DEPARTMENT OF CHEMICAL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY CALICUT.

WINTER SEMESTER 2014-15

Test 2

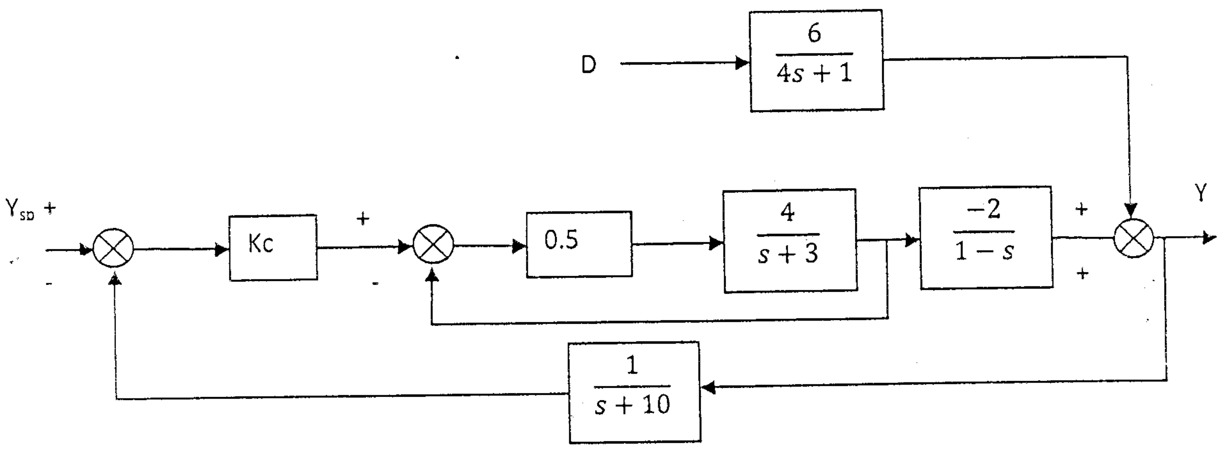
CH3007 PROCESS DYNAMICS AND CONTROL

Name:————————

Reg. No.————————

Duration: 1 hour 15 min | Date :08.04.2015 | Maximum Marks: [15]

1. The block diagram of a feed back control system is shown in figure. Determine the values of K_c that result in stable closed loop systems using Root Locus method. (3)

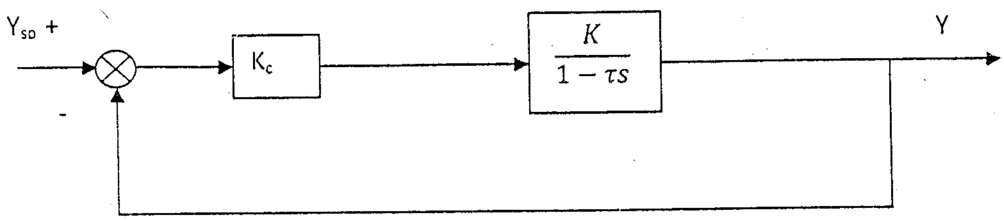


2. Draw the Bode plot for the transfer function (3)

$$\frac{5(s+1)e^{-s}}{s(5s+1)(0.2s+1)}$$

3. The question has been raised whether an open loop unstable process can be stabilized with a proportional – only controller. (3)
   (a) For the process and the controller shown in figure, find the range of K_c values that yield a stable response (Note that τ is positive)

$-K(1+\frac{1}{\tau_I s})$



   (b) Check the gain $Y(s)/Y_{sp}(s)$ to make sure that the process responds in the correct direction if Kc is within the range of part (a).

(c) For K=10 and τ =20, find the value of K_c that yields a pole at s = -0.1. What is the offset for these conditions?

4. A closed loop feedback control system consists of a second order process (3)

$$G_p(s) = \frac{K_p}{(\tau_1 s+1)(\tau_2 s+1)}$$

And a proportional controller ($G_c(s)= K_c$). The roots of characteristic equation of the closed loop system are -2 and -1 in absence of controller and roots are $-1.5 \pm 0.5i$ when K_c= 4

a) Determine K_p, τ_1, τ_2

b) Determine limits on K_c so that the response of the system to a unit step input is non-oscillatory

5. Consider two non-interacting system. The liquid level in the tank 2 is controlled by manipulating flow rate F_1 (Inlet flow rate of tank 1) through a proportional controller. A_1=5 ft^2 and A_2=2 ft^2. Initially, the system is at steady state with F_1=1 ft^3/min and h_1= 4 ft, h_2=3 ft. Find the values of the controller gain which produces (3)

a) Critically damped response

b) Underdamped response with a decay ratio of 0.25 for h_2

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