Homework

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Midterm Project

Problem 1

For all of the following, see the attached MATLAB file for the calculation.

(a)

step: 0.6656
ramp: 87.1807
accel: 1.1663e+04

(b)

step: 0.8002
ramp: 19.1654
accel: 7.0527e+03

(c)

step: 3.9954
ramp: 4.4321e+04
accel: 1.9645e+08

(d)

step: 0.8999
ramp: 206.1327
accel: 2.1452e+05

Problem 2

(a)

(b)

(c)

(d)

(e)

(f)

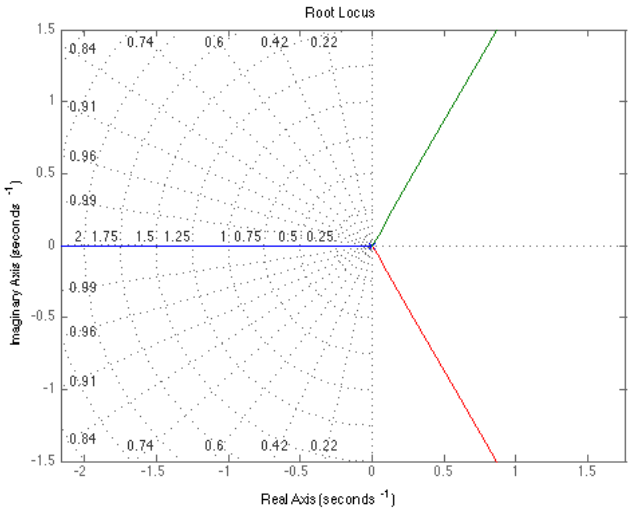
(g)

Homework 7

Problem 1

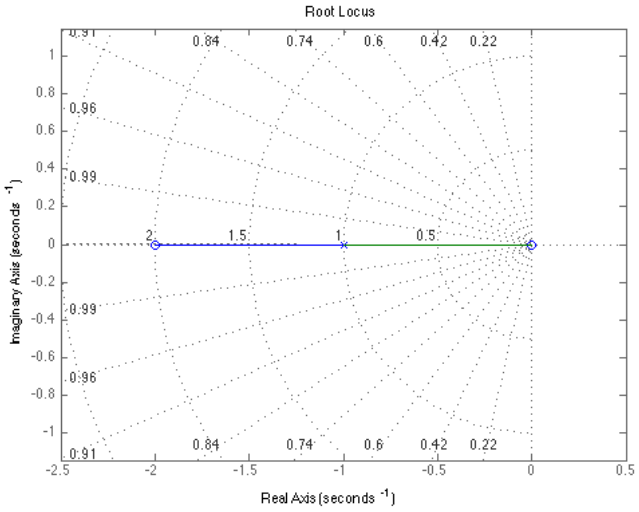
Root-locus plots of the following functions...

(a)



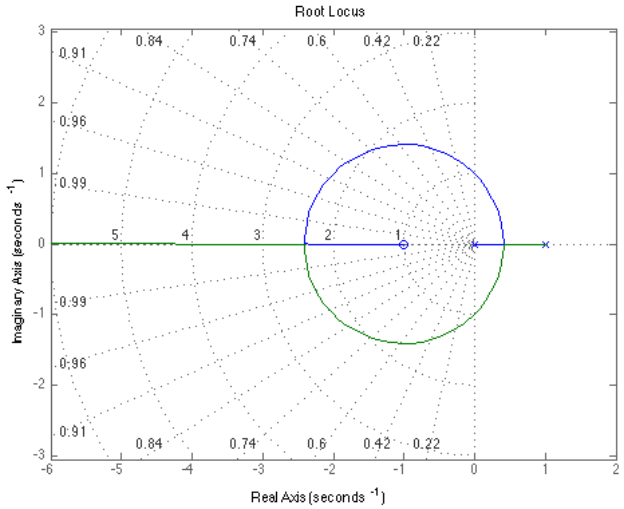
$$G(s) = \frac{1}{(s+0)^3}$$

(b)



