Automatic Control Systems – January 16th, 2025

Student:_____ ID:_____

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

$$G(s) = \frac{(4s+3)}{(s^2+8s+15)},$$

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



where

$$G(s)=\frac{3}{s^2+4s+3},$$

design K(s) in order to satisfy the following requirements:

- i. $e_{\infty}=0$ w.r.t. a step reference signal, r(t);
- ii. $e_{\infty r} \leq 0.1$ for multi-frequency disturbances, d(t), in the range [0.01 0.5] rad/s;
- iii. y(t) with overshoot to a step reference signal, r(t), less than 15% and settling time $t_{s5\%} \le 2$ sec;
- iv. attenuation $\geq 95\%$ for multi-frequency noise, n(t), in the range $[30 +\infty]$ rad/s.

Time available: 2 hours