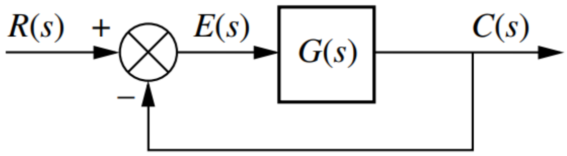
1. (10') Using the Routh-Hurwitz criterion and the unity-feedback system of figure below with

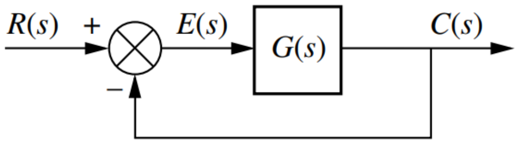
$$G(s) = \frac{1}{2s^4 + 5s^3 + s^2 + 2s}$$

tell whether or not the closed-loop system is stable.



2. (10') Find the range of K for the closed-loop stability if in figure below

$$G(s) = \frac{K(s-1)}{s(s+2)(s+3)}$$

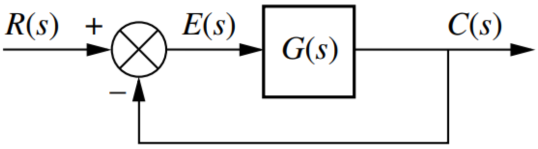


3. (15') Use a Routh array to find out how many poles of $T(s)$ are in the left half-plane, right half-plane, and on the $j\omega$-axis. (Hint: Count the sign changes in the first column to identify the poles in the right half-plane)

$$T(s) = \frac{s-2}{s^5 - 2s^4 + 4s^3 - 3s^2 + 2s - 3}$$

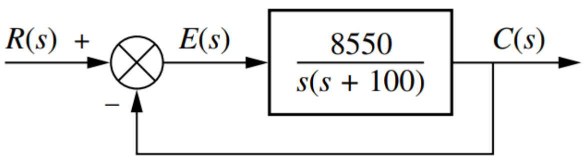
4. (5*5'=25') For the unity-feedback system shown in Figure below, where

$$G(s) = \frac{5000}{s(s+75)}$$



(1) What is the expected percent overshoot for a unit step input?
(2) What is the setting time for a unit step input?
(3) What is the steady-state error for an input of $5u(t)$?
(4) What is the steady-state error for an input of $5tu(t)$?
(5) What is the steady-state error for an input of $5t^2u(t)$?

5. (4*6'=24') Find ζ, ω_n,overshoot, peak time, rise time, and setting time for the system below. (Hint: The formula for rise time is $t_r = \frac{\pi-\beta}{\omega_n\sqrt{1-\zeta^2}}$, $\beta = \arctan\left(\frac{\sqrt{1-\zeta^2}}{\zeta}\right)$)



6. (16’) Refer to figure below. Find the value of K_1 and K_2 that will result in a step response with a peak value of 1.5 sec. and a setting time of 3 sec.