INDUSTRIAL INSTRUMENTATION
(AEI2202)

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) Dead-weight tester is used for
(a) Testing dead weight
(b) Generating high pressure
(c) Measuring process pressure continuously
(d) Calibrating the pressure gauge

(ii) The dead weight tester works on _____.
(a) Bernoulli's theorem (b) Pascal's law
(c) Seebeck effect (d) Thomson's effect.

(iii) The flapper-nozzle system is primarily used in _____ system.
(a) Electrical (b) Pneumatic
(c) Hydraulic (d) Thermal

(iv) Electromagnetic flowmeter is used to measure the flow of
(a) Wind (b) Conducting fluid in a plastic pipe
(c) Conducting fluid in a metal pipe (d) Non-conducting fluid in a metal pipe

(v) The Venturi flow meter works on _____ principle
(a) Bernoulii's (b) Seebeck's
(c) Archimedes' (d) Joules'

(vi) _____ level transmitter remains unaffected by the foam in the liquid
(a) Ultrasonic (b) Capacitance
(c) Guided wave radar (d) Differential pressure

(vii) If the ambient temperature is doubled and pressure fluctuates, then the transmission time of radar through air is
(a) Almost unaffected (b) Increases
(c) Decreases (d) Cannot be predicted

(viii) Sodium ions contribute to which characteristic of the water?
(a) Ph (b) TDS
(c) Suspended solids (d) Colour

(ix) Hazardous area classification is based on the presence of_____.
(a) Combustible dusts, vapors, and gases (b) Excessive moisture
(c) Corrosive gases (d) Noise levels

(x) SI unit of conductivity is _____.
(a) ohm/cm (b) Siemens/m
(c) Siemens/cm (d) mho

Fill in the blanks with the correct word

(xi) The term 'bluff' is related to _____.

(xii) A rotameter is called as a _____.

(xiii) The full form of NEMA in safety codes is _____.

(xiv) The radiation level detector uses _____ rays.

(xv) The amount of water absorbed by a solid or a liquid is called _____.

Group - B

2. (a) What is the function of a flapper-nozzle system? Draw the transfer characteristic of such a system. What are the live and dead zeros of a pneumatic transmitter? What is the supply pressure of such a system? *[(CO1)(Remember/LOCQ)]*
(b) How does a Bourdon tube type pressure gauge work? Show the selection criteria of a pressure gauge for a specific industrial process. *[(CO5)(Analyse /IOCQ)]*

(1 + 2 + 2 + 1) + (2 + 4) = 12

3. (a) Write down the working equation of a dead weight tester. What is the reason of spinning the weights during unloading? What dose 'dead weight' mean here? *[(CO1)(Apply/IOCQ)]*
(b) "Labelling the platform of a dead weight tester prior to calibration is crucial", Justify. Name the element used to label. What characteristics of a dead weight tester make it a standard tool for pressure calibration? *[(CO1)(Understand/IOCQ)]*

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

Group - C

4. (a) Define the terms 'Turndown' and 'Rangeability' of a flowmeter. What is pressure recovery in case of a head type flowmeter? *[(CO2)(Analyse/HOCQ)]*
(b) A Rotameter shows a linear relationship between the volumetric flow rate and the displacement of its float, Justify. *[(CO2)(Remember/LOCQ)]*
(c) What would happen when a rotameter, intended for water line, was installed in the milk flow line? How does one make a rotameter independent of viscosity variation? *[(CO2)(Apply/IOCQ)]*

(2 + 2) + 4 + (2 + 2) = 12

5. (a) What is an ultrasonic flow meter? How does an ultrasonic flow meter work? *[(CO3)(Remember/LOCQ)]*

(b) What is Transit-Time measurement and how does it work? What is the role of piezoelectric transducers in ultrasonic flow meters? What is the critical limitation of this approach? *[(CO2)(Remember/LOCQ)]*

(c) Why do ultrasonic flow meters require a minimum Reynolds number for accurate measurement? *[(CO2)(Apply/IOCQ)]*

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

Group - D

6. (a) What is liquid interface level measurement and why is it vital? List two industrial applications where liquid interface measurement is necessary. List two factors that affect the accuracy of liquid interface level measurement. *[(CO3)(Remember/LOCQ)]*

(b) Explain with a labelled diagram, how an ultrasonic level sensor can be used for interface detection. Why is a bubbler system used in interface level measurement? *[(CO3)(Apply/IOCQ)]*

(2 + 2 + 2) + (4 + 2) = 12

7. (a) A pressure gauge, used to measure liquid is installed 1 meter below the bottom of the tank. What type of error will occur and how that may be eliminated? Assume density of the water is 1000 kg/m^3. *[(CO3)(Analyse/HOCQ)]*

(b) What is a radiation type level detector? What types of radiation are used? How does the detector work? What are its main components? *[(CO3)(Remember/LOCQ)]*

4 + (2 + 2 + 2 + 2) = 12

Group - E

8. (a) What is the full form of pH? What are the main components of a pH meter? When water is added to an acidic solution and a basic solution, what would happen with the respective pH values? *[(CO4)(Analyse/IOCQ)]*

(b) How many electrodes are used in a pH meter? Describe the purpose of each. What is the range of a pH scale? If the pH of a solution is 4, calculate the concentration of Hydrogen ion. *[(CO4)(Remember/LOCQ)]*

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

9. (a) What is a turbidity meter? How does it differ from a TDS meter? *[(CO4)(Understand/LOCQ)]*

(b) A water sample contains sodium chloride, sodium and potassium bicarbonates. Name the meter with sound reasoning that fits the best for this application. *[(CO4)(Apply/HOCQ)]*

(c) Create a simple sensing circuit for a conductivity meter with appropriate specifications. *[(CO4)(Create/HOCQ)]*

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

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	46.87	36.46	16.67