Modern Control Systems ELG 4157 / SYS 5100

MATLAB Assignment 3

Q1) Convert the following continuous-time analog systems into their equivalent discrete-time digital ones using Matlab **c2d** function. Assume sampling period of 1 sec and a zero order hold device:

(a) $G_p(s) = \dfrac{1}{s}$

(b) $G_p(s) = \dfrac{s}{s^2 + 4}$

(c) $G_p(s) = \dfrac{s + 5}{s + 1}$

(d) $G_p(s) = \dfrac{1}{s(s + 1)}$

Q2) For the given second order closed-loop transfer function of a discrete system:

$$T(z) = \frac{Y(z)}{R(z)} = \frac{1.7(z + 0.46)}{z^2 + z + 0.5}$$

a) Use discrete form of Matlab function **tf** to plot the unit step response with sampling period of 0.1 sec.

b) Use Matlab function **d2c** to obtain the equivalent non-sampled continuous-time system.

c) Plot the unit step response in (b) and compare it with the discrete response in (a).

d) Try different values of the sampling period in (a) to obtain the best possible discrete-time response approximation of the continuous-time response in (b).

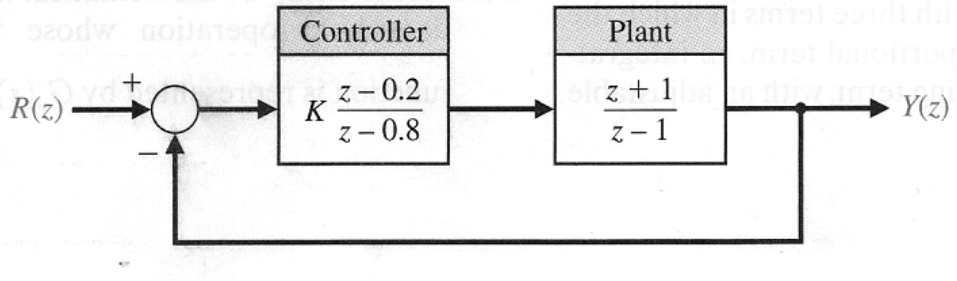
Q3) Consider the following discrete-time system:

$$G(z)D(z) = K\frac{z^2 + 3z + 3.75}{z^2 - 0.2z - 1.9}$$

a) Use Matlab function **rlocus** to plot the system root-locus.

b) Then use Matlab function **rlocfind** to determine the range of gain ***K*** for stability.

Q4) Repeat the steps of **Q3** above to determine the range of gain ***K*** for stability of the given closed-loop feedback system:



Q5) A certain process is modeled with the following transfer function:

$$G_p(s) = \frac{10}{s(s+5)}$$

a) Design a digital controller ***D(z)*** with sampling time of 0.02 sec such that to meet the following design specifications:

i) phase margin is greater than 45^o.

ii) settling-time with 2% criterion of less than 1 sec.

b) Simulate both the continuous-time and the sampled-time closed-loop systems to a unit-step input and compare the two responses.

Hint: consider first the following controller design in continuous time then convert to ***D(z)***:

$$G_c(s) = K\frac{s+a}{s+b}$$