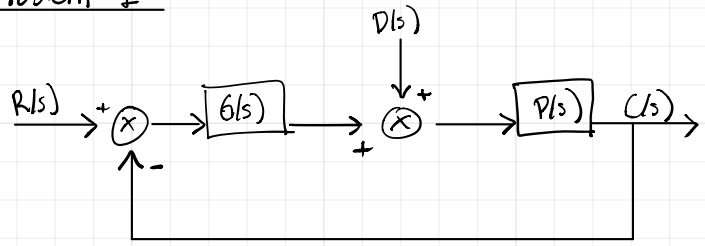
Problem 1



$$((R-C)G+D)P=C$$

$$(RG-CG+D)P=C$$

$$RPG-PCG+PD=C$$

$$RPG+PD=C+CPG$$

$$C=\frac{RPG+PD}{1+PG}$$

part a if $D=0$, $R=3/s$ $\quad \frac{C}{R}=T(s)=\frac{H(s)}{1+H(s)}$

$$e_{ss}=\lim_{s\to 0}\frac{sR(s)}{1+H(s)}=\frac{3}{1+\frac{49}{s^2+4s+4}}=\frac{3\cdot 4}{4+49}=0.226=e_{ss_a}$$

part c if $R=0$, $D=-\frac{1}{s}$ $\quad sC=\frac{sPD}{1+PG}=s\frac{\frac{-7}{(s+2)s}}{1+\frac{49}{(s+2)^2}}=\frac{-7(s+2)}{(s+2)^2+49}$

$$\lim_{s\to 0}(0-sC)=\frac{-7\cdot 2}{4+49}=0.264=e_{ss_c}$$

part e $E(s)=R(s)-C(s)$ $\quad sRPG=\left(\frac{3}{s}\right)\left(\frac{7}{s+2}\right)\left(\frac{7}{s+2}\right)=\frac{3\cdot 49}{(s+2)^2}$ $\quad sPD=\frac{-7}{s+2}$

$$1+PG=1+\frac{49}{s+2}=\frac{1}{(s+2)^2}\left(s^2+4s+4+49\right)$$

$$\therefore\ s(R(s)-C(s))=3-\frac{RPG-PD}{1+PG}=3-\frac{\frac{3\cdot 49}{(s+2)^2}-\frac{7}{s+2}}{\frac{1}{(s+2)^2}(s^2+4s+4+49)}=3-\frac{3\cdot 49-7s-14}{s^2+4s+4+49}$$

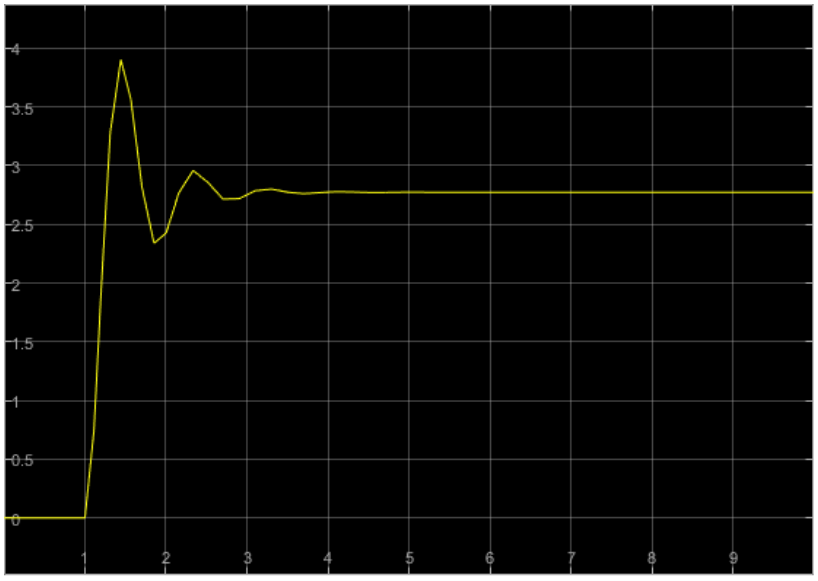
$$e_{ss}=\lim_{s\to 0}s(R(s)-C(s))=\lim_{s\to 0}\left(3-\frac{3\cdot 49-7s-14}{s^2+4s+4+49}\right)=3-\frac{3\cdot 49-14}{4+49}=0.491=e_{ss_e}$$

