Registration No : | | | | | | | | | | |

Total Number of Pages : 03 **B.Tech**
PCE6I102

6th Semester Regular/Back Examination 2018-19
PROCESS DYNAMICS & CONTROL
BRANCH : CHEM
Time : 3 Hours
Max Marks : 100
Q.CODE : F219

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right hand margin indicate marks. The figures in the right hand margin indicate marks. The ordinary, semi-log and log-log graph papers should be provided to the students in the examination hall.

Part- I

Q1 Only Short Answer Type Questions (Answer All-10) **(2 x 10)**

a) What do you mean by inferential control configuration?
b) Classify the different types of variables in the control system with example.
c) Differentiate between period of oscillation and natural period of oscillation.
d) Solve

$$\frac{d^2x}{dt^2}+3\frac{dx}{dt}+x=1 \text{ and } x(0)=x'(0)=0$$

e) Solve the following equation for y(t):

$$\int_o^t y(\tau)d\tau=\frac{dy(t)}{dt}\quad y(0)=1$$

f) A thermometer having a time constant of 0.1 min is at a steady state temperature of 80 °C. At time t=0, the thermometer is placed in a temperature bath maintained at 100°C. Determine the time needed for the thermometer to read 90°C.
g) Draw the block diagram for a process whose output and inputs are related by the following equation:

$$T'(s)=\left[Q(s)+\omega cT_i'(s)\right]\frac{1/\omega c}{\tau s+1}$$

h) What do you mean by on-off controller? Give an example.
i) State the Bode stability criterion in terms of gain margin and phase margin.
j) Which controller is known as rate controller and why?

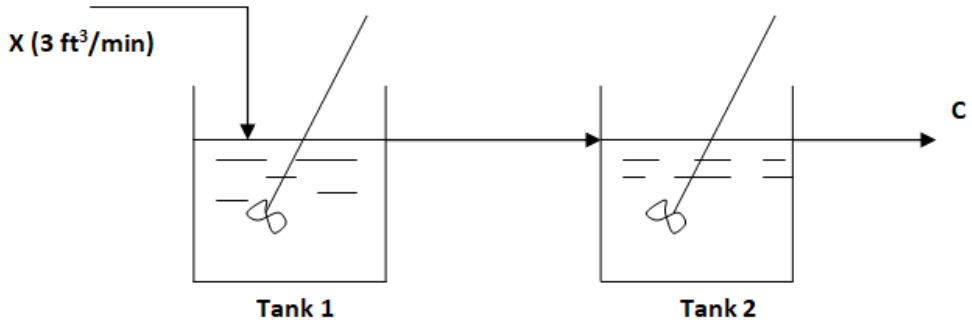
Part- II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) **(6 x 8)**

a) Discuss about the general needs of a control system.
b) Derive the transfer function of a liquid tank system.
c) A first order reaction $A \rightarrow B$ with the rate constant K is taking place in CSTR fed with A at concentration C_{AF} which remains unchanged. There are likely to be some deviations in feed rate (F) of A. Derive the transfer function between concentration of A in the outlet and feed rate of A assuming that volume V of reacting mixture remains unchanged.

d) 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 $y(t) = te^{-t}$. Determine the unit step response of this process.

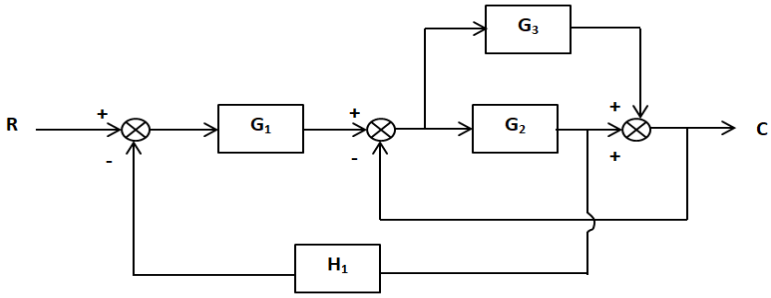
e) In the two-tank mixing process shown in figure below, x varies from 0 lb salt/ft^3 to 1 lb salt/ft^{3}according to a step function. At what time does the salt concentration in tank 2 reach 0.6 lb salt/ft^3? The holdup volume of each tank is 6 ft^3.



f) Discuss briefly the hardware of a control system.

