Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2022

Program Name : M Tech Chemical Engineering **Semester : II**

Course Name : Advanced Process Control **Time : 3 hours**

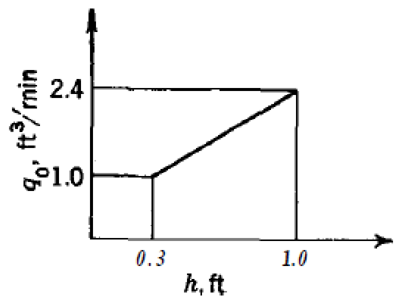
Course Code : CHPD 7013 **Max. Marks: 100**

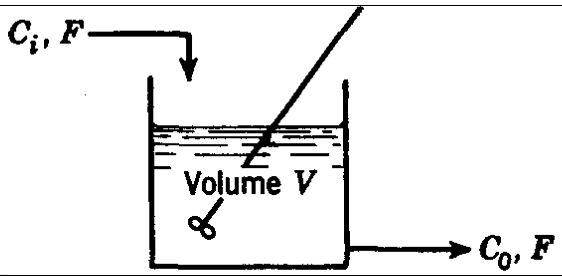
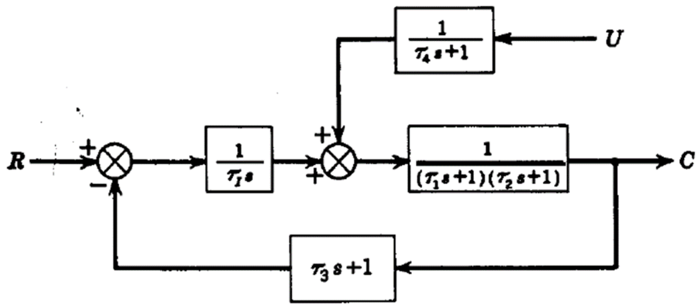
Nos. of page(s) : 03

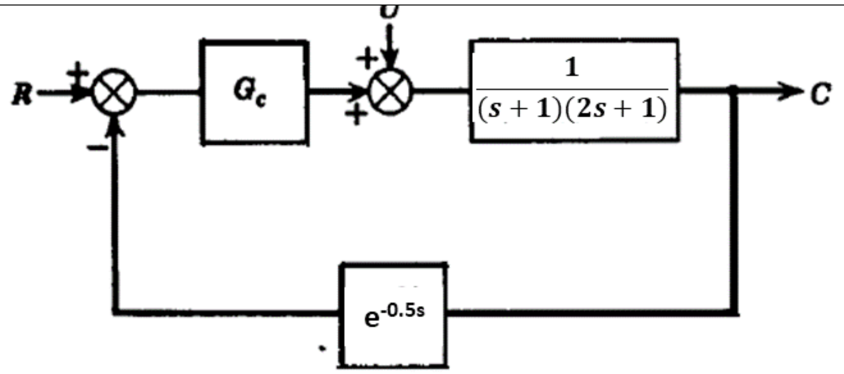
Instructions : Assume any missing data. Draw the diagrams, wherever necessary. Write roll number and name on any additional sheet that you use.

SECTION A

(6X10=60 marks)

S. No.		Marks	CO
1	***Outline*** the static and dynamic characteristics of instruments.	**10**	**CO1**
2	***List*** out different types of sensors with examples	**10**	**CO1**
3	A tank having a cross-sectional area of 2 ft^2 is operating at steady state with an inlet flow rate of 2.0 cfm. The flow-head characteristics are shown in figure below. Find the transfer function H(s)lQ(s). If the flow to the tank increases from 2.0 to 2.2 cfm according to a step change, ***indicate*** the level h two minutes after the change occurs.  	**10**	**CO2**
4	Consider the stirred-tank reactor shown in given figure. The reaction occurring is *A* --------→ *B* and it proceeds at a rate r = kC_o where r = moles *A* reacting/(volume)(time) k = reaction velocity constant C,(t) = concentration of *A* in reactor, moles/volume V = volume of mixture in reactor Further let *F* = constant feed rate, volume/time Ci(t) = concentration of *A in* feed stream. Assuming constant density and constant *V*, ***describe*** the transfer function relating the concentration in the reactor to the feed-steam concentration.	**10**	**CO2**

			
5	A proportional derivative controller with a second order transfer function (τ=1, ξ=2) connected in a feed back loop having measuring element of no dynamic lag, ***examine*** the offset, when the set point is given a unit step function.	**10**	**CO3**
6	a) A process of unknown transfer function is subjected to a unit-impulse input. The output of the process is measured accurately and is found to be represented by the function y(t) = te-t. ***Calculate*** the unit-step response of this process. b) For a control system, the characteristics equation is **$s^4+4s^3+6s^2+4s+(1+K) = 0$** ***Demonstrate*** value of k above which the system is unstable. Determine the value of k for which the two of the roots are on the imaginary axis, and determine the values of these imaginary roots and remaining roots are real.	**10**	**CO4**
SECTION B (2 X 20=40 marks)			
7	Given the control diagram shown below, ***analyze*** by means of the Routh criterion those values of τ_I for which the output C is stable for all inputs R and U.  **OR** Plot the bode ***diagram*** for the following control loop and evaluate the tuning parameters using Ziegler and Nichols control settings.	**20**	**CO3**

			
8	With neat diagrams and appropriate process and block diagrams ***appraise*** any two of the following a) Smith predictor b) Ratio control system c) Internal model control	**20**	**CO4**