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Question Paper Code	12181
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B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2023

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 (10 × 2 = 20 Marks)

Answer ALL Questions

- | | <i>Marks,
K-Level, CO</i> |
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| 1. Determine the volume flow rate through a pipe of 150 mm diameter when measured by an orifice plate of size 75 mm diameters. Coefficient of discharge is 0.6. | 2,K2,CO1 |
| 2. Summarize the requirements of Cold Junction Compensation for Thermocouples. | 2,K2,CO1 |
| 3. Indicate some important factors that affect the sensitivity of bourdon gauges. | 2,K2,CO2 |
| 4. A pressure difference of 1.1 psi occurs across a constriction in a 5-cm diameter pipe. The constriction constant is 0.009 cubic metre /s per square root of kpa. Find the flow rate in cubic metre /sec and flow velocity in m/s. | 2,K2,CO2 |
| 5. Classify the Centrifugal Pumps. | 2,K2,CO3 |
| 6. $1 m^3/h$ of water is pumped a head of 10 m. Calculate the theoretical pump power. | 2,K2,CO3 |
| 7. ISA standard for Alarm-ISA 18.2. Give the definition for Alarm put forth by these standards. | 2,K2,CO4 |
| 8. State the purpose of Interlocks. | 2,K2,CO4 |
| 9. Suggest a controller for Processes where load changes are unlikely and lag time is very small. | 2,K3,CO5 |
| 10. Derivative Controller action is also called rate action and anticipatory action. Why? | 2,K3,CO5 |

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

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| 11. a) (i) Outline the design Guidelines that should be considered when designing an analog signal-conditioning system for RTD. | 6,K2,CO1 |
| (ii) Explain in detail the need for cold junction compensation of thermocouples and the procedure using RTD. | 7,K3,CO1 |

OR

- b) Determine the nominal flow velocity V_2 at the orifice having a dia of 20 mm kept in a pipe of 40mm dia. Reynolds number is 10^5 . Assume density of water = 1000 kg per meter cube and Kinematic Viscosity is 10^{-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. 13,K3,CO1

12. a) (i) A C type bourdon tube made of Monel has $r=36.5\text{mm}$, $x=16\text{mm}$, $y=3\text{ mm}$, $t=0.35\text{mm}$, Calculate the displacement of the free end if a pressure of 1500kPa is applied. The modulus of elasticity for Monel is 180GN/squ. Meter. 7,K3,CO2
 (ii) Compare the frequently used materials used for the construction of Valve bodies and bonnet. 6,K2,CO2

OR

- b) Explain in detail about valve flow characteristics with necessary diagrams and equation for coefficient of discharge and stem movement. 13,K2,CO2

13. a) (i) State the reasons for the causes of cavitations in centrifugal Pumps. 6,K2,CO3
 (ii) Enumerate the Priming sequences for Positive Suction Head in a Pump. 7,K2,CO3

OR

- b) Use the simplest equation to calculate the thickness for a 6 NPS pipe (6.625 Do) at 875 psi pressure and allowable stress of 23,000 psi. Assume you want to bend the pipe with a bend radius of three times the nominal size, or 18 inch. in diameter. Calculate the new Thickness. 13,K3,CO3

14. a) Explain the functionality of various types of Interlocks. Also discuss the need for Alarm and Annunciator in Process Industries. 13,K4,CO4

OR

- b) Develop with interfacing diagram Microcontroller Based Data Acquisition System. 13,K4,CO4

15. a) Design a proportional – integral controller with a proportional band of 30% and an integration gain of 0.1% / (%-s). The 4- to 20-mA input converts to 0.4 to 2V signal, and the output is to be 0 – 10 V. Calculate values of G_P , G_I , R_2 , R_1 and C respectively. 13,K4,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. 13,K4,CO5

PART - C (1 × 15 = 15 Marks)

16. a) Computer based control Algorithms are more common in Process Industries .Develop algorithms with necessary flow chart for the implementation of discrete PID controller of a Temperature Process. *15,K4,CO4*

OR

- b) A temperature- Control system inputs the controlled variable as a range from 0 to 4V. The output is a heater requiring 0 to 8V. A PID is to be used with $K_p=24\%$ / %, $K_i=9\%$ (%-min), $K_D=0.7\%$ / (%-min). The period of the fastest expected change is estimated to be 8s. Develop the PID Circuit. *15,K4,CO5*