B. E. CHEMICAL ENGINEERING 3RD YEAR 2ND SEMESTER EXAMINATION, 2022

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 **FIVE** Questions.   5×10

1. 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. 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.   2+2+6

3. 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".

4. With a neat diagram explain the constructional features of a Platinum Resistance Temperature Detector. Describe in detail the general working principle of a Resistance Temperature Detector.   5+5

5. 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

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. Describe the transfer function of a PID controller. How can an electronic analog PID controller be developed employing two op-amps?   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

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(1st / 2nd-Semester/Repeat/Supplementary/Annual/Bi-Annual)

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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

	PART II	Marks
1	*Answer Question:1 and any TWO from the rest:* **Answer any four:** a) Discuss the various factors upon which the performance of obstruction type flow sensors depends. b) Distinguish between the working principle of volumetric flow sensor and positive displacement type flow sensor. c) State the difference in working principle between force balance and pneumatic balance methods for level transmission. d) If the movement of rotameter float is independent of fluid density, then prove that it must satisfies the relation the relation: $\rho_2 = 2\rho_1$, where ρ_1 is the density of fluid and ρ_2 is the density of float material e) Distinguish between hot cathode and cold cathode type vacuum pressure gauge. f) Discuss the process involved for separation in chromatography.	
2	a) Illustrate a suitable scheme for level gauge calibration uing Bubbler system following hydrostatic method. b) Explain the working principle of resistive /potentiometric type level sensor with suitable diagram. c) Illustrate a suitable scheme for level measurement and transmission system using force balance method.	4X5=20 5+4+6

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3.	a) Derive the input-output relation of McLeod gauge for vacuum pressure measurement. b) Explain how the relay amplifier in conjunction with flapper-nozzle can enhance the output pressure in pneumatic pressure transmitter c) A turbine type mass flow sensor has a bore of internal diameter 100 mm. The rotor consists of 20 number of blades, each of mean thickness of 5 mm, mounted on a hub of mean diameter of 30 mm. The clearance between the inlet blade tip and the bore is 2 mm and the inlet blade angle at tip is 25 degree. Estimate the flow meter constant K in pulses/m3 and the frequency of induced AC voltage.	**5+5+5**
4.	a) Explain why the components having lower molecular weight will be eluted later than that having higher molecular weight in chromatography b) Define retention time and resolution of chromatographic column. c) From a two component charomatogram following data are obtained as: $t_{RA}=19.92$ min, $t_{RB}=18.8$ min., $W_A=1.02$ min, $W_B=1.22$ min. The column length is 50 cm. Calculate the number of plates, plate height and resolution.	**5+5+5**
5.	**Write short notes on any three:** i) Application of diaphragm box. ii) Dead weight tester. iii) Pirani gauge iv) Vortex flow sensor v) Thermal ionization detector vi) Stationery and mobile phases	**3 X 5**