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

2023

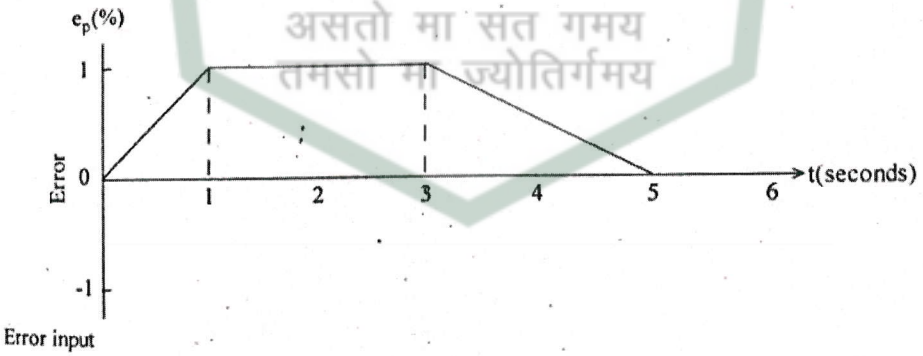
Process Control

Full Marks: 100

Time: Three hours

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

*Answer **any five** questions.*

1.	a)	What is the use of mathematical model in process control?	4
	b)	A tank system having a cross section area A = 2 m^2 time constant of 0.5 min and a resistance of 0.25 min/m^3 is operating at steady state with an inlet flow of 2 m^3/min. The flow is suddenly increased to 3 m^3/min. Plot the response of the tank level.	8
	c)	Develop a mathematical model for a mercury thermometer (maker necessary assumptions).	8
2.	a)	What is tuning of controller and its types?	2
	b)	Define and derive the transfer function of P, PI, PD and PID control?	8
	c)	Suppose the error, shown in Fig. 1 is applied to a proportional-derivative controller with $K_p = 5$, $K_D = 0.05$ and $K_0 = 50\%$. Draw a graph of the resulting controller output.  Figure 1	10
3.	a)	What is the use of evaluation criteria? Explain IAE, ISE, ITAE and ¼ decay ratio criterias.	12
	b)	With the neat block diagram, explain the function of a pneumatic PID controller	8

4.	a)	Explain the function of pneumatic actuator (air to close)	4
	b)	What is split range control? Explain with a simple example?	8
	c)	What is the generalized design procedure for feedforward control?	8
5.	a)	What are the inherent characteristics of control valves, give its expression and the response.	8
	b)	Explain cavitation and flashing in control valve	8
	c)	Discuss on control valve sizing. Find the proper C_v for a valve that must pump 180 gallons of ethyl alcohol per minute with a specific gravity of 0.8 at maximum pressure drop of 60 psi and identify the required valve size	4

Valve size cms	K_v	Valve size cms	K_v
0.75	0.25	7.50	95
1.25	2.50	100	150
2.50	12.0	15	350
3.75	30.0	20	625
5.00	50.0	30	1250

6.	a)	Explain issues involved in the multivariable control? Give a direct digital control for interaction control loop process as example (with flow chart).	10
	b)	The transfer function for a cascade system is given as: $Gp_1 = 2/(2s+1)(s+1)$; $Gp_2 = 3/(s+1)$; $G_{l2} = 1/(3s+1)$; G_{c1} is a proportional controller; $G_{c2} = 2$; $G_{m1} = 0.04$; $G_{m2} = 0.2$ i) Calculate the ultimate value of Kp_1 for primary controller for which simple feedback and cascade loop go into oscillations. ii) Compare the offset for simple feedback and cascade loop when $K_{p1} = 10$	10
7.	Answer any four of the following		4 x 5=20
	a)	Distinguish between feedforward and feedback control	
	b)	Adaptive control	
	c)	Mathematical model of U tube manometer	
	d)	Draw P&ID diagram of CSTH and explain it	
	e)	Obtain the closed loop response of second order undamped system	
	f)	Compare servo and regulator operation	