EE 3657

Homework # 4 – Assigned Th Jun 20 - Due Th Jun 27

Covers Routh and Steady-State Errors. Your notes and the textbook should be ample material to solve these problems.

1. The polynomial $a(s) = s^6 + 4s^5 + 3s^4 + 2s^3 + s^2 + 4s + 4$ satisfies the necessary condition for stability since all the $\{a_i\}$ are positive and non-zero. Determine how many, if any, roots of the system are in the RHP.
2. Consider a unity feedback system with feed-forward transfer function given as follows: $G(s) = \dfrac{K(s+1)}{s(s-1)(s+6)}$. Is the system open-loop stable? For what values of K? Is the system closed-loop stable? For what values of K?
3. Find the range of values of controller gains (K, K_I) so that the unity feedback system with controller given by $K + \dfrac{K_I}{s}$ and plant given by $G(s) = \dfrac{1}{(s+2)(s+1)}$ is stable.
4. Find if any roots of the polynomial $a(s) = s^5 + 3s^4 + 2s^3 + 6s^2 + 6s + 9$ are in the RHP.
5. Find if any roots of the polynomial $a(s) = s^5 + 5s^4 + 11s^3 + 23s^2 + 28s + 12$ are on the imaginary axis or in the RHP.
6. Consider a unity-feedback system with the closed-loop transfer function given by $\dfrac{C(s)}{R(s)} = \dfrac{Ks + b}{s^2 + as + b}$. Determine the open-loop transfer function $G(s)$. Show that the steady-state error in the unit-ramp response is given by $e_{ss} = 1/K_v = \dfrac{a-K}{b}$.
7. Consider a unity-feedback system with open-loop transfer function given by $G(s) = \dfrac{K}{s(Js + B)}$. Discuss the effects that varying the values of *K* and *B* has on the steady-state error in the unit-ramp response. Sketch typical unit-ramp response curves for a small, medium, and large value of *K*, assuming constant *B*.