

Ref. No.: Ex/IEE/PC/B/T/314/2025

B.I.E.E Third Year First Semester Examination 2025

Time: **3 hours**

Subject: **Process Instrumentation**

Full Marks: **100**

- Each module is associated with a course outcome.
- Answer all modules.
- Choices if provided, are limited to questions within a module.

Module A: Answer Question 1 and any TWO from the rest.

Coverage: Course Outcome 1

Question	Marks
1a. Name the variables measured by a tank gauging system. State some typical applications of such systems.	5
b. Distinguish between: • A point-level sensor and a level transmitter. • Level and Interface measurement.	2 2
2. Compare the advantages and limitations of measuring liquid level in a tank vented to the atmosphere using, a) a flange-mounted pressure transmitter, and b) a pressure transmitter with a remote seal diaphragm.	7
3. Radar level sensors are usually more accurate than ultrasonic level sensors. Justify this statement. Name the property of the liquid that determines the strength of the reflected signal in a radar-level gauge.	7
4. Explain the principle of operation of a vibrating fork-type level switch. Name the various types of process media that this sensor can monitor.	7

Module B: Answer all questions.

Coverage: Course Outcome 2

5. State if the following statements are true or false. Justify your answer. Answer any TWO. a. The output of a thermocouple is independent of the temperature distribution along the length of the conductors.	5 × 2 = 10
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[Turn over

Question	Marks
b. An extension cable is used to connect the output of a base metal thermocouple to a remote device because it is cheaper than a copper cable and reduces installation costs. c. A thermocouple in a protection tube has a faster speed of response than a mineral-insulated, metal-sheathed (MI) thermocouple.	
6a. Name the factors that influence the sensitivity of a Pt RTD.	2
b. Draw and explain the operation of a circuit that uses a constant voltage excitation and generates an output that varies linearly with the change in resistance of a 3-wire RTD. Does the output depend on the lead wire resistance?	5
c. What is the typical excitation current for a Pt100 RTD? What factors influence the choice of this current?	3
Module C: Answer all questions. Coverage: Course Outcome 3	
7a. What is flow totalization? Provide an example of an application where it is required.	3
b. Why does the performance of some flowmeters depend on the velocity profile of the fluid? How can the errors induced by velocity profile distortions be minimized?	5
c. Describe cavitation and flashing in the context of a flowmeter. How can they be prevented?	7
d. Distinguish between actual and standard volume flow rate. Which one is preferred and why? How are these flow rates determined?	7
8. List the variables measured by a Coriolis flowmeter and explain how each of these variables is measured.	10

Question	Marks
Module D: Answer any FIVE questions. Coverage: Course Outcome 4	
9. State if the following statements are true or false. Justify your answer. - Smart transmitters can measure multiple variables, whereas analog electronic transmitters are designed to measure only a single variable. - The accuracy of a smart transmitter is less influenced by changes in environmental parameters such as temperature. - Re-ranging analog transmitters is much easier than re-ranging smart transmitters. - Both analog and smart transmitters support bi-directional communication with the host system. - In the HART protocol, the digital transmission provides faster updates of the measured variable than the analog transmission. - HART protocol supports both analog and digital communication, but only one communication mode can be used at a time. - HART protocol cannot be used with two-wire transmitters; separate pairs of cables are required for the transmitter power supply and communication.	5×5 $= 25$