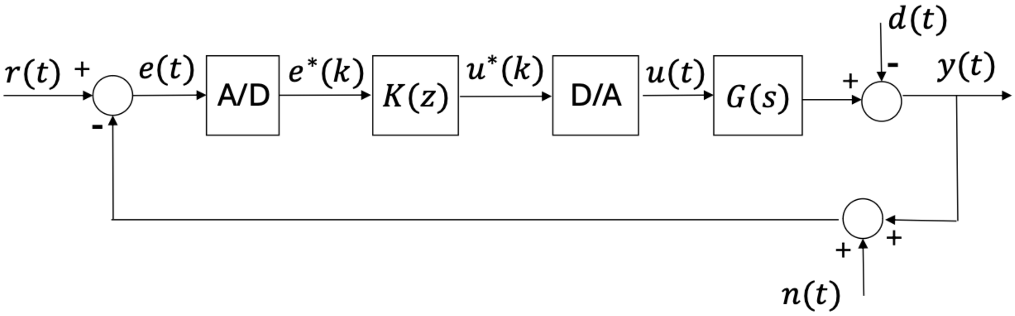
Industrial Automation – January 16th, 2024

Student:____ **ID:**____________________________

1. For the closed-loop control system shown in figure,



where

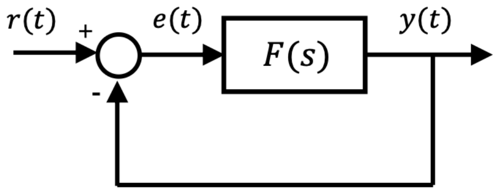
$$G(s) = \frac{15}{s^2 + 13s + 30},$$

a. design a digital control $K(z)$ by emulation of a continuous control design (i.e. by computing the discrete equivalent using Tustin's method) with a sampling time $T = 0.05$ sec, in order to satisfy the following requirements:

i. $e_{\infty r} \leq 0.1$ for multi-frequency disturbances, $d(t)$, in the range $[0\ \ 1]$ rad/s;
ii. $y(t)$ with overshoot to a step reference signal, $r(t)$, less than 15%;
iii. settling time $t_{s5\%} \leq 0.5$ sec;

b. discuss the action to be implemented for reducing the effect of high-frequency noise $n(t)$ (i.e., $n(t) = 0.1\sin(\omega t)$, with $\omega \in [110\ \ 130]$ rad/s).

2. For the closed-loop control system show in figure,



where the open loop function is defined by

$$F(s) = \frac{\rho(s+3)}{s(s^2 + 2s + 10)},$$

draw the root locus and discuss the stability of the closed-loop control system for $\boldsymbol{\rho}>0$.

Time available: 2 hours