INSTRUMENTATION AND INDUSTRIAL AUTOMATION
(AEIE 5133)

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) When the reading of a pH meter is going from 5 to 7 then, the hydrogen ion concentration of the solution is
(a) Halved (b) Doubled
(c) Increased 100 times (d) Decreased 100 times.

(ii) Dynamic characteristics of Capacitive transducers are similar to those of
(a) Low Pass Filters (b) High Pass Filters
(c) Band pass Filters (d) Notch Filters

(iii) Capacitive transducers are used in level measurement. Principle of operation used in this case is
(a) Change of Area of plates (b) Change of distances between plates
(c) Change of dielectric strength (d) None of these.

(iv) Fire or explosion could occur when
(a) Combustible materials like flammable gas, vapour, dust or fibres are present
(b) The combustible materials are mixed with the air in the proportions required to produce a flammable mixture
(c) A source of ignition acts to ignite the mixture
(d) All of above are true.

(v) Response of Feed-Forward control loop is_____ than Feedback control.
(a) Moderate (b) Slower (c) Faster (d) None of these.

(vi) Full form of SCADA is
(a) Super computer and data acquisition
(b) Supervisory control and digital acquisition
(c) Supervisory control and data acquisition
(d) Supervisory control and digital Adjustment.

(vii) Fluid with high Reynolds's number indicates that flow is
(a) Laminar (b) Turbulent (c) Erratic (d) Transitional

(viii) P&ID symbols depict which of the following types of information?
(a) Detailed functionality (b) Measurement range of the device
(c) Maintenance requirements (d) Process location of a device

(ix) At the input stage of an Instrumentation Amplifier, _____is/are used.
(a) two voltage followers (b) single voltage follower
(c) two differential amplifiers (d) a comparator

(x) An orifice plate suitable for measurement of fluid containing solid is
(a) Concentric orifice
(b) Eccentric orifice plates with holes towards bottom
(c) Eccentric orifice plates with holes towards top
(d) Segmental orifice plate with holes towards top.

Group- B

2 (a) Derive an equation to relate volumetric flow rate in a pipeline with differential pressure. Describe any non-obstruction type flow measuring technique. [(CO2) (Remember/LOCQ)]

(b) Liquid Flow in a pipe is being measured by an Orifice-meter. A bellow-LVDT Combo is used that provides output of 0.4V/K-Pa. What is the range of output for Flow variation between 0.1 M^3/mm to 0.5 M^3/mm. Given Orifice Flow constant k= 0.006 M^3/mm /K-Pa^{-2}. . [(CO2) (Evaluate/HOCQ)]

(3 + 4) + 5 =12

3. (a) State the advantages of an instrumentation amplifier. Derive the expression for overall gain. [(CO1) (Remember/LOCQ)]

(b) In a strain gauge, establish a relation between gauge factor and Poisson's ratio. [(CO1) (Solve/IOCQ)]

(c) A compressive force is applied to a structure. The strain is 5 micro-strain. Two separate strain gauges are attached to the structure, one is nickel wire strain gauge having a gauge factor of -12.1 and the other is nichrome wire strain gauge having a gauge factor of 2. Calculate the value of resistance of the gauge after they are strained, if initial resistance of strain gauge is 120 Ohm. [(CO1) (Evaluate /HOCQ)]

4 + 3 + 5 = 12

Group - C

4. (a) Draw and describe the conductivity cell. Also explain the significance of two and four sensors conductivity cell. [(CO2) (Understand/LOCQ)]

(b) Write the significance of Glass membrane in pH measurement. [(CO2) (Analyse /IOCQ)]

(4 + 4) + 4 = 12

5. (a) Explain the cascade control implemented in boiler drum level. Analyze with example why inner loop is faster than the outer loop in Cascade control. [(CO4) (Analyze/IOCQ)]
   (b) Analyze the working of ratio control with proper block diagram. [(CO3) (Analyze/IOCQ)]

(4 + 3) + 5 = 12

Group - D

6. (a) What is the necessity of hazardous area classification in industry? [(CO5) (Remember/LOCQ)]
   (b) Distinguish between Class, Division and Group classification according to hazardous area location. [(CO5) (Analyze/IOCQ)]
   (c) Explain the following terms: (i) NEMA4X, (ii) T5, and (iii) IP65. [(CO5) (Understand/LOCQ)]

2 + 7 + 3 = 12

7. (a) What are the different types of transmitting signals are used in the industrial transmitters for signal transmission? [(CO5) (Remember/LOCQ]
   (b) Distinguish between 2-wire and 4-wire transmitters connection with proper circuit diagram. [(CO5) (Analyze/IOCQ)]
   (c) What is HART Protocol? [(CO5) (Remember/LOCQ]
   (d) A level transmitter installed in a water tank shows an output of 4 to 20 mA for its level of 0 and 5m respectively. Measure the transmitting signal (in mA) for the tank level of 3 m. [(CO5) (Evaluate/HOCQ]

2 + 5 + 2 + 3 = 12

Group - E

8. (a) What are the advantages of Automation? Explain in detail about the component of Industrial Automation? [(CO4) (Remember/LOCQ)]
   (b) Describe hardware functionality of a Remote Terminal Unit (RTU) of SCADA system. [(CO6) (Explain/LOCQ)]

(3 + 4) + 5 = 12

9. (a) Realise push-button switch and XOR logic in Ladder diagram of PLC. [(CO6) (Create/HOCQ)]
   (b) Explain functional block diagram of input and output modules of PLC. [(CO6) (Remember/LOCQ)]

(3 + 3) + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	47.91%	32.29%	19.80%

Course Outcome (CO):

After the completion of the course students will be able to

1. Analyse the characteristics of resistive, inductive and capacitive sensors.
2. Learn various process variable measuring instruments.
3. Learn to read and draw the P&I diagrams.
4. Apply the knowledge of various control methodologies in industrial automation.
5. Learn industrial signal transmitter and safety in handling industrial instruments.
6. Explain the process automation and architecture

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

Department & Section	Submission Link
AEIE	https://classroom.google.com/c/NDEwMDE1NTEyNTU5/a/NDY0MTQ0NjUzNDcz/details