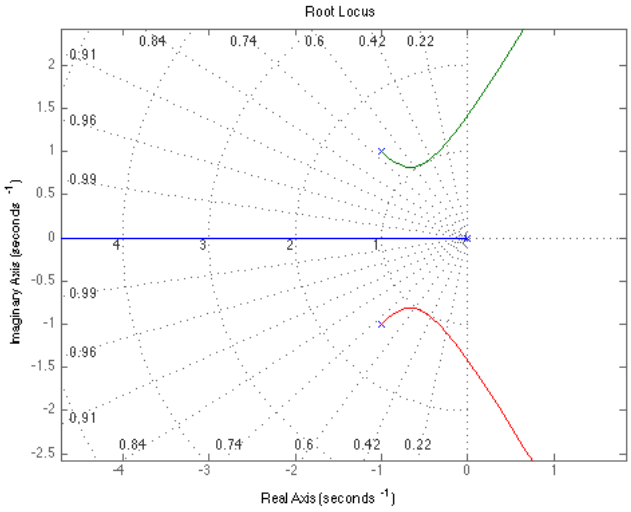
$$G(s) = \frac{(s+0)(s+2)}{(s+1)^2}$$

(c)



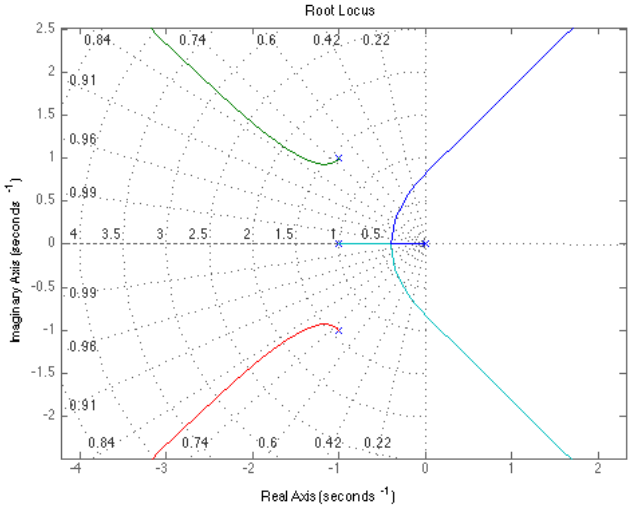
$$G(s) = \frac{s+1}{(s+0)(s-1)}$$

(d)



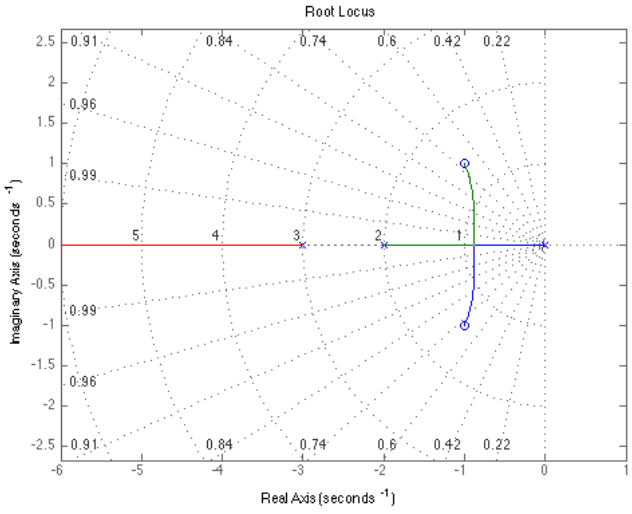
$$G(s) = \frac{1}{(s+0)(s+1+i)(s+1-i)}$$

(e)



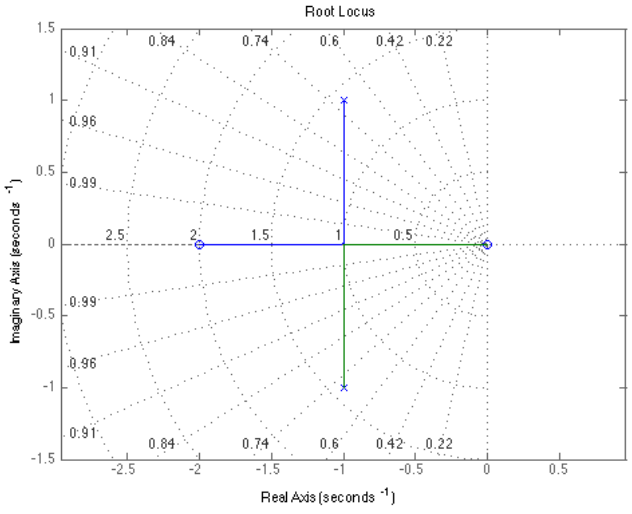
$$G(s) = \frac{1}{(s+0)(s+1+i)(s+1-i)(s+1)}$$

