Paper Code: CH-602	**Roll No.**										

B.Tech.

(SEM VI) EVEN SEMESTER EXAMINATION, 2015-16

PROCESS DYNAMICS & CONTROL

[Time: 3 hrs.] **[Max. Marks: 100]**

Note: i) In case of numerical problems assume data wherever not permitted
ii) Be precise in your answer.

Q 1. Attempt any four of the following: **[5x4=20]**

(a) Write the relative advantages and disadvantages of feed forward and feedback control.
(b) Discuss the Time-Integral performance criteria.
(c) With an example explain Transportation lag in any system.
(d) Give the importance of Laplace Transformation.
(e) Write the sort note on Linearization of nonlinear system.
(f) Discuss the One Quarter Decay Ratio criteria for controller tuning.

Q 2. Attempt any two parts of the following: **[10x2=20]**

(a) Solve for x(t) by using Laplace Transformation

$$\frac{d^3x}{dt^3}+\frac{3d^2x}{dt^2}+\frac{3dx}{dt}+x=1$$

If x (0) = x' (0) = x'' (0) = 0.

(b) Define terms 'rise time', 'overshoot' and 'decay ratio' in the response of a second order system. Obtain the expressions for them in term of τ and ξ.

(c) Give one example each of a system with first order and second order dynamics. Derive the transfer function of a second order system.

Q 3. Attempt any two parts of the following: **[10x2=20]**

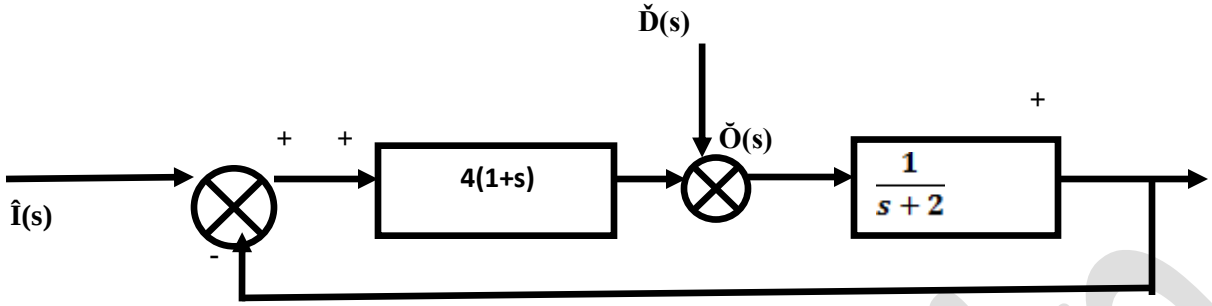
(a) There are N storage tanks of volume V arranged so that when water is fed into the first tank, an equal volume of liquid overflows from the first tank into the second tank, and so on. Each tank initially contains component **A** at some concentration C_O and is equipped with a perfect stirrer. At time zero, a stream of zero concentration is fed into the first tank at a volumetric rate q. find the resulting concentration in each tank as a function of time.

(b) A control system having transfer function is expressed as

$$G(s)=\frac{Y(s)}{X(s)}=\frac{5}{\tau^2s^2+2\xi\tau s+1}$$

The radian frequency for the control system is 1.9 rad/min. The time constant is 0.5 min. The control system is subjected to a step change of the magnitude 2. Calculate:
(i) Rise time (ii) Decay ratio (iii) Maximum value of Y (t) (iv) Response time

(c) The figure shows a feedback control loop. Find the variation of the process output O_p for a unit step change in set point and find the offset.



Q 4. Attempt any two parts of the following: **[10x2=20]**

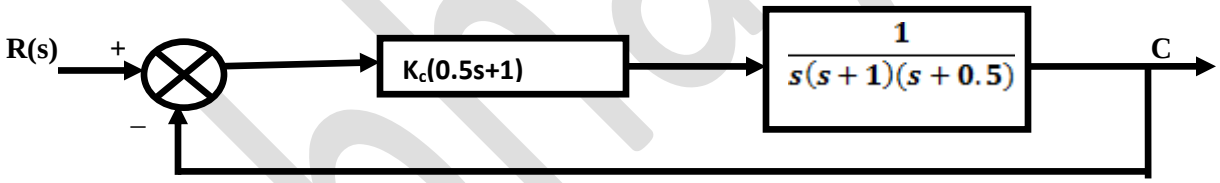
(a) A mercury thermometer having a time constant of 0.1 min is placed in a temperature bath at 100°F and allowed to come to equilibrium with the bath. At time t = 0, the temperature of the bath begins to vary sinusoidal about its average temperature of l00 °F with an amplitude of 2°F If the frequency of oscillation is 10/π cycles/min, plot the ultimate response of the thermometer reading as a function of time. What is the phase lag?

(b) A process reaction curve study gave the following values from the graph, $\mathbf{t_{ad}}$=0.2min, $\boldsymbol{\tau}$ =4 min, **K**=8. Find the PID controller parameters.

(c) The open loop transfer function of a process is $\frac{1}{2(4s+1)^4}$. Find the cross-over frequency and the ultimate gain if the time constant is given in seconds.

Q5. Attempt any two parts of the following: **[10x2=20]**

(a) A control system is represented by means of a block diagram shown in figure



Determine the value of **Kc** gain of controller which just causes instability. Use Routh criterion. Also determine the location of the pair of roots lie on the imaginary axis for the control system.

(b) A process shows the amplitude ratio of 0.2 at a cross-over frequency of 15 rad/s. finds the ultimate gain and the period of sustained oscillations. For use of a P-controller, recommend the value of K_c.

(c) A second order process of transfer function $Gp = \frac{1}{3.2+2s+s^2}$ is being controlled with a PI-controller. Find the relation for the controller parameters for stable operation of the system. Assume all other elements in loop have unity gain.