Problem 1

Part b: step input, no error:

```
fprintf('Problem 1, Part b: The steady state error is %0.3f
(%0.1f%%)\n',abs(3-simout.Data(end)),abs(3-simout.Data(end))/3*100)
```

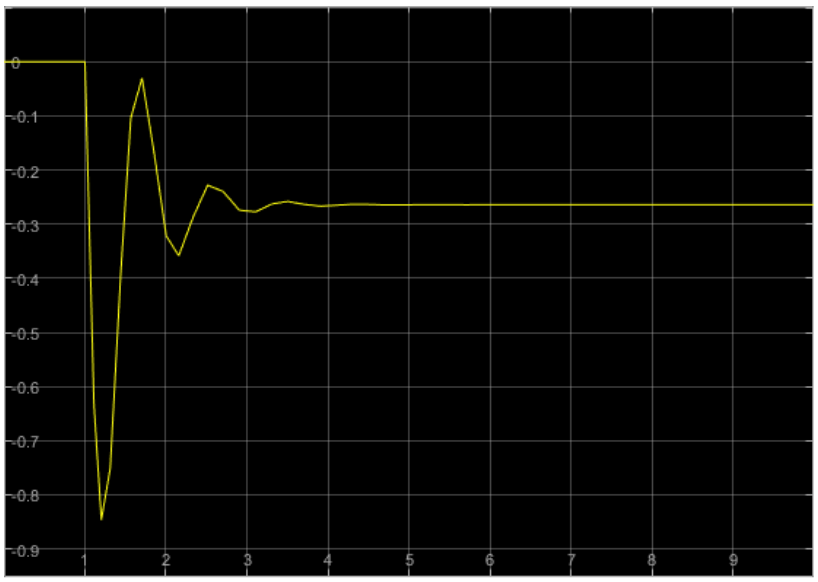
```
Problem 1, Part b: The steady state error is 0.226 (7.5%)
>>
```



Part d: no input, negative step disturbance

```
fprintf('Problem 1, Part d: The steady state error is %0.3f
(%0.1f%%)\n',abs(simout.Data(end)),abs(simout.Data(end))/3*100)
```

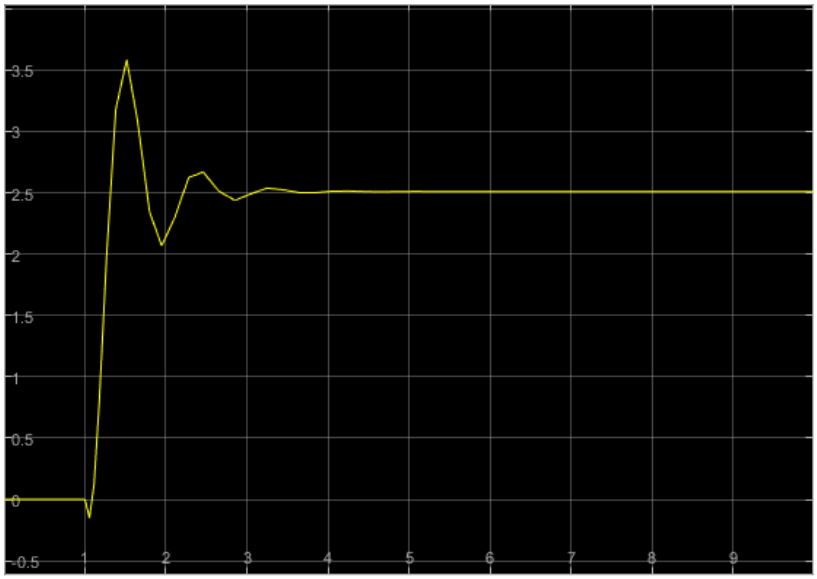
```
Problem 1, Part d: The steady state error is 0.264 (8.8%)
>>
```



Part f: step input, negative step disturbance

```
fprintf('Problem 1, Part f: The steady state error is %0.3f
(%0.1f%%)\n',abs(3-simout.Data(end)),abs(3-simout.Data(end))/3*100)
```

```
Problem 1, Part f: The steady state error is 0.491 (16.4%)
>>
```



