U.S.N.										

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

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**

Branch: Chemical Engineering **Duration: 3 hrs.**

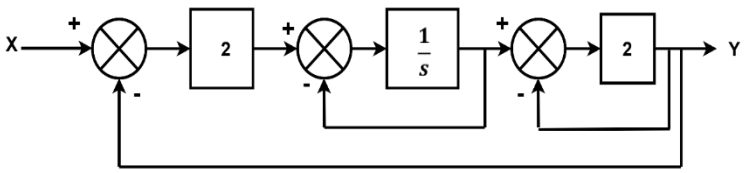
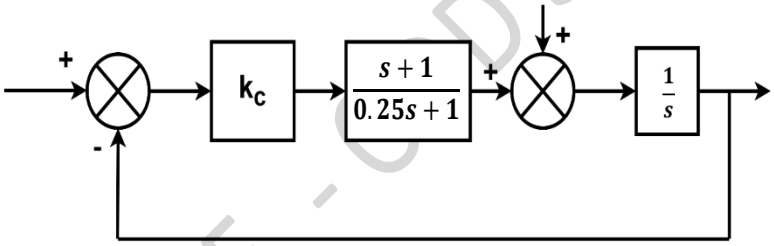
Course Code: 19CH5DCPCE **Max Marks: 100**

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 the transfer function for a mixing process in which a stream of solution containing dissolved salt flows at a constant volumetric flow rate into a tank of constant hold-up volume.	1	1	**10**
	b)	Derive the sinusoidal response of a first-order system.	1	1	**10**
		OR			
2	a)	Develop the transfer function for a mercury-in-glass thermometer. State clearly the assumptions	1	1	**10**
	b)	A thermometer having a time constant of 0.2 min is placed in a temperature bath and after the thermometer comes to equilibrium with the bath, the temperature of the bath is increased linearly with time at the rate of 1°C / min what is the difference between the indicated temperature and bath temperature 0.1 min after the change in temperature begins.	1	1	**10**
		UNIT - II			
3	a)	Derive the sinusoidal response of a second order system	2	1	**10**
	b)	A block of mass W resting on a horizontal frictionless table is attached to a linear spring and a viscous damper. The system is free to oscillate horizontally under the influence of a forcing function. Develop the transfer function relating the displacement (Y) and force (F) for a damped vibrator	2	1	**10**
		OR			
4	a)	Derive the unit step response of a second order system for $\xi < 1$.	2	1	**10**
	b)	What are inherently second order systems? Develop the transfer function relating the pressure difference across the manometer limbs to the manometer reading, h.	2	1	**10**
		UNIT - III			
5	a)	Explain the construction and working of a pneumatic control valve	3	1	**10**
	b)	A unit-step change in error is introduced into a PID controller. If K_C = 10, τ_I = 1 and τ_D = 0.5. plot the response of the controller P(t).	3	1	**10**
		OR			

	6	a)	What is the motivation for addition of integral, derivative controller to proportional controller? Explain.	3	1	**10**
		b)	Derive the transfer function for PID controller.	3	1	**10**
			UNIT - IV			
	7	a)	Develop the overall transfer function for proportional control for load change in a unity feedback control loop and discuss the unit step response.	4	1	**10**
		b)	Derive the transfer function Y/X for the control system shown below 	4	1	**10**
			OR			
	8	a)	Develop the overall transfer function for proportional control for unit step change in a feedback control loop with measurement lag and discuss the unit step response.	4	1	**10**
		b)	For the control system shown in figure below i. Obtain the closed loop transfer function. ii. Find the value of K_C for which the closed loop response has a ξ of 2.3. iii. Find the offset for a unit-step change in setpoint, if $K_C = 4$. 	4	1	**10**
			UNIT - V			
	9	a)	Explain the Routh array test for finding the stability of a control system.	5	1	**10**
		b)	A proportional derivative controller having the gain and is used to control two first order system in series having time constants $\tau_1 = 1$ and $\tau_2 = 0.5$. If the gain of the process is 0.5. Sketch the root locus diagram. The transfer function of the measuring element is 1/s.	5	1	**10**
			OR			
	10	a)	Determine the stability of the control system with the characteristic equation using Routh criterion. $s^4 + 3s^3 + 5s^2 + 4s + 2 = 0.$	5	1	**10**
		b)	Discuss the Zeigler-Nicholas's controller tuning method.	5	1	**10**

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