INSTRUMENTATION AND TELEMETRY
(AEIE 4121)

Time Allotted : 2½ hrs   **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 4 (four)</u> from Group B to E, taking <u>one</u> from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Degree of agreement among a group of measurement is termed as
(a) Accuracy   (b) Precision   (c) Resolution   (d) Threshold.

(ii) Which one of the following is an example of passive transducer?
(a) Photovoltaic cell   (b) Thermocouple
(c) Piezoelectric   (d) Strain Gauge.

(iii) LVDT has.
(a) Two primary coils connected in phase and a secondary coil
(b) Two primary coils connected in phase opposition and a secondary coil
(c) One primary coil and two secondary coils connected in phase
(d) One primary coil and two secondary coils connected in phase opposition.

(iv) Which one of the following instrument is commonly used to measure vacuum pressure?
(a) McLeod Gauge   (b) Bellow
(c) Capsule   (d) Bordon Tube.

(v) Best choice for measuring temperature in the range of -50°C to 150°C is
(a) Thermocouple   (b) LM35   (c) Thermistor   (d) RTD.

(vi) Which of the following flow meter is of non-contact type?
(a) Ultrasonic type   (b) Venturimeter
(c) Pitot Tube   (d) Orifice Plate.

(vii) The temperature above 2000°C can be measured using
(a) Thermocouple   (b) RTD
(c) Thermistor   (d) Pyrometer.

(viii) CMRR for an OPAMP is
(a) Unity   (b) Zero
(c) Very High   (d) Less than unity.

(ix)   TDM is a technique where
   (a) Different signals operates with different frequency with a guard band in between
   (b) All signals operate with the same frequency at different times
   (c) Transmitting multiple optical signals simultaneously over a single optical fiber, each with a different wavelength
   (d) Multiple antennas are used at both the transmitter and receiver ends to create parallel communication channels.

(x)   FDM is a technique where
   (a) Different signals operates with different frequency with a guard band in between
   (b) All signals operate with the same frequency at different times
   (c) Transmitting multiple optical signals simultaneously over a single optical fiber, each with a different wavelength
   (d) Multiple antennas are used at both the transmitter and receiver ends to create parallel communication channels.

Fill in the blanks with the correct word

(xi)   The resolution for 10 bit ADC with voltage range 0-5 Volt is _____.

(xii)   The temperature compensation in Strain Gauge quarter bridge configuration is done using _____ gauge.

(xiii) The working of head type flowmeters is based on _____ principle.

(xiv)   Sampling theorem states that the sampling rate must be equal to or greater than _____the highest frequency in the signal.

(xv)   IEEE 802.11 standards apply to all _____ devices.

Group - B

2. (a) Define gauge factor and hence derive the expression for the same.
                                            [(CO2)(Remember/Understand/LOCQ)]
    (b) Explain how can capacitive transducer be applied for measurement of humidity?
                                            [(CO4)(Apply/IOCQ)]
    (c) Define Villary effect and name a material shows this effect.   *[(CO3)(Remember/IOCQ)]*
                                            (1 + 4) + 5 + 2 = 12

3. (a) Draw the signal conditioning circuit used for strain gauge in quarter bridge configuration and hence find the sensitivity expression.   *[(CO4)(Apply/IOCQ)]*
    (b) Define voltage sensitivity of piezoelectric transducer. Find the relation between charge and voltage sensitivity.   *[(CO2)(Understand/LOCQ)]*
    (c) Explain with necessary schematic diagram, how hall sensor can be applied to measure speed of a vehicle.   *[(CO4)(Apply/IOCQ)]*
                                            (2 + 3) + (1 + 2) + 4 = 12

Group - C

4. (a) Draw a neat labelled diagram of Bordon tube.   *[(CO3)(understand/LOCQ)]*

(b) Derive the volume flow rate equation for orifice meter. Also draw the pressure profile along the flow axis for orifice plate. *[(CO3)(Apply/IOCQ)]*

(c) How can capacitive sensors be used to measure differential pressure? Explain how this can be used to measure level of a liquid column with necessary schematic diagram. *[(CO3)(Create/HOCQ)]*

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

5. (a) Derive the volume flow rate equation for pitot tube. How can Pitot tube be modified to measure average flow rate? *[(CO3)(Analyse/IOCQ)]*

(b) Draw the signal conditioning circuit for 3-wire RTD and find the output expression. *[(CO4)(Apply/IOCQ)]*

(c) How can thermistor be use as inrush current limiter for inductive load? *[(CO4)(Create/HOCQ)]*

(3 + 2) + 4 + 3 = 12

Group - D

6. (a) Find the output expression of integrator circuit using OPAMP. State one application of such circuit. *[(CO4)(Analyse/IOCQ)]*

(b) Describe working of counter comparator type ADC with necessary block diagram. *[(CO4)(Analyse/IOCQ)]*

(c) State sampling theorem and quantization error. *[(CO5)(Remember/LOCQ)]*

(3 + 1) + 5 + 3 = 12

7. (a) With necessary block/circuit diagram explain the current telemetry system. *[(CO3)(Analyse/IOCQ)]*

(b) Describe operation of a current to voltage converter. *[(CO4)(Remember/LOCQ)]*

(c) Describe briefly the function of various layers of fiber optic cable. *[(CO2)(Understand/LOCQ)]*

5 + 4 + 3 = 12

Group - E

8. (a) What do you mean by phase shift keying (PSK)? Describe working of PSK modulator with necessary schematic diagram. *[(CO5)(Analyse/IOCQ)]*

(b) Draw and describe the block diagram of frequency shift keying demodulator. *[(CO5)(Analyse/IOCQ)]*

(2 + 5) + 5 = 12

9. (a) What do you mean by frequency shift keying (FSK)? Describe working of FSK modulator with necessary schematic diagram. *[(CO5)(Analyse/IOCQ)]*

(b) Draw and describe the block diagram of quadrature phase shift keying demodulator. *[(CO5)(Analyse/IOCQ)]*

(2 + 5) + 5 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	16.67	75	8.33

Course Outcome (CO):

After the completion of the course students will be able to
1. Understand different blocks of generalized measurement system.
2. Clarify operation of indigenous sensors and transducers.
3. Gain knowledge of measurement system for industrial parameters like pressure, flow, level and temperature.
4. Design various signal conditioning circuits for sensors.
5. Select telemetry system required for a given application.
6. Justify the need of process data multiplexing and de-multiplexing in telemetry.

LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.