Problem 2

$$A(s) = \frac{1}{s(s+3)(s+7)(s+8)} \qquad B(s) = \frac{s+30}{s^2+20s+200} \qquad T(s) = \frac{K\,A(s)}{1+K\,A(s)\,B(s)}$$

for Matlab, $G(s) = A(s)\,B(s)$, $T(s) = \frac{K}{B(s)} \cdot \frac{A(s)\,B(s)}{1+K\,A(s)\,B(s)}$

$$CE = 1 + K\,A(s)\,B(s)$$

```
% Author:   Bradley Anderson
% Date:     Nov-11 2017
% Name:     ME 430, Computer Assignment 2, Problem 2
% Purpose:  Takes a transfer function and plots its root-locus.
%           Prompts the user to choose a value from the plot,
%           and then asks the user to choose a value of K from
%           the information learned. Plots the step response
%           with that K value.

clear, clf, clc

s = tf('s');

A = 1/(s*(s+3)*(s+7)*(s+8));
B = (s+30)/(s^2+20*s+200);

sys = A/(1+A*B);

subplot(2,2,1)
rlocus(sys)

subplot(2,2,2)
rlocus(sys)
title('Root Locus Close-Up')
hold on
axis( [-2 2  -2 2] )
sgrid(0.707,0)
rlocfind(sys)

%prompt = 'Please enter a value for K: ';
%K=input(prompt);
K = 135;
fprintf('\n')

subplot(2,1,2)
sys2 = K*A/(1+K*A*B);
step(sys2)
```

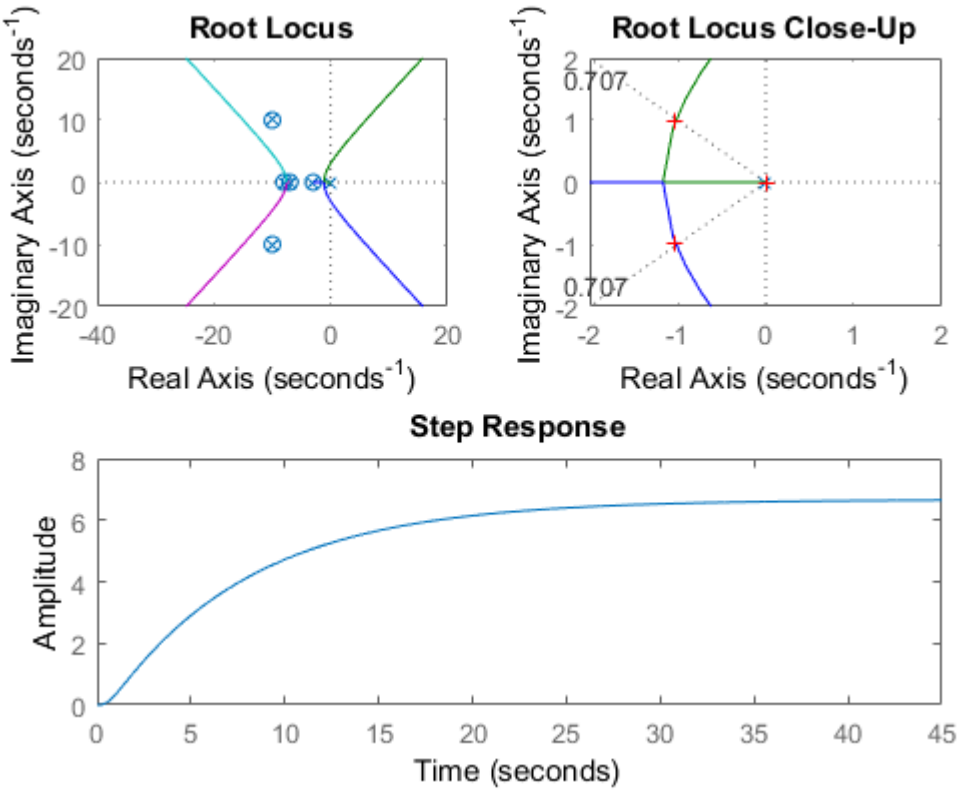
```
Select a point in the graphics window

selected_point =

  -1.0341 + 0.9839i


ans =

  133.3154
```



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