U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

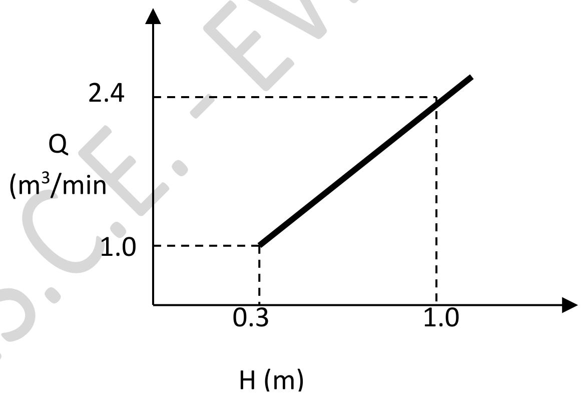
Autonomous Institute Affiliated to VTU

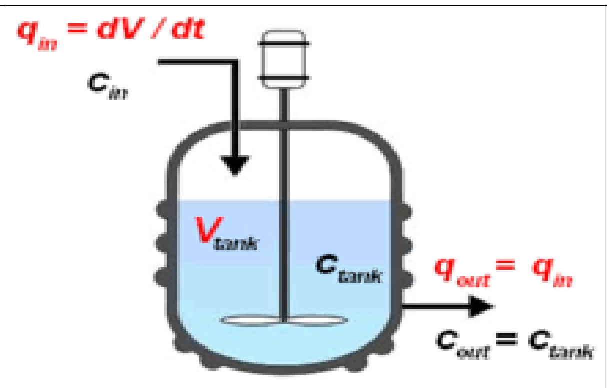
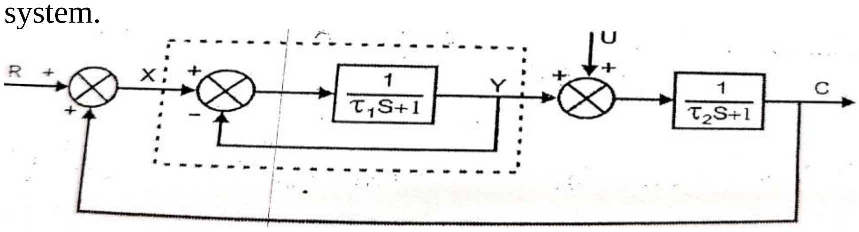
June 2025 Semester End Main Examinations

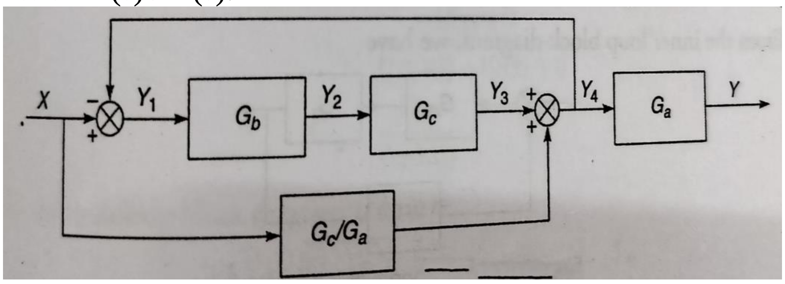
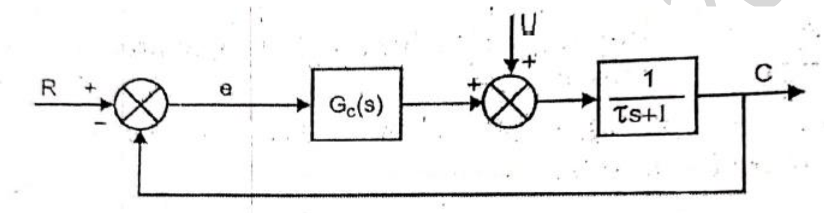
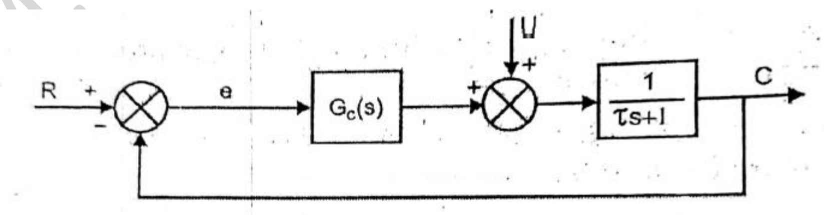
Programme: B.E. **Semester: VI**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 23CH6PCPCE **Max Marks: 100**
Course: Process Control Engineering

