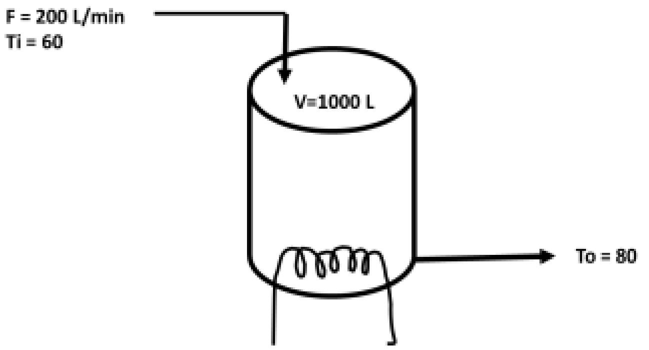
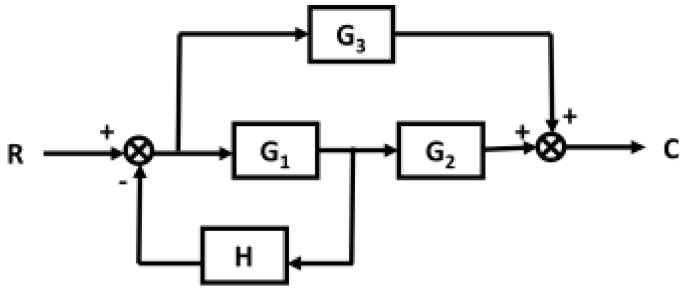
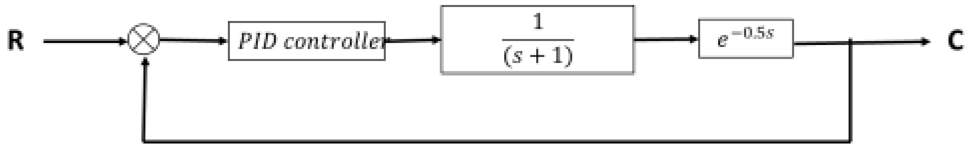
Name: Enrolment No:	UPES UNIVERSITY WITH A PURPOSE

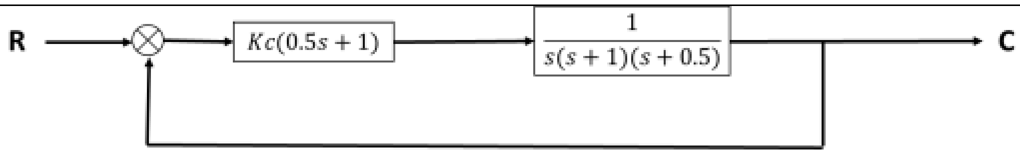
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2021

Program Name : B. Tech. (CERP) **Semester : VI**
Course Name : Process Control **Time : 3 hours**
Course Code : CHCE 3033 **Max. Marks: 100**
Nos. of page(s) : 03
Instructions : Assume any missing data. Draw the diagrams, wherever necessary. Use your own graph sheets. Write roll number and name on any additional sheet that you use.

SECTION A
(6X10=60 marks)

S. No.		Marks	CO
1	Solve the following differential equations using Laplace Transforms. a) $\frac{dx}{dt} - x = 2sint \qquad x(0) = 0$ b) $\frac{d^2x}{dt^2} + 9x = cos2t \qquad x(0) = 1\ and\ x'(0) = A$	**10**	**CO1**
2	 Develop transfer function that relates output temperature of the heating tank system to the inlet temperature of the stream. Derive an expression for the output temperature to the step input in the inlet temperature from 60 to 70 ^{O}C according to a step change. (Use numerical values)	**10**	**CO2**
3	The overall transfer function of the process is given by $\frac{16}{1.5s^2+2.4s+6}$. If a step change of magnitude 6 is introduced into the system, calculate 1. Overshoot 2. Period of oscillation 3. Rise time 4. Ultimate value 5. Maximum value of response	**10**	**CO3**

4	a) Reduce the given block diagram and find C/R  b) A PID controller output in time domain is given by $$P(t) = 30 + 5 \in (t) + 1.25 \int_0^t \epsilon(t)dt + 15\frac{d\epsilon(t)}{dt}$$ The transfer function of the process to be controlled is $\frac{10}{200s+1}$. Find the characteristic equation of the feedback closed loop system when the measuring element has no dynamic lag.	**10**	**CO4**
5	A proportional derivative controller with a time constant of 4min is used to control two non-interacting liquid levels with time constants of 1 and 0.5 respectively in a negative feedback control system. The process has a gain of 0.5 (The numerator in the process transfer function will have 0.5). The measuring element has no dynamic lag with a unity transfer function. Determine the value of Kc for which the system is stable. Draw the process diagram and block diagram.	**10**	**CO5**
6	Using Ziegler-Nichols rules, determine proportional gain, derivative and integral time for the system shown below. (Do not plot the bode diagram and use Bode stability criterion)  **OR** Explain Cohen and Coon rules for tuning a controller.	**10**	**CO6**
SECTION B **(2 X 20=40 marks)**			
7	Find the stability of the following system for Kc=1,2 and 3. For any value of Kc if the system is on verge of instability condition, evaluate the roots of the characteristic equation for which the system goes to instability.	**20**	**CO5**

	 **OR** Plot the root locus for the open loop transfer function $\frac{K}{s(s+4)(s^2+2s+2)}$		
8	With neat diagrams and appropriate process and block diagrams explain a) Cascade control system b) Ratio control system	**20**	**CO6**