Name: Enrolment No:	

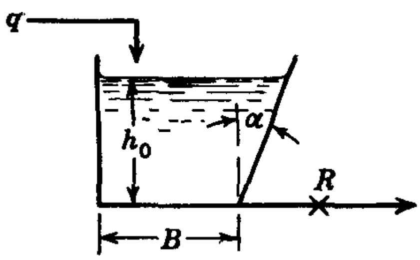
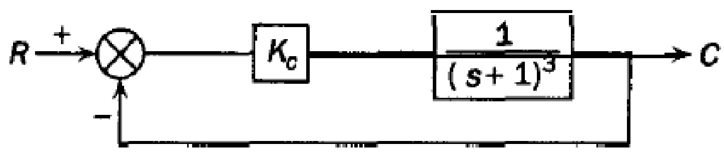
UPES
End Semester Examination, May 2025

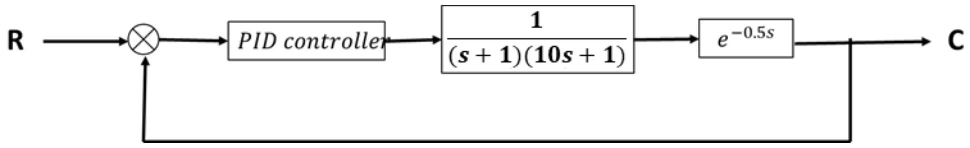
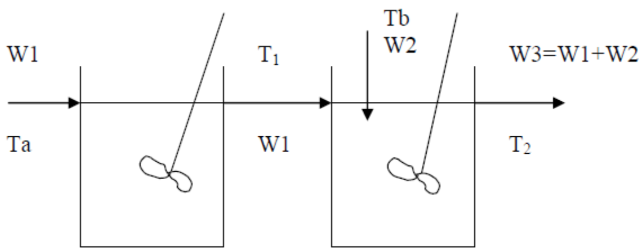
Program Name : M Tech Chemical Engineering **Semester : II**
Course Name : Advanced Process Control **Time : 3 hours**
Course Code : CHPD 7013 **Max. Marks: 100**
Nos. of page(s) : 02

SECTION A
(5QX4M=20 marks)

S. No.		Marks	CO
1	***Outline*** in detail LVDT with a neat diagram. State various applications of LVDT in the industry.	4	CO1
2	***Recall*** about the inherent characteristics of control valves	4	CO1
3	***Describe*** bode stability criteria and crossover frequency	4	CO2
4	***Explain*** what is root locus	4	CO2
5	***Interpret*** the substitution rule.	4	CO3

SECTION B
(4QX4M=40 marks)

S. No.		Marks	CO
6	A thermometer having first-order dynamics with a time constant of 1 min is placed in a temperature bath at 100°F. After the thermometer reaches steady state, it is suddenly placed in a bath at 110°F at t = 0 and left there for 1 min, after which it is immediately returned to the bath at 100°F. ***Identify*** the thermometer reading at t = 0.5 min and at t = 2.0 min.	10	CO2
7	***Demonstrate*** a formula for finding the time constant of the liquid-level system shown below, when the average operating level is h,. The resistance R is linear. The tank has three vertical walls and one which slopes at an angle α from the vertical as shown in figure. The distance separating the parallel walls is 1. 	10	CO3
8	 In the control system shown above, ***calculate*** the value of Kc for which the system is on the verge of the instability. The controller is replaced by a PD controller, for which	10	CO4

	the transfer function is $K_c(1+\tau_D s)$. if Kc = 10, determine the range of τ_D for which the system is stable.		
9	Using Ziegler-Nichols rules, ***design*** proportional gain, derivative and integral time for the system shown below. (Do not plot the bode diagram and use Bode stability criterion)  **OR** With a neat diagram explain the distillation column control system by explaining the types of controllers that could be used.	**10**	**CO5**
SECTION C **(2Q X 20M=40 marks)**			
10	The two tank heating process shown in figure below consist of two identical , well stirred tanks in series. At steady state Ta = Tb = 60°F. At t = 0 , temp of each stream changes according to a step function Ta'(t) = 10 u(t) Tb'(t) = 20 u(t) (a) ***Choose*** a block diagram that relates T2' , the deviation in the temp of tank2, to Ta' and Tb'. (b) ***Illustrate*** an expression for T2'(s) and T2'(t) W1 = W2 = 250 lb/min V1 = V2 = 10 ft3 $\rho_1 = \rho_2$ = 50 lb/ft3 C = 1 Btu/lb (°F)  **OR** Plot the root locus ***diagram*** for the open loop transfer function $\frac{K(s+6)}{s(s+2)(s+4)(s+9)}$	**20**	**CO3**
11	With neat diagrams and appropriate process and block diagrams ***appraise*** any two of the following 1. Smith Predictor 2. Ratio controller 3. Cascade controller	**20**	**CO5**