Question Paper Code | **13188**

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024

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) (20 × 1 = 20 Marks)
Answer ALL Questions

		Marks	K–Level	CO
1.	A design engineer needs to choose the appropriate wire for connecting an RTD sensor to a measuring circuit. Which of the following wire materials is the most appropriate for this application?	1	K1	CO1
	(a) Copper wire (b) Aluminium wire (c) Platinum wire (d) Nickel wire			
2.	An operator notices that the flow rate indicated by the rotameter is fluctuating rapidly. Which of the following is the most likely cause of the problem?	1	K1	CO1
	(a)The fluid flow is pulsating (b) The float is damaged or stuck			
	(c) The fluid temperature has changed (d) The rotameter is not properly calibrated			
3.	What is the unit of measurement used in a rotameter?	1	K1	CO1
	(a) Liters (b) Cubic meters per second (c) Pascal (d) Newton			
4.	Which forces are acting in a rotameter?	1	K1	CO1
	(a) Gravitational force and magnetic force (b) Buoyancy force and magnetic force			
	(c) Up thrust force and weight of the float (d) Viscous force and weight of the float			
5.	Which among the following fluid parameters are not controlled by the control valves?	1	K1	CO2
	(a) Pressure (b) Rate of flow (c) Speed (d) Direction of flow			
6.	The valve packing of control valves is used ____	1	K1	CO2
	(a) to prevent the fluid from escaping			
	(b) to control the force generated by actuators			
	(c) to control different parameters of the fluid			
	(d) to control the direction of flow			
7.	Which among the following are not the 'work parameters' of the fluid?	1	K1	CO2
	(a) Direction (b) Speed (c) Pressure (d) Temperature of flow			
8.	Which of the following quantities can be measured using bellows?	1	K1	CO2
	(a) Absolute pressure (b) Gauge pressure (c) Differential pressure (d) All of the mentioned			
9.	Which factor ensures that a pump has a long life and a small depreciation cost?	1	K1	CO3
	(a) Power (b) Efficiency (c) Reliability (d) Depreciation			
10.	What is the primary objective of preventive maintenance for a pump system?	1	K1	CO3
	(a) Minimize system downtime (b) Extend pump lifespan			
	(c) Repair pump components after failure (d) Enhance overall system reliability			
11.	What is the purpose of a pump impeller in pump operation?	1	K1	CO3
	(a) To control the flow rate (b) To regulate the pump speed			
	(c) To increase the pump efficiency (d) To seal the pump casing			
12.	The Q-H curve for a pump is typically provided by whom?	1	K2	CO3
	(a) Pump operator (b) Pump manufacturer (c) Regulatory authority (d) Fluid supplier			
13.	Example of PLC Pump Permissive Interlock is	1	K1	CO4
	(a) Valve Open Limit Switch (b) Low Oil Pressure			
	(c) Low Bearing temperature (d) High Bearing Temperature			

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

14. Which of the following is the primary function of a PID controller?   *1*   *K1*   *CO4*
    (a) Frequency modulation   (b) Temperature control
    (c) Data encryption   (d) Audio amplification
15. What is the purpose of tuning a PID controller?   *1*   *K1*   *CO4*
    (a) Adjusting the physical size of the controller
    (b) Calibrating the display settings
    (c) Optimizing the PID parameters for better performance
    (d) Changing the power supply voltage
16. What is the sampling time in a microprocessor-based PID controller?   *1*   *K1*   *CO4*
    (a) The time it takes to process one control loop iteration
    (b) The duration of a single measurement
    (c) The time between consecutive measurements
    (d) The time it takes to power on the controller
17. In a controller, what does the "set point" represent?   *1*   *K1*   *CO5*
    (a) The value to which the controlled variable should be maintained
    (b) The bias error
    (c)The controller's output value
    (d) The integral time (Ti)
18. A temperature control system consistently overshoots the set point. Which parameter should be adjusted to reduce this overshooting?   *1*   *K2*   *CO5*
    (a) Increase integral time (Ti)   (b) Increase proportional gain (Kp)
    (c) Increase derivative time (Td)   (d) Decrease integral time (Ti)
19. How many control terms are included in a PID controller?   *1*   *K1*   *CO5*
    (a) One   (b) Two   (c) Three   (d) Four
20. What is the primary purpose of a controller's bias setting?   *1*   *K1*   *CO5*
    (a) To control the sensitivity of the controller
    (b) To maintain a constant set point
    (c) To eliminate transient errors
    (d) To offset the controlled variable from the set point

