ME 5200/6200 Classical Controls **Fall 2020**

Homework 07 **Due Thurs, Nov. 5, turn in via CANVAS**

Do the following problems and show all your work for full credit. Note: not all problems will be graded, but you must complete all problems to get full credit.

Problem 1 [40 pts]

Consider the following loop transfer functions where K is a constant. Sketch the root locus for each for 0< K < ∞ by hand, showing the details for all steps to draw root locus discussed in class.

$$\text{(a)}\quad G_c(s)G(s) = \frac{K}{s(s+10)(s+8)}$$

$$\text{(b)}\quad G_c(s)G(s) = \frac{K}{(s^2+2s+2)(s+2)}$$

$$\text{(c)}\quad G_c(s)G(s) = \frac{K(s+5)}{s(s+1)(s+10)}$$

$$\text{(d)}\quad G_c(s)G(s) = \frac{K(s^2+4s+8)}{s^2(s+1)}$$

Problem 2 [20 pts]

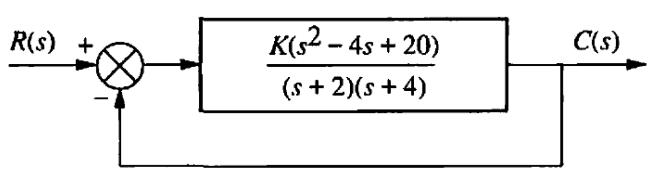
The yaw-control dynamics for an attack jet has an open-loop transfer function given by

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

Suppose you use negative feedback using proportional gain K. (a) Determine the root locus breakaway point and (b) the value of the root on the jω-axis and the gain required for those roots, and (c) sketch the root locus by hand. Show all your steps!

Problem 3 [30 pts] (Design problem)

Consider the following closed-loop system. Sketch the root locus by hand and then find:



a. The exact point and gain where the locus crosses the 0.45 damping ratio line

b. The exact point and gain where the locus crosses the $j\omega$-axis

c. The breakaway point on the real axis

d. The range of K within which the system is stable