

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) A U-tube manometer is primarily used for measuring____.
 - (a) Very high pressures
 - (b) Vacuum pressure only
 - (c) Small pressure differences
 - (d) Humidity
- (ii) The best fit pressure gauge for measuring very low pressure is ____.
 - (a) Bourdon tube
 - (b) Bellows
 - (c) Diaphragm
 - (d) Manometer
- (iii) A Pirani gauge is used to measure _____.
 - (a) Atmospheric Pressure
 - (b) Atmospheric Temperature
 - (c) Humidity
 - (d) Vacuum pressure
- (iv) Electromagnetic flow meter cannot be used for the measurement of ____ flow
 - (a) Water
 - (b) Bidirectional
 - (c) Air
 - (d) Milk
- (v) A venturimeter measures _____ of a flowing fluid.
 - (a) Velocity
 - (b) Volumetric flow rate
 - (c) Pressure
 - (d) Reynolds number
- (vi) A Pitot tube is used to measure which of the following?
 - (a) Pressure
 - (b) Flow velocity
 - (c) Viscosity
 - (d) Density
- (vii) Boiler drum level measurement depend on_____.
 - (a) Differential pressure
 - (b) Density
 - (c) Steam flow rate
 - (d) Viscosity
- (viii) In a closed tank, the pressure at the top of the tank (inside) is due to_____.
 - (a) Vacuum pressure
 - (b) Vapour pressure
 - (c) Atmospheric pressure
 - (d) None of the above options

- (ix) The most suitable level detector for powders and granular solids is ____.
- (a) Capacitance (b) Guided waves
(c) Vibrating fork (d) Ultrasonic
- (x) Intrinsically safe (IS) equipment is designed to
- (a) Limit energy to prevent ignition
(b) Operate only in non-hazardous areas
(c) Withstand high-pressure explosions
(d) None of the above options

Fill in the blanks with the correct word

- (xi) Positive displacement flow meters are _____ flow meters.
- (xii) The ultrasonic level measurement depends on the principle of ____.
- (xiii) The temperature at which the water vapour starts condensing is called as ____.
- (xiv) A buffer is a solution which maintains a constant value of ____.
- (xv) _____ flowmeters measure the actual mass flow of a fluid directly, independent of density changes.

Group - B

2. (a) How does a diaphragm pressure gauge work? What are the types of diaphragms? Discuss the relative merits of diaphragm types. [[C01](Remember/LOCQ)]
- (b) State some of the key selection criteria of the diaphragm-type pressure gauges. Create a scheme with a diaphragm to translate electrical signal. [[C05](Understand/LOCQ)]
- (3 + 1 + 2) + (2 + 4) = 12**
3. (a) Draw a diagram to explain how an LVDT can be used with a diaphragm or bellows for the measurement of pressure. [[C05](Analyse/IOCQ)]
- (b) Find out the readings and errors in the Bourdon gauge reading, if it is mounted (i) 20 meters below the water pipeline whose pressure is to be measured, (ii) 30 meters above the pipeline (Assume the water line pressure to be 10 kg/cm²). [[C05](Analyse/IOCQ)]
- (2 + 4) + (3 + 3) = 12**

Group - C

4. (a) What are the different types of orifice plates? What is β -ratio of an orifice plate? What do you mean by orifice tappings? [[C02](Remember/LOCQ)]
- (b) An orifice plate is designed to create a differential pressure of 100 mm of WC. Find the flow rate when the differential pressure is observed as 50 mm of WC. Specify the range and span of the orifice plate flow meter. [[C05](Analyse/IOCQ)]
- (2 + 2 + 2) + (4 + 2) = 12**

5. (a) What is a square root extractor? Which kind of flowmeter makes use of such an extractor? Construct a scheme to incorporate this extractor into the flow sensing and monitoring process. [[CO2](Understand/LOCQ)]
- (b) Show the pressure profile of a flowing liquid as it passes from the upstream to the downstream lines through an orifice plate. [[CO2](Remember/LOCQ)]
- (c) Why is the discharge coefficient (C_d) of an orifice plate flowmeter higher than that of a venturimeter? [[CO2](Apply/IOCQ)]
- (1 + 1 + 4) + 4 + 2 = 12**

Group - D

6. (a) Discuss the use of a capacitive transducer to measure the liquid level in a tank. [[CO3](Understand/LOCQ)]
- (b) A storage tank handles a liquid with unpredictable density. Identify the best fit level measurement technology. Show a neat and labelled diagram. [[CO3](Create/HOCQ)]
- (c) What are the similarities between the displacer type and float type measurement techniques? [[CO3](Remember/LOCQ)]
- 4 + (1 + 4) + 3 = 12**
7. (a) What are the key differences in measuring the level of bulk solids compared to liquids? Differentiate between point-level detection and continuous-level measurement in solid level measurement. Note the challenges industries face in solid level measurement. [[CO3](Understand/LOCQ)]
- (b) A 2-wire pressure transmitter of range 0.2 -1kg/cm² is used for measuring the level in a uniform tank of height 2 meters. Calculate the pressure transmitter output for a level of (i) 1 meter, and (ii) 1.5 meters. [[CO3](Analyse/IOCQ)]
- (2 + 4 + 2) + (2 + 2) = 12**

Group - E

8. (a) The pH of a solution is 10. What type of solution is this? What is the role of a temperature sensor in pH measurement? [[CO4](Analyse/IOCQ)]
- (b) How is conductivity related to pH? The pH of a solution is increasing; does it mean the electrical conductivity of the solution is increasing? Justify. [[CO4](Understand/LOCQ)]
- (c) What is a psychrometer? Where does it find application? [[CO4](Remember/LOCQ)]
- (1 + 2) + (3 + 3) + (2 + 1) = 12**
9. (a) What are NEMA and IP ratings, and why are they important for hazardous area instrumentation? What level of protection does IP67 provide, and where is it commonly used? [[CO6](Remember/LOCQ)]
- (b) What is the purpose of a Zener barrier in an intrinsically safe system? With a neat and labelled circuit diagram, explain how it works. [[CO6](Apply/IOCQ)]
- (2 + 2 + 2) + (2 + 4) = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	60.42	34.38	5.20