Fayoum University
Faculty of engineering-Electrical Department
3rd year Electric Power and Machines

Automatic Control

EPM 308
Final Exam- Jan. 2016
Time: 3 hrs.
75 Grades

Question 1 [20 grades]:

a. Find $G(s) = \frac{Eo(s)}{T(s)}$ for the system shown in Figure 1.

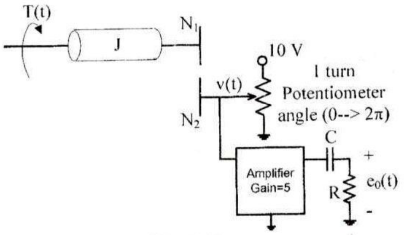

Figure 1

b. For the control system given by the block diagram shown in Figure 2 below find the transfer function $G(s) = \frac{C(s)}{R(s)}$ in terms of the transfer functions of the subsystems (G_1 through G_8) using Block Diagram Reduction.

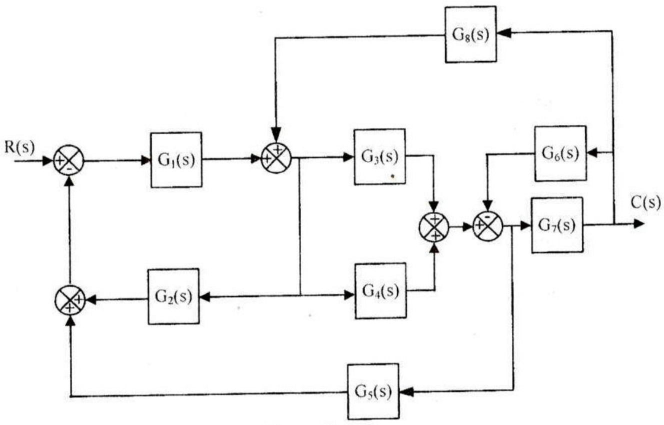

Figure 2

c. Using Mason's rule, find the transfer function $G(s) = \frac{C(s)}{R(s)}$ for the system represented by Figure 3.

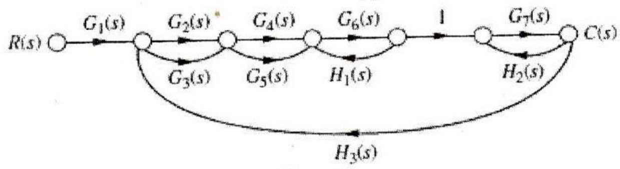

Figure 3

GOOD LUCK

12 JAN. 2016

DR. AMR ABDALLAH

Fayoum University
Faculty of engineering-Electrical Department
3rd year Electric Power and Machines

EPM 308
Final Exam- Jan. 2016
Time: 3 hrs.
75 Grades

Automatic Control

Question 2 [15 grades]:

a. Consider the feedback control system shown in Figure 4, determine the feedback coefficients K_1 and K_2 that yield percentage overshoot of 6% and settling time of 2 seconds for the closed loop system's step response.

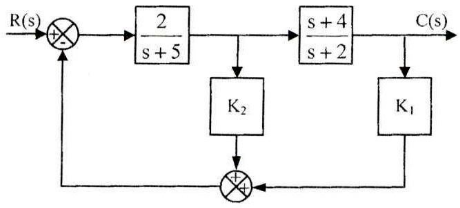

Figure 4

b. The signal D(s) represents disturbance to the feedback control system shown in Figure 5. The feedforward transfer function $G_d(s)$ is used to eliminate the effect of D(s) on the output C(s). Find the transfer function $C(s)/D(s)|_{R(s)=0}$ and determine the expression of $G_d(s)$ so that the effect of D(s) is entirely eliminated.

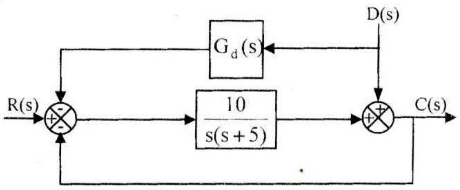

Figure 5

Question 3 [15 grades]:

a. The system of Figure 6 is to have the following specifications: velocity error constant $K_v = 10$, damping ratio $\zeta = 0.5$. Find the values of K_1 and K_f required for the specifications of the system to be met.

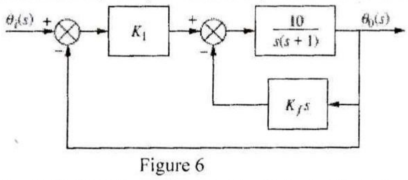

Figure 6

b. For the system shown in Figure 7, find the value of gain, K that will make the system oscillate. Also, find the frequency of oscillation.

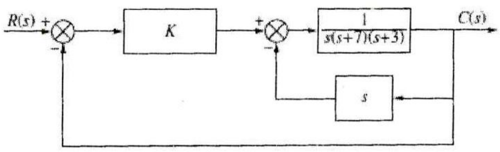

Figure 7

GOOD LUCK

12 JAN. 2016

DR. AMR ABDALLAH

Question 4 [15 grades]:

For the unity feedback system shown in Figure 8, it is required to design the proportional differential controller (that is selection of K_p and T_d) such that the damping ratio ζ of the closed loop system is 0.7 and its natural frequency ω_n is 0.5 rad/sec.

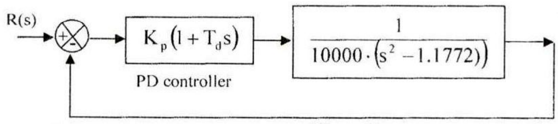

Figure 8

a. Identify the closed loop poles required to satisfy the design criteria (that is ζ=0.7 and ω_n = 0.5 rad/sec).
b. Using the angle condition of the root locus applied at the closed loop poles in (a) find the value of the time constant T_d.
c. Using the magnitude condition of the root locus applied at the closed loop poles in (a) find the gain K_p.
d. Prove that the complex branches of the system root-locus for the parameter K_p describes a complete circle. Find the center and radius of this circle.
e. Draw exactly the root locus of the system for the parameter K_p.
f. Find the range of the gain K that result in an under-damped closed-loop system.

Question 5 [10 grades]:

For the unity feedback control system with a feed-forward transfer function:

$$G(s)=\frac{100(s+2)}{s(s+1)(s+4)}$$

a. Plot the Bode diagram (magnitude and phase).
b. Estimate the transient response of the system (%OS, T_s, T_p, T_r)