Total number of printed pages: **03** **B.Tech(UG)/6th /UIE601**

2025

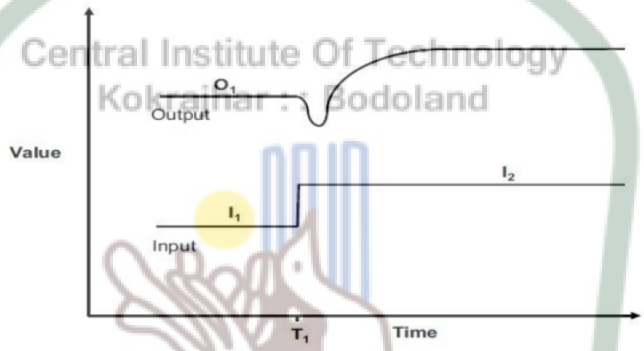
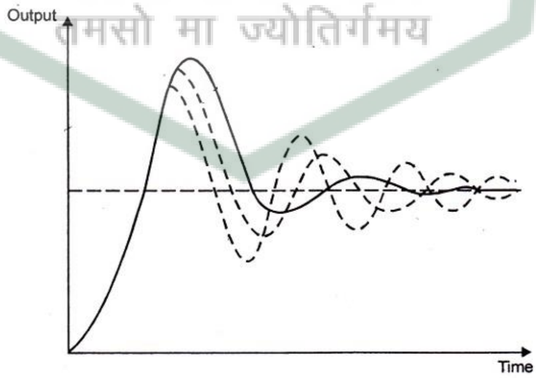
Process Control

Full Marks: 100

Time: Three hours

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

*Answer **any five** questions.*

1.	a)	Identify the response given below (fig. 01). Explain it with a suitable example?  Figure 1	10
	b)	A tank system having a time constant of 0.5 min and a resistance of 0.23 min/m^2 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 (assume area of cross section A = 2m^2)	10
2.	a)	Label the time integral criteria for the closed loop responses shown in the fig. 02. Explain general guidance to select it.  Figure 2	10
	b)	Draw the equivalent circuit and derive the transfer function for the figure given below?	10

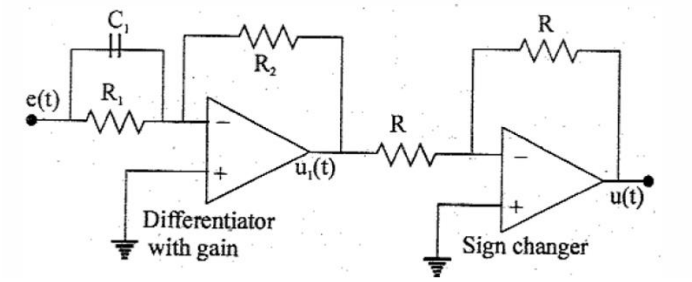


Figure 3

3 a) A unity feedback control system with open loop gain of G(s). Using derivative control that damping ratio is to made 0.8. Determine the value of T_d. Also determine the rise time, peak time & peak overshoot without and with derivative control. Hence the input to the system is unit step. **10**

$$G(s) = \frac{4}{s^2 + 2s}$$

b) A Pneumatic PI controller has an output of 10 psi at setpoint (error zero). When the setpoint is displaced 0.5 inches, the following data is obtained (Table 1). Determine K_p & T_i. **10**

Time, sec	0	20	60	80	100	120
Output, psi	9	8	7	6	5	4

4 a) For a unity feedback system, process transfer function is given by $G_p(s) = \frac{8}{(3S+1)(4S+2)(5S+3)}$. The controller is of PID mode. Calculate the optimal values of controller parameter based on ultimate cycle method of tuning. **10**

b) Draw a plot of the three-mode controller output for the errors shown below. **10**

$E_p = 2t\%$ (0-1 sec)
$E_p = 2\%$ (1-3 sec)
$E_p = -t/2+2.5\%$ (3-5 sec)

Assume $K_p = 5$, $K_i = 0.7$ /sec, $K_d = 0.5$ sec and $P(0) = 20\%$.

5. a) Compare Feed forward control (FFC) and Feedback control (FBC) as the properties listed in the Table 2. **10**

Property	**FFC**	**FBC**
Design principle		
Measured variable		
Controller system configuration		
Action		
Typical controller		

	b)	The transfer function for a cascade system is given as: $G_{p1} = \frac{2}{(3s+1)(2s+1)}$ $G_{p2} = \frac{4}{s+1}$ $G_{l2} = \frac{1}{(2s+1)}$ $G_{c2} = 5$ $G_{m1} = 0.05$ $G_{m2} = 0.2$ G_{c1} is a P controller i) Calculate the ultimate value of K_{p1} for primary controller for which simple feedback and cascade loop go into oscillations. ii) Compare the offset for simple feedback and cascade loop when $K_{p1} = 12$	10
6.	a)	Explain the working principle of I/P converter & air to open pneumatic actuator with neat sketch?	5+5
	b)	Write about inherent characteristics of control valves and valve sizing?	6+4
7.	a)	List the silent features of override control to protect a boiler system with neat sketch.	10
	b)	Write short note on solid-solid mixing and gas station mixing control scheme.	5+5

****THE END****