Automatic Control – EEE 2002 Tutorial Exercise VII

1. For the first order system with an OLTF: $G(s)=\dfrac{1}{s+1}$**, find:**

a. Time constant (without using Matlab/Simulink)

b. Steady state value (without using Matlab/Simulink)

c. Type (without using Matlab/Simulink)

d. Order (without using Matlab/Simulink)

e. Step response (**with Matlab/Simulink**), crosscheck your previous answers (where applicable).

2. Add a controller Gc=K and find for the closed loop system:

a. Time constant (without using Matlab/Simulink)

b. Plot the pole location as a function of K (**with Matlab/Simulink**).

c. Steady state value (without using Matlab/Simulink)

d. Type (without using Matlab/Simulink)

e. Order (without using Matlab/Simulink)

f. Steady state error (without using Matlab/Simulink)

g. Steady state error with the formula that uses the type of the system (without using Matlab/Simulink).

h. Step response (**with Matlab/Simulink**) for K=1, 10, 1000, crosscheck your previous answers (where applicable)

i. Prove that by increasing the gain we cannot have an unstable system (**with Matlab/Simulink**).

3. For the second order system with an OLTF: $G(s)=\dfrac{1}{(s+1)(s+2)}$**, find:**

a. Damping factor and natural frequency (without using Matlab/Simulink)

b. Steady state value (without using Matlab/Simulink)

c. Type (without using Matlab/Simulink)

d. Order (without using Matlab/Simulink)

e. Step response (**with Matlab/Simulink**), crosscheck your previous answers (where applicable).

4. Add a controller Gc=K and find for the closed loop system:

a. Damping factor and natural frequency (without using Matlab/Simulink)

b. Plot the pole location as a function of K (**with Matlab**).

c. Steady state value (without using Matlab/Simulink)

d. Type (without using Matlab/Simulink)
e. Order (without using Matlab/Simulink)
f. Steady state error (without using Matlab/Simulink)
g. Steady state error with the formula that uses the type of the system (without using Matlab/Simulink).
h. Step response **(with Matlab/Simulink**) for various values of K; crosscheck your previous answers (where applicable)
i. Find the value of K where we start to have oscillations; what is the value of s at that point?
j. Prove that by increasing the gain we cannot have an unstable system.

5. For the third order system with an OLTF: $G(s) = \frac{1}{(s+1)(s+2)(s+3)}$ **, find:**

a. Damping factor and natural frequency (without using Matlab/Simulink)
b. Steady state value (without using Matlab/Simulink)
c. Type (without using Matlab/Simulink)
d. Order (without using Matlab/Simulink)
e. Step response (**with Matlab/Simulink**), crosscheck your previous answers (where applicable).

6. Add a controller Gc=K and find for the closed loop system:

a. Damping factor and natural frequency (without using Matlab/Simulink)
b. Plot the pole location as a function of K (**with Matlab**).
c. Steady state value (without using Matlab/Simulink)
d. Type (without using Matlab/Simulink)
e. Order (without using Matlab/Simulink)
f. Steady state error (without using Matlab/Simulink)
g. Steady state error with the formula that uses the type of the system (without using Matlab/Simulink).
h. Step response **(with Matlab/Simulink**) for various values of K; crosscheck your previous answers (where applicable)
i. Find the value of K where we start to have oscillations; what is the value of s at that point?
j. Prove that by increasing the gain we can have an unstable system. What is the value of s when we have a marginally stable system?
k. Find the frequency of the oscillations when the system is marginal stable.