B.TECH /CHE/EE /7TH SEM/AEIE 4121/2021

INSTRUMENTATION AND TELEMETRY
(AEIE 4121)

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) Which of the following transducer is an active transducer?
(a) Strain gauge (b) Thermocouple
(c) Photodiode (d) Resistive potentiometer

(ii) Gauge factor of semiconductor type strain gauge is
(a) 2 – 3 (b) 10 - 20
(c) 50 – 200 (d) 6 - 10

(iii) To make LVDT direction sensitive the suitable signal conditioning circuit is
(a) Wheatstone bridge (b) Instrumentation amplifier
(c) Analog to digital converter (d) Phase demodulator circuit

(iv) Which of the following transducer can also be used as inverse transducer?
(a) LVDT (b) Piezoelectric transducer
(c) Strain gauge (d) Capacitive transducer

(v) Optical pyrometer is used to measure
(a) light intensity of light (b) low temperature
(c) high temperature (d) high pressure.

(vi) Pt-100 means the resistance of the RTD
(a) at 0°C is 100 ohms (b) exhibits 100 ohms at 100°C
(c) at 100°C is 200 ohms (d) exhibits 400 ohms at 100°C.

(vii) MQTT is _____ protocol.
(a) Machine to Machine
(b) Internet of Things
(c) Machine to Machine and Internet of Things
(d) Machine Things

(viii) In current telemetry system the range of current signal is
(a) 0–20 mA (b) 4–10 mA
(c) 0–100 mA (d) 4 - 20 mA

(ix) J-type thermocouple is made by
(a) copper-constantan (b) iron-constantan
(c) chromel- alumel (d) chromel- constantan.

(x) Optical fibres use _____ as a transmission media.
(a) visible light (b) LASER
(c) micro-wave (d) both (a) and (b).

Group- B

2. (a) Determine the sensitivity of the parallel plate type capacitive transducer for the measurement of displacement. [(CO2) (Analyze/IOCQ)]

(b) A strain gauge having nominal resistance 100 ohms and gauge factor 2 is connected toone arm of a Wheatstone bridge. In unstrained condition all the arm resistances are same. The strain gauge is cemented on a beam. As a result of the bending of the beam the strain gauge is strained and the unbalance voltage of the bridge is 2.5 mV. The supply voltage of the bridge is 8 volt. Find the change in resistance of the strain gauge. Also find the strainexperienced by it. [(CO2) (Evaluate/HOCQ)]

(c) Why temperature compensation circuit is required for strain gauge while measuring strain? [(CO4)(Understand/LOCQ)]

5 + 5 + 2 = 12

3. (a) Draw the phase sensitive demodulator circuit for LVDT to make the core displacement direction sensitive. Hence draw the graph of output voltage against the core displacement for the position of the core above null, below null and at null. [(CO4) (Analyze/IOCQ)]

(b) With a neat diagram of equivalent circuit of piezoelectric transducer for the measurement of displacement determine the expression of transfer function. [(CO2) (Evaluate/HOCQ)]

(c) What is Hall Effect? Show how Hall voltage is related to flux density of a magnetic field for a Hall Effect transducer. [(CO4) (Analyze/IOCQ)]

4 + 5 + 3 = 12

Group - C

4. (a) Describe the arrangement of diaphragms used to measure differential pressure. [(CO2, CO3) (Understand/LOCQ)]

(b) Can we use Bernoulli's theorem to measure the flow rate of fluid in real life applications? Justify the statement. [(CO2, CO3) (Evaluate/HOCQ)]

(c) How liquid level is measured using resistive method?

[(CO2, CO3)(Analyze/IOCQ)]

4 + 5 + 3 = 12

5. (a) Describe self –heating problem of RTD. [(CO2, CO3) (Understand/LOCQ)]

(b) What is the problem in 2 wire RTD connection? By evaluating 3-wire and 4-wire RTD connections for temperature measurement show how this problem can be removed. [(CO2, CO3) (Understand/LOCQ)]

(c) How can we utilize capacitive sensor for liquid level measurement?

[(CO2, CO3) (Apply/IOCQ)]

2 + (1 + 4) + 5 = 12

Group - D

6. (a) Design and explain a current telemetry system to transmit pressure data to remote end. [(CO5) (Evaluate/HOCQ)]

(b) Draw a current to voltage converter circuits and hence make the circuit analysis of the circuit. [(CO4) (Analyze/IOCQ)]

(c) Design and explain the scheme of frequency telemetry system.

[(CO5)(Evaluate/HOCQ)]

4 + 4 + 4 = 12

7. (a) Draw the generalized block diagram of a fibre-optic communication system. Hence explain briefly the function of each block of the system.

[(CO1) (Explain/LOCQ)]

(b) Explain the operation of a ramp type analog to digital converter.

[(CO4) (Analyze/IOCQ)]

(c) What is quantization error occurred in analog to digital converter?

[(CO4)(Understand/LOCQ)]

(1 + 5) + 4 + 2 = 12

Group - E

8. (a) Evaluate the advantages of wireless telemetry over conventional telemetry network from an industrial point of view. [(CO6) (Evaluate/HOCQ)]]

(b) Using PAM/PM/PM design a system to transmit data from multiple transducers intime division multiplexing system. [(CO6) (Design/HOCQ)]

(c) How the transmitted data at the receiving end are retrieved in time division multiplexing system? [(CO6)(Analyze/IOCQ)]

4 + 4 + 4 = 12

9. (a) State the characteristics of MQTT protocol. [(CO6) (Remember/LOCQ)]

(b) What role does the application layer in the IoT solution stack play?

[(CO5)(Remember/LOCQ)]

(c) What are the advantages of IoT solutions over a wireless sensor network from an application point of view. [(CO5) (Analyze/IOCQ)]

4 + 4 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	23.96%	43.75%	32.29%

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

Department & Section	Submission Link
CHE	https://classroom.google.com/c/NDA1MzcxMTE1NTIy/a/NDY0MTcxNDY1ODk0/details
EE	https://classroom.google.com/c/NDA1MzcxMTE1NTIy/a/NDY0MTY4MjU1MzM4/details