B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

Seventh Semester

Instrumentation and Control Engineering

(Common to Electronics and Instrumentation Engineering)

20ICPW701 - INSTRUMENTATION SYSTEM DESIGN WITH LABORATORY

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K–Level	CO

1. When designing an orifice plate for a fluid with unknown viscosity variation, which orifice geometry offers the most stability in discharge coefficient? — 1, K1, CO1
   (a) Eccentric orifice   (b) Conical inlet orifice
   (c) Square-edged orifice   (d) Quadrant-edged orifice

2. While performing zero adjustment, the high- and low-pressure sides of a D/P transmitter are equalized. Justify — 1, K1, CO1
   (a) To remove effect of atmospheric pressure difference
   (b) To ensure no process pressure is acting
   (c) To verify calibration at true zero differential
   (d) All of the above

3. The Bourdon tube tends to straighten under pressure .Give reason. — 1, K1, CO2
   (a) Pressure acts axially along the tube
   (b) Pressure acts on inner surface causing circumferential strain
   (c) It is designed to expand radially only
   (d) It vibrates under pressure

4. In selecting control valve characteristics: For a heat exchanger with nonlinear load changes, which valve characteristic is ideal? — 1, K1, CO2
   (a) Linear   (b) Quick opening   (c) Equal percentage   (d) Stepwise

5. Which of the following is a positive displacement pump? — 1, K1, CO3
   (a) Centrifugal pump   (b) Gear pump   (c) Turbine pump   (d) Jet pump

6. When several pumps are connected in parallel, the system can deliver: — 1, K1, CO3
   (a) Higher head at same discharge   (b) Higher discharge at same head
   (c) Both higher head and discharge   (d) Lower efficiency

7. State the primary use of an annunciator system — 1, K1, CO4
   (a) Measure current and voltage   (b) Indicate and identify abnormal conditions
   (c) Control process variables automatically   (d) Generate analog control signals

8. In a PID controller, the integral term is used to: — 1, K1, CO4
   (a) Reduce steady-state error   (b) Increase system stability
   (c) Anticipate future error   (d) Reduce response speed

9. List the main function of a proportional (P) controller. — 1, K1, CO5
   (a) Eliminate steady-state error completely   (b) Reduce the rise time and steady-state error
   (c) Anticipate future error   (d) Eliminate overshoot

10. What are feedback resistors and capacitors commonly used to adjust in electronic controllers: — 1, K1, CO5
    (a) Proportional band, integral time, and derivative time   (b) Output bias and damping
    (c) Sensor calibration   (d) Power supply voltage

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

11. What happens to the discharge coefficient when the Reynolds number drops below 10^4? — 2, K1, CO1

12. How is the EMF of a thermocouple related to the temperature difference? — 2, K1, CO1

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create   **13867**

13.	If the purge air flow is too high in a bubbler system, what is the likely effect on measurement accuracy?	2	K1 CO2
14.	What does the flow coefficient (Cv) represent in control valve sizing?	2	K1 CO2
15.	Jet pump is called a "pump without moving parts"? Justify your answer.	2	K2 CO3
16.	List the factors considered when selecting a pump.	2	K1 CO3
17.	State the flip-flop type most commonly used for alarm memory.	2	K1 CO4
18.	Differentiate between continuous and digital PID control.	2	K2 CO4
19.	Can derivative action alone eliminate steady-state error? Justify your answer.	2	K2 CO5
20.	How does improper sampling rate in a digital PID controller affect integral and derivative action differently?	2	K1 CO5
21.	List the advantage of using PLCs for interlock logic design.	2	K1 CO4
22.	Mention the hidden risk of increasing integral gain aggressively in a PI controller.	2	K1 CO5

PART - C (6 × 11 = 66 Marks)
Answer ALL Questions

23.	a)	Evaluate the performance of RTDs versus thermistors in industrial temperature sensing applications.	11	K3 CO1
		OR		
	b)	Construct a cold junction compensation circuit for thermocouple using RTD.	11	K3 CO1
24.	a)	A pressure gauge installed near a pump discharge repeatedly fails (tube rupture or pointer erratic). Provide a step-by-step diagnostic and corrective plan focusing on Bourdon tube design, pulsation, over-range and vibration issues.	11	K4 CO2
		OR		
	b)	Analyse how actuator and positioner design affect valve responsiveness, hysteresis, dead band and reliability.	11	K4 CO2
25.	a)	Describe the relationship between head, discharge, and efficiency in a centrifugal pump.	11	K2 CO3
		OR		
	b)	Discuss how Net Positive Suction Head (NPSH), efficiency, and cost trade-offs influence pump selection in industrial applications.	11	K2 CO3
26.	a)	Explain the effect of using an OR gate instead of an AND gate in an interlock circuit for a safety-critical machine.	11	K2 CO4
		OR		
	b)	Explain the role of ADC resolution in determining data accuracy in a microcontroller-based data acquisition system.	11	K2 CO4
27.	a)	Compare and contrast the behavior of a PD controller and a PID controller when a sudden step change occurs in setpoint.	11	K2 CO5
		OR		
	b)	Discuss the challenges in tuning PID controllers for processes with long dead times.	11	K2 CO5
28.	a)	Discuss about safe operating procedure for starting and stopping a multi-stage pump.	11	K2 CO3
		OR		
	b)	Explain the effect of misalignment, unbalance, and hydraulic forces on pump noise levels.	11	K2 CO3