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Develop first order transfer function for mercury thermometer.	*CO1*	*PO 2*	**08**
	b)	A tank having a cross-sectional area of 2 m^2 is operating at steady state with an inlet flow rate of 2.0 m^3/min. The flow head characteristics are shown in Figure. i. Develop the transfer function H(s)/Q(s) ii. If the flow to the tank increases from 2.0 to 2.2 m^3/min according to a step change, calculate the level h two minutes after the change occurs. 	*CO2*	*PO2*	**12**
		OR			
2	a)	Develop first order transfer function for continuous stirred tank reactor by referring below sketch. Assume the reaction is of first order reaction. $A \rightarrow B$; First order reaction rate can be written as r = K C_{out} .	*CO1*	*PO2*	**08**

			 			
		b)	A thermometer is observed to exhibit the first order dynamics is having time constant 10 second and it is placed in bath. After the thermometer reaches steady state temperature of 30° C with the bath, the temperature of the bath is linearly increased with time at a rate of 6° C /minute. Sketch the response of the thermometer. Determine the dynamic error and time lag for the system.	CO2	PO2	**12**
			UNIT - II			
	3	a)	Derive transient response for second order under damped system for step input.	CO2	PO2	**10**
		b)	A step change of magnitude 6 is introduced into a system having transfer function $\frac{Y(S)}{X(S)} = \frac{10}{(S^2 + 1.6S + 4)}$ Determine: i) % Overshoot; ii) Decay ratio; iii) Rise time; iv) Period of oscillation.	CO2	PO2	**10**
			OR			
	4	a)	Obtain a response equation when a system is subjected to impulse forcing function for a second order underdamped system and critically damped system.	CO2	PO2	**10**
		b)	The overall transfer function of the control system is given as, $G(s) = \frac{16}{(1.5\,S^2 + 2.4S + 6)}$ A step change of magnitude 6 is introduced into the system. Evaluate: i) %Overshoot; ii) Period of oscillation; iii) Natural period of oscillation; iv) Ultimate value of response.	CO2	PO2	**10**
			UNIT - III			
	5	a)	Discuss transfer function of servo and regulating system for negative feedback.	CO3	PO4	**10**
		b)	Using the block diagram reduction technique. Simplify the overall transfer function of the multiloop block diagram shown in figure. Write overall transfer function for both servo and regulating system.  	CO3	PO4	**10**

			OR			
	6	a)	Derive the transfer function for PD and PI controller.	*CO3*	*PO4*	**10**
		b)	Simplify the given block diagram and evaluate overall transfer function Y(s) / X(s). 	*CO3*	*PO4*	**10**
			UNIT - IV			
	7	a)	Develop offset equation for PD controller in case of servo mechanism for step change for the following block diagram. 	*CO3*	*PO4*	**10**
		b)	A proportional derivative controller is used to control the multicapacity control system having time constants τ_1 =1 min and τ_2= 1.8 min. The gain of controller Kc = 4 and derivative time τ_d = 50 min. assume unity feedback control. A step change of magnitude 0.8 is given to the set point. The system is subjected to servo mechanism control. Evaluate the offset.	*CO3*	*PO4*	**10**
			OR			
	8	a)	Develop offset equation for PID controller in case of regulator mechanism for step change for the following block diagram. 	*CO3*	*PO4*	**10**
		b)	A proportional integral controller is used to control the first order control system with time constant of 4 seconds and τ_i= 60 second. The gain of the controller is 4. The load variable is given a step change of 0.8. Determine the offset.	*CO3*	*PO4*	**10**
			UNIT - V			
	9	a)	Discuss stepwise procedure to plot Routh hurwitz stability criteria.	*CO4*	*PO4*	**10**

		b)	Determine the stability of the control system whose transfer function is given by the characteristics equation. $$s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$$	*CO4*	*PO4*	**10**
			OR			
	10	a)	Discuss the rules for plotting the root locus diagram.	*CO4*	*PO4*	**10**
		b)	Draw bode diagram for the system having transfer function $G(s) = \frac{1}{(S+1)}$.	*CO4*	*PO4*	**10**

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