(f)



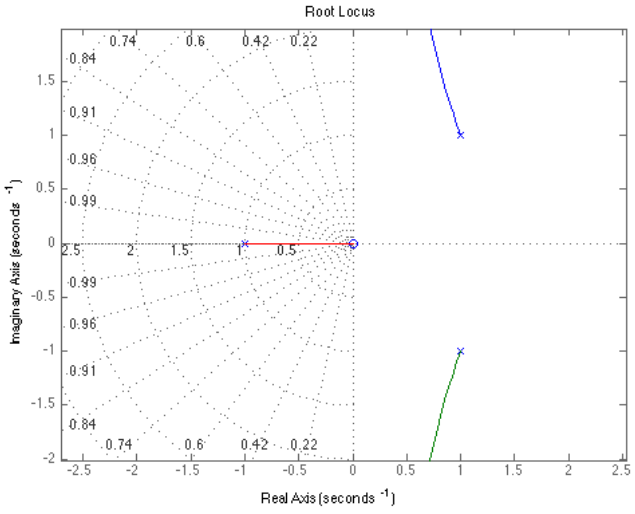
$$G(s) = \frac{(s+1-i)(s+1+i)}{(s+0)(s+2)(s+3)}$$

(g)



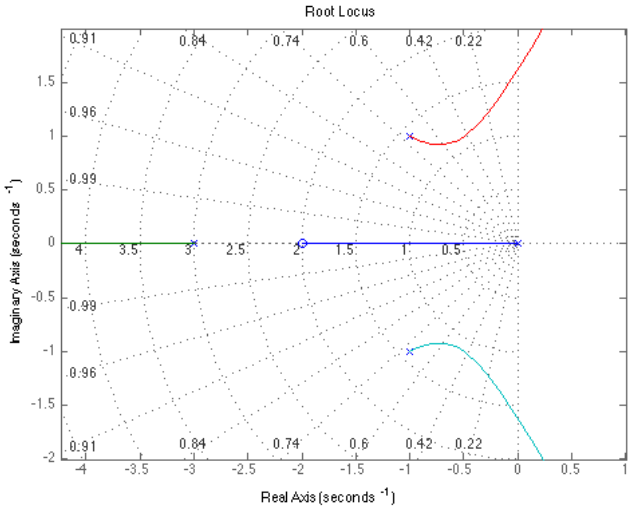
$$G(s) = \frac{(s+0)(s+2)}{(s+1-i)(s+1+i)}$$

(h)



$$G(s) = \frac{(s+0)}{(s+1)(s-1-i)(s-1+i)}$$

(i)



$$G(s) = \frac{(s+2)}{(s+0)(s+3)(s+1-i)(s+1+i)}$$

Problem 4

First we apply our reduction rules to the system as follows:

$$\begin{aligned}
G(s) &= \frac{20}{(s+1)(s+4)} \\
&= \frac{\dfrac{20}{(s+1)(s+4)}}{1 + \dfrac{20}{(s+1)(s+4)} \times K} \\
&= \frac{20}{s^2 + 5s + 4 + 20K} \times \frac{1}{s} \\
&= \frac{\dfrac{20}{s^3 + 5s^2 + 4s + 20Ks}}{1 + \dfrac{20}{s^3 + 5s^2 + 4s + 20Ks}} \\
&= \frac{20}{s^3 + 5s^2 + 4s + 20Ks + 20}
\end{aligned}$$

Problem 5

Determine damping ration, ζ, for maximum overshoot, M_p, given:

$$\begin{aligned}
M_p &= e^{-\left(\zeta/\sqrt{1-\zeta^2}\right)\pi} \\
0.1 &= e^{-\left(\zeta/\sqrt{1-\zeta^2}\right)\pi} \\
\zeta &\approx 0.826085
\end{aligned}$$