Ref No: EX/Che/PC/B/Elec/T/321/2024

B. E. CHEMICAL ENGINEERING 3RD YEAR 2ND SEMESTER EXAMINATION, 2024

SUBJECT: - PRINCIPLES OF MEASUREMENTS AND INSTRUMENTATION

Time: Three hours | Full Marks: 100 (50 marks for each part)

(Use separate Answer Script for each part)

PART – I

Answer any THREE questions. TWO marks are reserved for neatness.

1. a) Give a brief description of the following static performance parameters of instruments: (i) Static Sensitivity, (ii) Resolution, and (iii) Linearity. 6
   b) Derive the transfer function of a general second-order instrument. Hence derive the frequency-response relation of it and sketch the frequency-response characteristics. 10

2. a) Prove that, in electrical resistance strain gauges, $F = 1 + 2\mu$ where, F is the gauge factor and μ is poisson's ratio. 6
   b) How does the ambient temperature variation affect the measurement accuracy in strain gauges? Under what condition is a dummy gauge used? Derive bridge sensitivity in such a condition for Wheatstone bridge method based strain measuring system, using one active and one dummy gauge. 3+2+5

3. a) Differentiate between Seebeck effect, Peltier effect and Thomson effect in thermocouples. What is neutral temperature in a thermocouple? 4+2
   b) How can cold junction/reference junction compensation be carried out in thermocouples employing two temperature-controlled ovens? 4
   c) Explain in detail series connection and parallel connection of thermocouples. Under what circumstances will they be useful in practical situation? 6

4. a) Describe the transfer function of a PID controller. How can an electronic analog PID controller be developed employing two op-amps? 8
   b) With the help of a neat diagram obtain an expression for the transfer function of a PD pneumatic controller. What is the function of a relay valve? 8

5. Write short notes on any **TWO**: 8×2
   a) Linearization of RTDs;
   b) Constant current type anemometer (CCA);
   c) Total radiation pyrometer;
   d) Random errors in measurements and their statistical measures.

[Turn over

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BACHELOR OF CHEMICAL ENGINEERING (3RD YR 2ST SEMESTER)
EXAMINATION, 2024

SUBJECT: - PRINCIPLES OF MEASUREMENT & INSTRUMENTATION

Full Marks 100

Time: ~~Two hours~~/Three hours/ ~~Four hours~~/ ~~Six hours~~ (50 marks for each part)

Use a separate Answer-Script for each part

No. of Questions	PART II	Marks
	Answer question:-1 and any two from the rest.	
1.	***Distinguish in brief between the following two (any four):-*** a) Float type and hydrostatic type level sensor. b) Level measurement and transmission using force balance and pneumatic balance method c) Working principle of obstruction type flow sensor for incompressible and compressible fluid d) Obstruction type flow sensor and variable area type low sensor e) hot cathode and cold cathode type Ionization gauge	**4X5=20**
2.	a) Illustrate a suitable scheme for level measurement and transmission system using pneumatic balance float type level sensing mechanism. b) What are the disadvantages of float type level sensors? How these disadvantages can be eliminated? c) Describe with diagram, the working principle of bubbler method to measure the level.	**5+5+5**
3.	a) Explain the working principle of dead weight tester. Why it is used? b) Explain with diagram, how flapper-nozzle system can be used as essential element of pressure transmission. How, the output pressure range can be magnified using relay amplifier? c) Referring to working principle of Pirani gauge, explain how the performance of the gauge depends on the nature of	

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BACHELOR OF CHEMICAL ENGINEERING (3RD YR 2ST SEMESTER)

EXAMINATION, 2024

(~~1st~~ /-2nd-Semester)

SUBJECT: - PRINCIPLES OF MEASUREMENT & INSTRUMENTATION

Full Marks 100

Time: ~~Two hours~~/Three hours/ ~~Four hours~~/ ~~Six hours~~ (50 marks for each part)

	gas under vacuum?	6+4+5
4.	a) If the flow rate reading by rotameter is to be independent of the fluid density, then prove that $\rho_2 = 2\rho_1$, where ρ_2 is the density of float material and ρ_1 is the density of fluid. b) Describe the working principle of reciprocating piston type flow sensor, showing its each part in a diagram. c) 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.	5+5+5
5.	**Write short notes on any three of the following:** d) McLeod gauge e) Differential pressure transmitter f) Thermocouple type vacuum gauge g) Rotameter h) Quantity flow meter	3X5=15