Total number of printed pages: **02** **B.Tech(UG)/6th /UIE601**

2024

Process Control

Full Marks: 100

Time: Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

<table>
<tr><td>1.</td><td>a)</td><td>Define process control. What is its need? List the advantages and applications.</td><td>10</td></tr>
<tr><td></td><td>b)</td><td>Explain the explain the evaluation criteria of one-quarter decay ration, ISE, IAE and ITAE of the controller settings.</td><td>10</td></tr>
<tr><td>2.</td><td>a)</td><td>Design and derive the gains of electronic and pneumatic proportional-derivative (PD) controllers.</td><td>10</td></tr>
<tr><td></td><td>b)</td><td>Derive the response of an interacting 2-tank level control system with unity feedback to a unit step input.</td><td>10</td></tr>
<tr><td>3</td><td>a)</td><td>Explain the two-position controller with suitable example. What is its controller output conditions?</td><td>10</td></tr>
<tr><td></td><td>b)</td><td>Given the error values plot a graph of a proportional-integral control output as a function of time. $K_p = 4$, $K_i = 1.0$/sec and $P_i(0) = 40\%$.
From 0 - 1sec, e = t, From 1 – 3sec, e =1, From 3 – 5sec, e = 0.</td><td>10</td></tr>
<tr><td>4.</td><td>a)</td><td>The PI controller indicates an output of 10mA when the error is zero. The set point is suddenly increased to 14 mA and the controller output is recorded and is given below.
<table>
<tr><td>Time t, sec</td><td>0</td><td>10</td><td>20</td><td>30</td><td>40</td></tr>
<tr><td>Output mA</td><td>10</td><td>12</td><td>14</td><td>16</td><td>18</td></tr>
</table>
Find K_p and T_i</td><td>10</td></tr>
<tr><td></td><td>b)</td><td>A unity feedback control system with open loop gain of G(s). Using derivative control that damping ratio is to made 0.9. Determine the value of T_d. Also determine the rise time, peak time & peak overshoot without and with derivative control. The input to the system is unit step.
$$G(s) = \frac{5}{s^2 + s}.$$</td><td>10</td></tr>
<tr><td>5.</td><td>a)</td><td>What is cavitation and flashing in a control valve? Explain them briefly with a</td><td>10</td></tr>
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		neat diagram.	
	b)	Discuss on control valve sizing. Find the proper C_v for a valve that must pump 200 gallons of ethyl alcohol per minute with a specific gravity of 0.8 at maximum pressure of 50 psi and identify the required valve size	6
	c)	An equal percentage valve has a maximum flow of 40 m^3/s and a minimum of 2 m^3/s. if the full travel is 10cm, find the flow at a 5 cm opening.	4
6.	a)	The transfer function for a cascade system is given as: $G_{p1} = \frac{3}{(2s+1)(3s+1)}$ $G_{p2} = \frac{2}{(s+1)}$ $G_{l2} = \frac{1}{(2s+1)}$ $G_{c2} = 4$ $G_{m1} = 0.06$ $G_{m2} = 0.04$ G_{c1} is a Proportional controller i) Calculate the ultimate value of Kp1 for primary controller for which simple feedback and cascade loop go into oscillations. ii) Compare the offset for simple feedback and cascade loop when $K_{p1} = 15$	10
	b)	Explain the practical aspects of controller design and analysis of the feedforward-feedback control loop	10
7.	a)	What is override controller? Describe a situation where you could use it?	10
	b)	Explain the control scheme of the in-line blending process, considering it as an example for a multiloop Single Input Single Output (SISO) system, and derive the characteristic equation	10

****THE END****