PART - B (10 × 2 = 20 Marks)
Answer ALL Questions

21.	Summarise the requirements of Cold Junction Compensation for Thermocouples.	*2*	*K2*	*CO1*
22.	Illustrate with formula the parameters needed to find the volumetric flow rate of Rotameter.	*2*	*K2*	*CO1*
23.	Materials used for the design of bourdon gauge influences the application. Justify.	*2*	*K1*	*CO2*
24.	Give the applications of Globe Valve and Gate Valve.	*2*	*K1*	*CO2*
25.	Classify the Pumps on the basis of mechanical principle of operation.	*2*	*K2*	*CO3*
26.	What are the causes for cavitations in Pumps?	*2*	*K1*	*CO3*
27.	Draw the block diagram of PID controller configuration used in microprocessor based controller design.	*2*	*K1*	*CO4*
28.	State the concept of Alarm Annunciator with necessary examples.	*2*	*K1*	*CO4*
29.	Draw the diagram of a practical derivative mode controller using Opamp.	*2*	*K1*	*CO5*
30.	Give the Expressions for the various gains of a three mode controller.	*2*	*K1*	*CO5*

PART - C (6 × 10 = 60 Marks)
Answer ALL Questions

31.	a)	Make use of Bernoulli's equation; derive the volumetric flow rate and Cd for orifice meter.	*10*	*K2*	*CO1*

OR

b)	Determine the nominal flow velocity V2 at the orifice having a dia of 20 mm kept in a pipe of 40mm dia. Reynolds number is 10 powers 5. Assume density of water = 1000 kg per meter cube and Kinematic Viscosity id 10 power -2 stokes (square cm/ sec). For this given problem also calculate the pressure difference at the tappings. Assume corner tapping is selected. Coefficient of Discharge= 0.61.	*10*	*K3*	*CO1*

32. a) Compare the C type and Spiral forms of bourdon tube design and discuss in detail the design criteria with respect to pressure measurement applications. | *10* | *K2* | *CO2*

OR

b) Write notes on (i) Hydraulic Actuators (ii) Spring less Diaphragm Actuators. | *10* | *K2* | *CO2*

33. a) Calculate the critical length of 6NPS s40 pipe and correction factors A and B. | *10* | *K3* | *CO3*

OR

b) Explain in detail Pump Characteristic Curves and the inferences. | *10* | *K2* | *CO3*

34. a) Draw and explain an Alarm Logic circuit for House Alarm Application. | *10* | *K2* | *CO4*

OR

b) Construct with interfacing diagram in detail for Microcontroller Based Data Acquisition System. | *10* | *K3* | *CO4*

35. a) An integral control system will have a measurement range of 0.4 to 2.0V and an output range of 0 to 6.8V. Design an Op amp integral controller to implement a gain of k_I=4% (%-min). Specify the values of G_I, R and C. | *10* | *K3* | *CO5*

OR

b) A proportional - derivative controller has a 0.4 to 2.0V input measurement range, a 0 to 5V output, K_P=5% / %, and K_D=0.08% per (%-min). The period of the fastest expected signal change is 1.5S. Implement this controller with a op amp circuit. | *10* | *K3* | *CO5*

36. a) i) Explain in detail about time version Variables of Discrete PID controller. Brief with necessary equations. | *5* | *K2* | *CO4*

ii) A type-J thermocouple (TC) with a 0° C reference is used to control temperature between 100° and 200° C. Design a proportional – integral controller with a 40% band and a 0.08min reset (integral) time. The final control element requires a 0-10V range. | *5* | *K3* | *CO5*

OR

b) i) Explain with a functional block diagram of MBAS 9400 microcontroller based Alarm system with design features and functional features with Technical specifications. | *5* | *K2* | *CO4*

ii) A temperature controller controls temperature from 100° to 200^oC. A sensor provides an output of 2 to 8v for this temperature range. The controller output drives a heater with an output of 0 to 5 volts. What circuit gain is needed if the Proportional controller is to be used with a gain of 4% / %? | *5* | *K3* | *CO5*

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