

Ref. No.:Ex/IEE/PC/B/T/313/2025

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 any THREE questions. Coverage: Course Outcome 1

Question	Marks
1. Explain the principle of operation of a through-air FMCW radar level gauge.	10
2. Describe the construction and operating principle of a magnetostrictive level sensor.	10
3. Describe the principle of operation of a Hydrostatic Tank Gauging system. Name the variables that this system measures, and explain how they are determined.	10
4. Describe a capacitive level sensor used to measure the level of a non-conducting liquid in a vertically mounted, cylindrical metallic tank. Does the sensor output vary linearly with the liquid level? Derive the relationship between the sensor output and the tank level.	10

Module B: Answer all questions. Coverage: Course Outcome 2

5a. Differentiate between a grounded junction and an insulated junction mineral insulated thermocouple.	5
b. Differentiate between a compensating cable and an extension cable.	5

Question	Marks
6a. Draw and explain a circuit that uses a 4-wire RTD with a constant current source excitation, and generates an output that changes linearly with variations in resistance.	6
b. What is self-heating error in an RTD? On what factors does the choice of excitation current of an RTD depend?	5
7. Why are temperature sensors placed within a thermowell? What are the drawbacks of using a thermowell?	5
Module C: Answer any THREE questions. Coverage: Course Outcome 3	
8. Describe the principle of operation of a vortex shedding flowmeter. Can this flow meter be used to measure laminar flows?	8
9. Describe the principle of operation of a variable area flow meter. Does a change in fluid density affect the calibration of this flow meter? Justify your answer.	6 2
10. Describe the principle of operation of a transit-time ultrasonic flow meter. Does the measurement accuracy of this flowmeter depend upon the velocity profile of the flowing fluid?	6 2
11. Can electromagnetic flowmeters be used to measure the flow rate of gases? Explain. Which type of field coil excitation is best suited for the rejection of noise voltages picked up by the electrodes of an electromagnetic flowmeter? Justify your answer.	2 6

Question	Marks
ModuleD:Answer any FOUR. Coverage:Course Outcome 4	
12.State if the following statements are true or false. Justify your answer. a. Smart transmitters are more accurate than analog electronic transmitters. b. HART protocol supports simultaneous analog and digital communication by field devices. c. HART protocol allows multiple transmitters to be connected to the host system with a much lesser length of cable. d. HART protocol supports multivariable transmitters, unlike analog electronic transmitters. e. Smart transmitters can be reranged remotely.	5 × 4 = 20