CM3310
Exam 2
March 18, 2004
Open book/Open Notes

Name: _____ Box No. _____

1. (25 pts) Given the block diagram in Figure 1, obtain the equivalent transfer function of T_{set} to T.

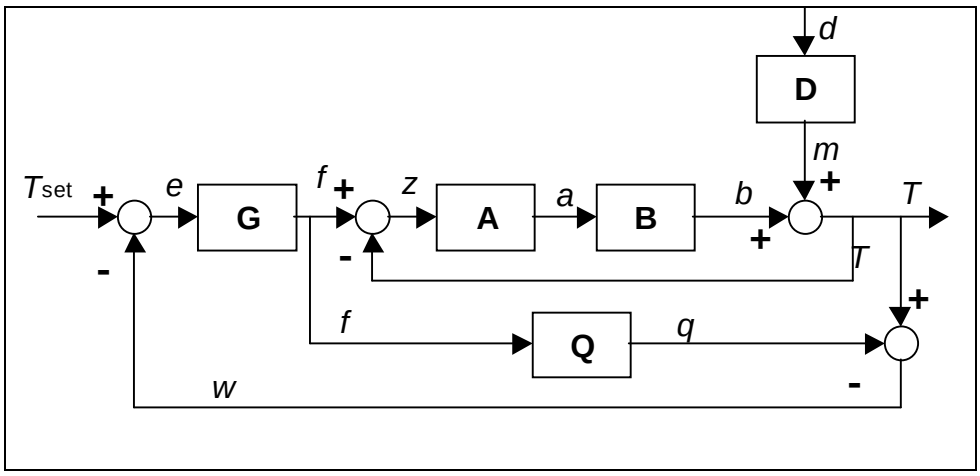

Figure 1.

(*Hint*: the transfer function from d to T is : $\frac{D(1-GQ)}{GAB+(1+AB)(1-GQ)}$)

2. (25 pts) A set of reactions are described by the following equations:

$$\frac{dC_A}{dt} = -(k_{AB} + k_{AC})C_A + k_{BA}C_B$$
$$\frac{dC_B}{dt} = k_{AB}C_A - k_{BA}C_B + C_{Bin}$$

where C_A and C_B are concentrations of A and B, while C_{Bin} is the concentrations of B in the feed. Obtain the transfer functions from C_{Bin} to $C_{A,}$ assuming zero initial conditions (e.g. all concentrations are perturbed variables). The constants are k_{AB}=0.2, k_{BA}=0.7, k_{AC}=0.3.

3. (25 pts) For the block diagram shown in Figure 2, determine the range of values of K_c for which the system is stable.

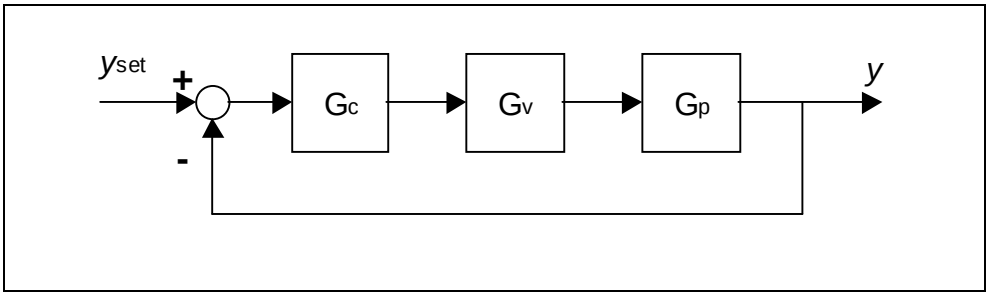

Figure 2.

where,

$$G_c = K_c\left(\frac{2s+1}{s+1}\right)$$

$$G_v = 2\frac{1}{s+1}$$

$$G_p = \frac{-2s+1}{(3s+1)}$$

4. (25 pts) For the control system given in Figure 3, design a PI controller for G_c using the Ziegler-Nichols tuning rules.

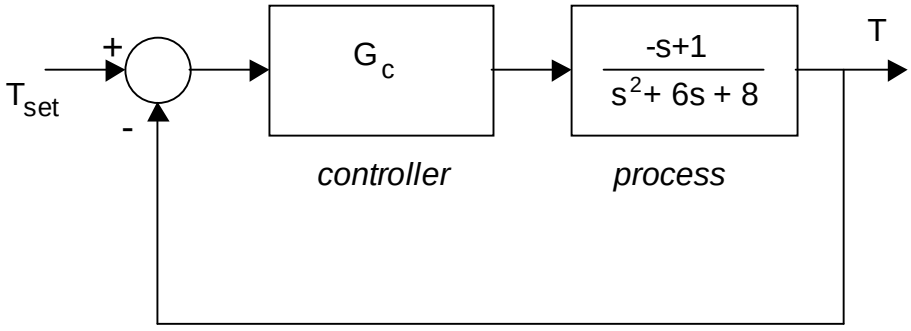

Figure 3.

5. Bonus (10pts): If one used a proportional controller with gain, Kc = 4, in the control system in Figure 3, determine the value of the steady state error for T_{set} = 50 .