Max Marks 60   : Attempt All questions. Answers should be brief to the point, and accompanied by neatly drawn relevant figures / circuits.

Q1. (a) With reference to sensors / transducers define the following : (i) accuracy (ii) precision (iii) systematic errors (iv) random errors (v) hysterisis (vi) backlash.   (6)
(b) Explain with help of suitable example the difference between (i) and (ii) and also between (v) and (vi).   (4)

Q2. (a) With help of neat diagram explain the principle and working of LVDT.   (6)
(b) In context of linear displacement measurement compare LVDT & potentiometric sensor wrt resolution, wear & tear giving suitable explanation for the difference   (4)

Q3. (a) Draw the circuit diagram of a fully active strain gauge bridge with zeroing and sensitivity adjustments & show proper placement of the gauges on cantilever   (4)
(b) Derive and calculate the values of offset and sensitivity resistances for the extreme case of tolerances given that tolerances for gauge resistances is $\pm$ 5%, gauge factor $\pm$10% and battery voltage $\pm$20% and the nominal gauge resistance being 100 ohms.   (6)

Q4. (a) Explain with help of neat diagram and V-I characteristics the principle and working of photodiode   (6)
(b) A photodiode has dark current of 1 nA, sensitivity 1nA/lux. Design a suitable amplifier with offset and sensitivity adjustments which gives   100 mV for 100 lux and 0 mV for 0 lux.   (4)

Q5. (a) Draw 3 wire and 4 wire RTD bridge circuits and explain two important advantages of 4 wire over 3 wire sensor.   (4)
(b) An RTD has $R_o = 100$ ohms at 0^0C and resistance R_t at t ^0C given by
$R_t = R_o(1+at)$ where $a = 4 \times 10^{-3} / {}^0C$ and bridge excitation voltage being 10 V.
Give for this circuit, $\Sigma R = 100$ ohm for arms of the bridge   (6)
(i)   Difference amplifier design for gain of 10 and loading error less than 1%
(ii) Output voltage of amplifier at $100\ {}^0C$.
(iii) Offset error in temperature at $0\ {}^0C$ taking CMRR as 100 dB

Q6. Explain with help of neat diagrams where needed   (10)
   (a) why nano sensors are classified by their size
   (b) why color of nano particle should undergo change if another particle adheres to it
   (c) how a micro cantilever can be made to detect presence of a specific substance
   (d) why cross sensitivity to temperature is reduced using fully active strain gauge bridge
   (e) why electromagnetic flow sensor cannot be used to measure flow of electrically non-conducting fluids