation of LVDT is based on the variation of
   (a) Self inductance　　　　　(b) Mutual inductance
   (c) Permanence　　　　　　(d) Reluctance.

   (iii) The sensitivity factor of strain gauge is normally of the order of
   (a) 1-1.5　　(b) 1.5-2　　(c) 0.5-1.0　　(d) 5-10.

   (iv) Quartz and Rochelle salt belongs to _____ of piezo-electric
   (a) natural group　　　　　(b) synthetic group
   (c) natural or synthetic group　(d) fibre group.

   (v) Hall effect transducer is used for measuring
   (a) Magnetic field　　　　　(b) Electric field
   (c) current　　　　　　　　(d) both (a) and (c).

   (vi) Capacitive transducers are normally employed for_____ measurements
   (a) Static　　　　　　　　(b) Dynamic
   (c) transient　　　　　　　(d) Both static and dynamic.