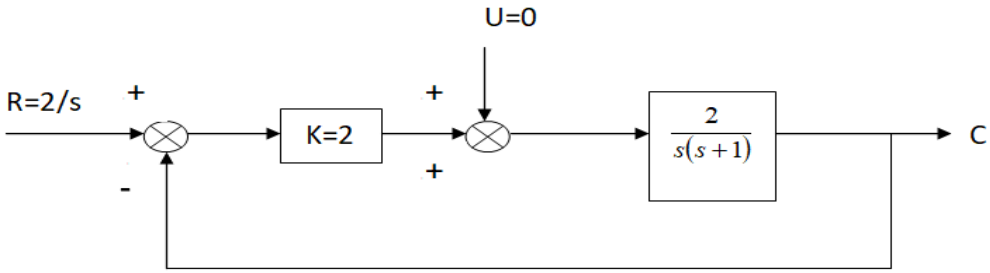
g) What do you mean by proportional band?
A pneumatic proportional controller is used to control temperature within the range of 60 to 100 °F. The controller is adlusted so that the output pressure goes from 3 psi (valve fully open) to 15 psi (valve fully closed) as measured temperature goes for 71 to 75 °F with the set point held constant. Find the gain and the proportional band.

h) Determine the overall transfer function for the following block diagrams.

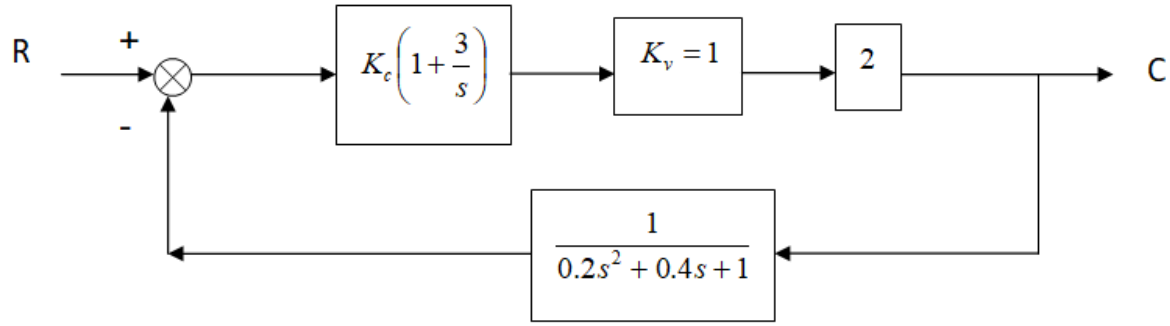


i) For the control system given below, determine :

- $\frac{C(s)}{R(s)}$
- Offset
- $C(\infty)$



j) By means of the Routh test, determine the stability of the system given below for $K_c = 2$.



k) What do you mean by filter? Classify the different types of filter.

l) Write short notes on :

- Ratio control
- Cascade control

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 a) Prove that the manometer is of a second order system. **(6)**

b) A step change of magnitude 5 is introduced into a system having the transfer function **(10)**

$$\frac{Y(s)}{X(s)} = \frac{10}{s^2+2s+5}$$

Determine :

- Percent overshoot
- Rise time
- Maximum value of Y(t)
- Ultimate value of Y(t)
- Peroid of oscillation

Q4 Sketch the root locus plot for the open loop transfer function given below and determine the stability. **(16)**

$$G(s)H(s) = \frac{K(s+0.1)}{s(s-0.2)(s^2+s+0.6)}$$

Q5 Plot the Bode diagram for the control system whose overall transfer function is given by : **(16)**

$$G(s) = \frac{10(0.2s+1)e^{-s/10}}{(s+1)(0.1s+1)}$$

Q6 For the control system of transfer function given by: $1/(s+1)^3$, determine the controller setting for a PI controller using C-C method and model the process reaction curve. **(16)**