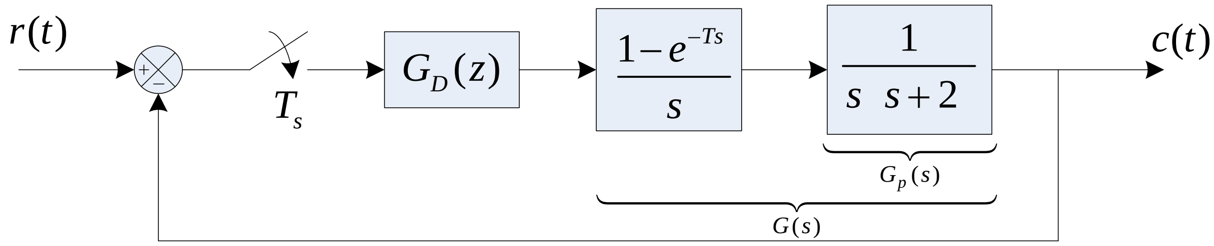
Date of Issue: 13.05.2016
Deadline: 30.05.2016 (must be submitted at the final exam).

KON 326E
COMPUTER CONTROLLED SYSTEMS
PROJECT – 4

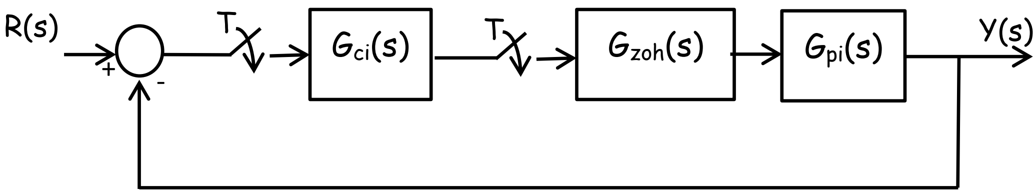
1)



Design of a digital controller is required on w-plane for the system given in the above figure where the sampling period is $T_S = 0.1$s. The phase margin and the gain margin is required to be 55^o and 10 dB, respectively. Also the coefficient of static velocity error should be 5 s^{-1}.

a) Find the controller $G_D(z)$ which satisfies the requirements specified above. Plot the unit step and unit ramp responses of the closed loop system and interpret the results you obtained.
b) Compare the frequency responses of $G_p(s)$ and $G(w)$ and comment on the relationship between them.
c) Plot the root locus of $G_D(z).G(z)$ and analyze the effect of the controller you found.
d) Consider the controller as $G_D(z) = K_D$ where K_D is the controller gain that you found in (a) and obtain the unit step response of the closed loop system with this controller. Interpret these results by comparing them with the results which you obtained in (a).

2)



Consider the closed loop system given in the above figure where G_{ci} are the controllers, G_{pi} are the systems and *i* represents **your** project group number. Each controller corresponding to each system is designed to yield a specific transient and steady state behavior for each closed loop system. In this question, investigation of the effects of the different sampling periods and the different transformation techniques closed loop system performance is aimed.

$G_{pi}(s) = \frac{5}{s+8}$	$G_{ci}(s) = \frac{35.5(s+8.5)}{s(s+19)}$	i = 1
$G_{pi}(s) = \frac{2}{s+3}$	$G_{ci}(s) = \frac{18.8(s+3.5)}{s(s+9.1)}$	i = 2
$G_{pi}(s) = \frac{2}{s+1}$	$G_{ci}(s) = \frac{5.85(s+8.5)}{s(s+5.2)}$	i = 3

Requirements to be done:

Define five different sampling periods, $T = \{\frac{2}{p_{maks}}, \frac{1}{p_{maks}}, \frac{1}{2p_{maks}}, \frac{1}{5p_{maks}}, \frac{1}{10p_{maks}}\}$, where p_{maks} is the biggest magnitude of the poles of the continuous closed loop system. The value of the sampling period can be round to values in miliseconds (ms).

Obtain the approximate discrete models of $G_c(s)$ using Tustin transformation for each sampling period you defined. Plot the unit step response of the closed loop systems for each obtained discrete controller using MATLAB. Compare the closed loop unit step responses with discrete controllers with the unit step response of the continuous closed loop system and interpret the results.