Automatic Control Systems – December 17th, 2024

Student:_____ ID:_____

1. Given the LTI system defined by the transfer function G(s),

$$G(s) = \frac{(s+20)}{(s^2+2s+10)},$$

- a. calculate the analytic expression of the forced response to a step input of unitary amplitude (i.e., step response);
- b. draw the qualitative step response.
- 2. For the closed-loop control system shown in figure,



where

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

,

- a. design K(s) in order to satisfy the following requirements:
 - i. $e_{\infty r} \leq 0.1$ for multi-frequency disturbances, d(t), in the range $\begin{bmatrix} 0 & 1 \end{bmatrix}$ rad/s
 - ii. y(t) without overshoot to a step reference signal r(t);
 - iii. settling time $t_{s5\%} \leq 0.3$ sec;
- b. for the designed controller, evaluate the effect of multifrequency noise, $n(t) = 0.1 \sin(\omega t)$, with $\omega \in [70 + \infty]$ rad/s, on the system output y(t).

Time available: 2 hours