

**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
any 4 (four) from Group B to E, taking one 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) 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.
- (ii) Which of the following optical transducers is an active transducer?
(a) Photo-voltaic cell (b) Photo-transistor
(c) Photo-emissive cell (d) Photo-diode.
- (iii) Electromagnetic flow meter relies on_____ law.
(a) Faraday's (b) Pascal's
(c) Joule's (d) Ohm's
- (iv) Which one is used a pressure gauge?
(a) Bourdon tube (b) Orifice plate
(c) Venture tube (d) Rota meter.
- (v) An Instrumentation amplifier has CMRR value in the order of _____dB.
(a) 10 (b) 20 (c) 50 (d) 100
- (vi) 4~20 mA signal can be transformed into frequency range of:
(a) 5~15 Hz (b) 2 ~ 4 Hz
(c) 50 ~70 Hz (d) 70 ~ 85 Hz
- (vii) Which integrated circuit can be used as a current to voltage converter?
(a) LM741 (b) LM555 (c) IP 556 (d) IP 135
- (viii) Full form of MQTT _____
(a) Message Queuing Telemetry Transport
(b) Message Queuing Telegram Transport
(c) Message Queue Telegram Transport
(d) Message Queue Telemetry Transport.

- (ix) QPSK system uses a phase shift of
 (a) Π (b) $\Pi/2$ (c) $\Pi/4$ (d) 2Π
- (x) The bit rate of a communication system is 34 Mbps. The modulation scheme is QPSK. The baud rate of the system is
 (a) 34 Mbps (b) 68 Mbps (c) 17 Mbps (d) 51 Mbps.

Fill in the blanks with the correct word

- (xi) In 3 – 15 psi signal that corresponds to 0 – 100% scale, the psi value at 25% is _____.
- (xii) Piezoelectric crystals are used for measurement of _____ changes.
- (xiii) Capacitive transducer, used to measure liquid level, detects change of _____.
- (xiv) The operation of a thermocouple is based on_____.
- (xv) Op-Amp in the form of trans-impedance amplifier can be used as _____ converter.

Group - B

2. (a) What do you mean by telemetry & why is it required? [[C05](Remember/LOCQ)]
 (b) Draw the block diagram of a basic telemetry system identifying different parts in it. Briefly describe each part. [[C05](Understand/LOCQ)]
 (c) What are the different types of Electrical Telemetry system? [[C05](Remember/LOCQ)]
3 + 6 + 3 = 12
3. (a) Define Sensors and Transducers. Classify transducers. [[C03](Remember/LOCQ)]
 (b) “All sensors are not transducers, however, all transducers are sensors” — Justify the statement. [[C02](Understand/LOCQ)]
 (c) Fill the following table’s right column with the appropriate transducer types.

Transducers	Types
Thermocouple	
RTD	
Thermistors	
Semiconductor Temperature sensors	
LED	
Photodiode	
Capacitive	
Resistive	
LVDT	
Piezoelectric crystal	
Proximity sensor	
Element having two junctions made up by two dissimilar materials	

[[C02](Apply/IOCQ)]
4 + 2 + 6 = 12

Group - C

4. (a) What is a Thermistor? What type of Transducer is it? What are the two primary types of thermistor? *[[CO3](Analyse/IOCQ)]*
- (b) Calculate the resistance of an NTC thermistor at 40°C, given that it has a resistance of 5 kΩ at 25°C and a β value of 3950K. Explain the use of a PTC thermistor for over-current protection in an electronic circuit. *[[CO4](Analyse/IOCQ)]*
- (c) What is a Thermocouple? What type of Transducer is it? Name the generic and trade names of at least two types of thermocouples, mentioning their corresponding temperature ranges? *[[CO2](Remember/LOCQ)]*
- (1 + 1 + 2) + (2 + 2) + (2 + 2) = 12**
5. (a) An industrial load draws 500 A of current. How can a Hall sensor be used for the measurement of such magnitude of current? Explain briefly with a neat sketch. *[[CO3](Create/HOCQ)]*
- (b) A costly tachometer-based RPM (Rotation per minute) sensor of a rotating motor is malfunctioning. An engineer wants to replace that with a low cost optical speed sensor. Show a scheme for measurement of RPM of the motor using the developed sensor. *[[CO4](Create/HOCQ)]*
- (c) Show a scheme to measure the thickness of a paper sheet using a capacitive transducer and IC 555 timer. *[[CO2](Apply/IOCQ)]*
- 4 + 4 + 4 = 12**

Group - D

6. (a) What are the ideal characteristics of an Instrumentation amplifier? What is its CMRR value? *[[CO4](Remember/LOCQ)]*
- (b) What are its sections? State the functions of each section. *[[CO4](Remember/LOCQ)]*
- (c) Show the circuit diagram of a non-inverting amplifier interfaced with a T-type thermocouple. *[[CO4](Apply/IOCQ)]*
- (3 + 1) + 4 + 4 = 12**
7. (a) State Sampling thermo and prove it. *[[CO4](Understand/LOCQ)]*
- (b) Describe Sample and Hold circuit. *[[CO4](Understand/LOCQ)]*
- (c) In a Fibre-optical cable the refractive indices of the core, cladding and air are 1.59, 1.56 and 1.00 respectively. Calculate the critical incidence angle and the numerical aperture. *[[CO5](Analyse/IOCQ)]*
- 5 + 3 + (2 + 2) = 12**

Group - E

8. (a) Draw and explain the block diagram of a complete telemetry scheme using FDM and demultiplexing. *[[CO6](Analyse/IOCQ)]*
- (b) How does TDM differ from FDM system? *[[CO6](Analyse/IOCQ)]*
- 10 + 2 = 12**

9. (a) State the various parts of an IoT system from the device perspective. *[(CO5) (Remember/LOCQ)]*
- (b) What role does cloud play in an IoT system? *[(CO5) (Analyse/IOCQ)]*
- (c) List few features of MQTT protocol. *[(CO5) (Remember/LOCQ)]*
- 4 + 3 + 5 = 12**
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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	48.95	42.71	8.33