Ref No: Ex/Che/PC/B/Elec/T/321/2025

BACHELOR OF CHEMICAL ENGINEERING EXAMINATION, 2025

3rd year, 2nd Semester

SUBJECT: - PRINCIPLES OF MEASUREMENTS AND INSTRUMENTATION

Time: Three hours | Full Marks: 100 (Each Part 50 Marks)

PART – I

Answer any **FIVE** Questions. 5×10

1. How can you classify errors in measurements? What are the important objectives for applying statistics to measurement data? 5+5

2. Prove that, in electrical resistance strain gauges, $F = 1 + 2\mu$ where, F is the gauge factor and μ is poisson's ratio. 6+4
   Why do we employ pulse type excitation voltages for bridge measurements using RTDs? Describe the implementation of such a scheme in details.

3. Describe the constructional details of a platinum resistance temperature detector. Hence describe Siemen's 3-lead arrangement used for RTDs. 5+5

4. Differentiate between total radiation pyrometer and selective radiation pyrometer. Is there any difference between the terms **emittance** and **emissivity**? With a neat schematic diagram, explain in detail the operating principle of Fery's total radiation pyrometer. 4+2+4

5. How can you implement a cold/reference junction compensation scheme for a thermocouple, using a thermistor based bridge circuit? 7+3
   In the context of thermocouples, explain the "law of intermediate metals".

6. Explain the advantages of parallel realization of PID control rule using electronic circuits than cascade realization. 5+5
   Explain how integral windup effect can be eliminated using Clegg integrator?

7. How can a pneumatic Proportional-Derivative controller be developed using Baffle-Nozzle amplifiers and bellows? 10

8. How can you broadly classify actuators? With a neat sketch explain the operating principle of spring-diaphragm actuator with positioner. Hence derive the relation between change in output position and change in input pressure. 2+3+5

[Turn over

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B.E. CHEMICAL ENGINEERING THIRD YEAR SECOND SEMESTER EXAMINATION- 2025

SUBJECT: - PRINCIPLES OF MEASUREMENT & INSTRUMENTATION

Time: Three hours **Full Marks: 100**

Use a separate Answer-Script for each part

No. of Questions	PART II (50 Marks)	Marks
	Answer question: -1 and any two from the rest.	
1.	***Answer any four:*** a) Discuss the principle of general pressure and vacuum pressure measurement. b) Distinguish between the working principles of displacer type and float type level sensing method. c) Discuss working principles of volumetric flow sensor and positive displacement type flow sensor. d) State the differences between hot cathode and cold cathode type vacuum pressure gauges. e) Compare the advantages and disadvantages of Orifice and Venturi type flow meters.	**4X5=20**
2.	a) State the working principle of Thermocouple type vacuum pressure sensor. b) Describe the working principle of Diaphragm type level sensor. c) Compare the performance between resistive type and capacitive type level sensor.	**5+5+5**
3.	a) Describe the working principle of pneumatic type differential pressure transmitter with the help of necessary diagram. b) Derive the expression of flow rate for a turbine type flow meter. What is the significance of meter constant? Show the waveform of electrical signal obtained from the magnetic pick up attached to this flow meter.	**7+8**
4.	a) State the working principle for the flow measurement of compressible fluid using Rotameter and Pitot Tube.	

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	b) Write down the flow rate equation of an Orifice type flow meter. What is meant by discharge coefficient in an Orifice type flowmeter?	**10+5**
5.	**Write short notes on any three of the following:** a) McLeod gauge b) Thermal ionization and Flame ionization detector. c) Ring balance manometer. d) Differential pressure transmitter e) Ultrasonic flowmeter f) Torque type mass flow meter	**3X5=15**