U.S.N.										

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

Autonomous Institute Affiliated to VTU

June / July 2025 Semester End Main Examinations

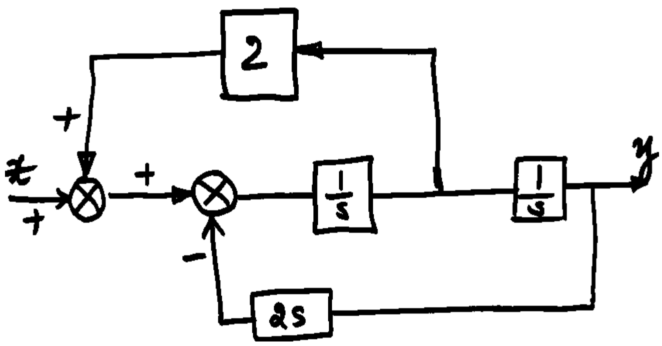
Programme: B.E.
Branch: Chemical Engineering
Course Code: 22CH5PCPCE
Course: Process Control Engineering

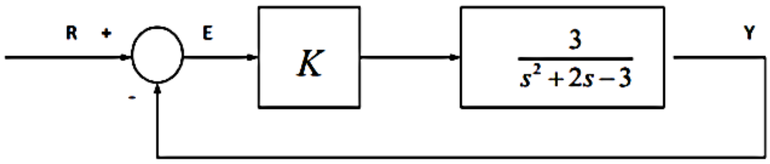
Semester: V
Duration: 3 hrs.
Max Marks: 100

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.

			CO	PO	Marks
		UNIT - I			
1	a)	Develop the transfer function for a first-order system by considering a liquid-level process where the flow out of the tank follows a square root relationship with the head.	*CO1*	*PO1*	**10**
	b)	A thermometer having a time constant of 0.1 min is placed in a temperature bath. After the thermometer comes to equilibrium with the bath, the temperature of bath is increased linearly with time at a rate of 1 ^{o}C /min. what is the difference between the indicated temperature and the bath temperature at t = 0.1 min after the change in temperature begin?	*CO1*	*PO1*	**10**
		OR			
2	a)	A pair of interacting tanks of cross sectional area A_1 and A_2 are functioning. Determine the transfer function for the whole system. The time constants are τ_1 and τ_2 respectively.	*CO1*	*PO2*	**10**
	b)	The step forcing function of X(t)= A is applied to a first order system. Determine and explain the dynamic response Y(t).	*CO1*	*PO2*	**10**
		UNIT - II			
3	a)	A second order system has been given a sinusoidal input. Derive the sinusoidal response.	*CO 2*	*PO 1*	**10**
	b)	A black 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.	*CO 2*	*PO 2*	**10**
		OR			
4	a)	Define inherently second order systems. Develop the transfer function for manometer relating the pressure difference across the manometer limbs to the manometer reading, h.	*CO 2*	*PO 2*	**10**

		b)	A step change of magnitude 4 is introduced in to a system having transfer function $$\frac{Y(s)}{X(s} = \frac{10}{s^2 + 16s + 4}$$ Determine percentage overshoot, rise time, maximum value of Y(t), ultimate value of Y(t), period of oscillation.	*CO 2*	*PO 2*	**10**
			UNIT - III			
	5	a)	What is the motivation for addition of integral and derivative control modes to a proportional controller? Write down the expression and transfer function for a PID controller.	*CO3*	*PO 2*	**6**
		b)	Differentiate between i. Negative feedback and positive feedback ii. Servo problem and regulator problem	*CO3*	*PO2*	**6**
		c)	A unit-step change in error is introduced into a PID controller. If Kc = 10 , τ_I = 1 and τ_D = 0.5. Plot the response of the controller P(t).	*CO3*	*PO2*	**8**
			OR			
	6	a)	A first order process is controlled with a PI controller. For the system under steady state conditions assume that $G_p(s) = G_d(s) = \frac{1}{s+3}$ and $G_m(s) = G_f(s) = 1$. Determine the values of the controller gain Kc and reset time τ_I that can satisfy, if possible, for the following condition when decay ratio of the closed loop response is equal to 0.25.	*CO3*	*PO4*	**12**
		b)	Give a schematic diagram for the feedback control system to control the temperature of liquid inside the stirred tank, which is heated by steam passing through the steam coil immersed inside the tank. Identify different variables involved in the process.	*CO1*	*PO2*	**08**
			UNIT - IV			
	7	a)	Consider a simple unity feed-back control system. The transfer function of control valve and process are 1 and 1/τs + 1, respectively. Develop the overall transfer function for proportional control for unit step change in set point and discuss the response	*CO 4*	*PO1*	**10**
		b)	Derive the transfer function Y/X for the control system shown below 	*CO 4*	*PO2*	**10**
			OR			

	8	a)	Consider the process controlled by a P controller as shown in the figure.  Plot the impulse response for the process to show that the process is unstable.	***CO3***	***PO4***	**10**
		b)	Consider the process under feedback control with the following transfer functions: $G_c = 5$, $G_f = 1$, $G_p = \frac{2}{(s+1)(3s+1)}$, $G_m = 1$. For a set point change of magnitude 2, derive an expression for the closed loop response.	***CO3***	***PO4***	**10**
			UNIT - V			
	9	a)	Plot the root locus diagram for the open loop transfer function G = K (s+0.25)/ s (s+1) (s+2)	***CO*** 5	***PO*** 2	**10**
		b)	The characteristic equation of a control system is given by $$1+\frac{Kc}{(S)(S+1)(S+2)(S+3)}=0$$ Determine the value of K_c for which system is stable.	***CO*** 5	***PO*** 2	**10**
			OR			
	10	a)	Explain the concept of stability in linear control systems. Discuss the Routh Test and its significance in stability analysis.	***CO4***	***PO4***	**08**
		b)	A unity feedback system has the transfer function: $$G(s) = \frac{80}{s\,(s+2)(s+20)}$$ Draw the Bode plot. Comment on the stability of the system.	***CO4***	***PO4***	**12**

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