

Sl. No. of Question Paper: 2271

Unique Paper Code : 2511202

Name of the Course : B. Tech. Instrumentation

Name of the Paper : Transducer

Semester : II

Duration : 3 Hours

Max. Marks : 75

F-4

Attempt FIVE questions in all. Question No. 1 is compulsory.

- Q: 1(a) Differentiate between Transducers and Inverse transducers? Give one example of each category. (2+1)
- (b) A transducer showing a low hysteresis gives better repeatability- Comment. (3)
- (c) Explain the principle of working and constructional details of a photo-transistor. (3)
- (d) The output of a LVDT is 1.5 V at maximum displacement. At a load of $0.5M\Omega$ the deviation from linearity is maximum and it is ± 0.003 V. From a straight line through origin, find the linearity at the given load. (3)
- (e) List at least three applications of an inductive transducer. (3)

- Q. 2(a) Small output voltage exists at the null position of a LVDT- comment on the statement. (3)
- (b) Explain the principle and working of a liquid level measurement system using a capacitive transducer. (5)
- (c) Figure 1 shows an electromagnetic type of balance which utilizes the modulation of light energy falling on a phototube for the measurement of an unknown force. Draw a generalized block diagram of measurement system and explain the function of each block. (7)

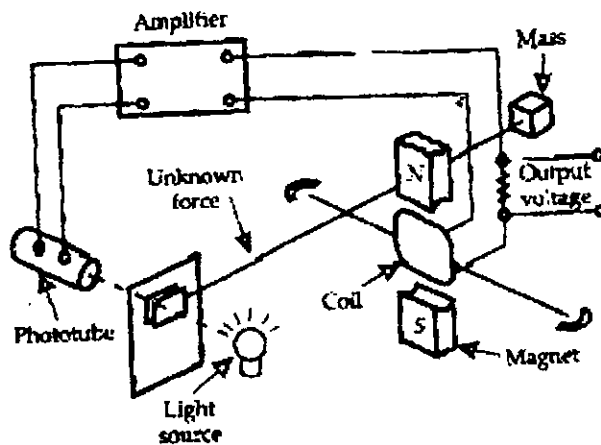


Figure 1

- Q.3(a) A wheatstone bridge requires a change of 7Ω in the unknown arm of the bridge to produce a change in deflection of 3mm of the galvanometer. Determine the sensitivity and inverse sensitivity. (4)
- (b) Define and explain one desirable and undesirable dynamic characteristic of instrumentation system (5)
- (c) Derive an expression for the estimation of gauge factor in a wire wound strain gauge. (6)

- Q.4(a) Define threshold and dead time with supporting graphs/diagram. (5)
- (b) A multimeter having a sensitivity of $2000 \Omega/V$ is used for the measurement of voltage across a circuit having an output resistance of 10Ω . The open circuit voltage of the circuit is $6 V$. Find the reading of the multimeter when it is set to its $10 V$ scale. Find the percentage error. (5)
- (c) A platinum thermometer has a resistance of 150Ω at $25^\circ C$. Find
 (i) its resistance at $60^\circ C$ if the platinum has a resistance temperature coefficient of $0.00392/^\circ C$.
 (ii) If the thermometer has a resistance of 200Ω . Calculate the temperature. (5)
- Q.5(a) An LVDT with a secondary voltage of $5V$ has a range of $\pm 25mm$. Find the output voltage when the core is $- 18.75 mm$ from the center. Plot the output voltage vs. core position for a core movement going from $+18.75 mm$ to $-10 mm$. (5)
- (b) List the requirements of a conductor material to be used in RTD's. Why gold and silver are rarely used for the construction of RTD's. (5)
- (c) The output of an instrument under particular environmental conditions is given by the relationship $q_o = a + bq_i$ where q_i is input, a and b are constants and $b \neq 1$. Identify the static characteristics which can explain this type of output. Explain the characteristics also. (5)
- Q.6(a) In a variable capacitor transducer the diaphragms are $20 mm$ in diameter and $4 mm$ apart. If a pressure produces an average deflection of $0.25 mm$, calculate the value of capacitance after the application of force. The capacitance before application of force is $400 pf$. (4)
- (b) A resistor has a nominal value of $10 \Omega \pm 0.1\%$. A voltage is applied across the resistor and the power consumed in the resistor is calculated in two ways:
 (i) $P = E^2 / R$ and (ii) $P = E \cdot I$
 Calculate the uncertainty in the power determination in each case when the measured value of E and I are $100V \pm 1\%$ and $10 A \pm 1\%$ respectively. (5)
- (c) Describe the principle and applications of a Hall Effect transducer. (6)
- Q.7(a) Explain why purely mechanical instruments cannot be used for dynamic measurements. (3)
- (b) Draw the equivalent circuit of a piezoelectric transducer. A piezoelectric crystal having dimensions of $5mm \times 5mm \times 1.5mm$ and a voltage sensitivity of $0.055 V\text{-m/N}$ is used for the force measurement. Calculate the force if the voltage developed is $120 V$. (2+3)
- (c) Explain the principle of a photoconductive cell. How it could be used for counting the bottles of soft drink moving on a conveyor belt. (3+4)