

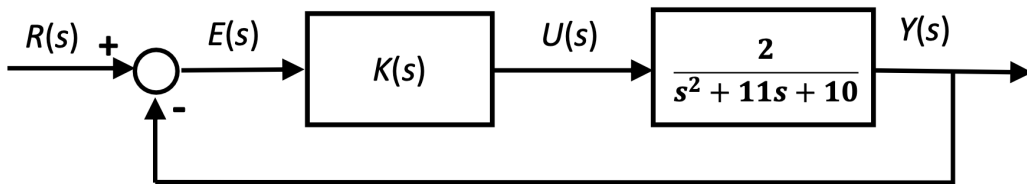
Automatic Control Systems – November 8, 2023

Student: _____ ID: _____

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

$$G(s) = \frac{(s + 10)}{(s^2 + 4s + 13)},$$

- 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 system shown in figure,



- a. devise $K(s)$ in order to satisfy the following requirements:
 - i. $e_{\infty} \leq 0.1$ w.r.t. a reference step signal $r(t) = 2 \cdot 1(t)$;
 - ii. no overshoot;
 - iii. settling time $t_{s5\%} \leq 0.3$ s;
- b. draw the qualitative response $y(t)$ of the devised closed loop system to a square wave

$$\text{reference signal, } r(t) = \begin{cases} 1, & 0 < t \leq T/2 \\ 0, & T/2 \leq t < T \end{cases}, \text{ with } T = 1 \text{ s.}$$

Time available: 2 hours