ECEN 4138 HW 8 Problem 5.26

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Housekeeping

```
clc; clear; close all;
```

Setup

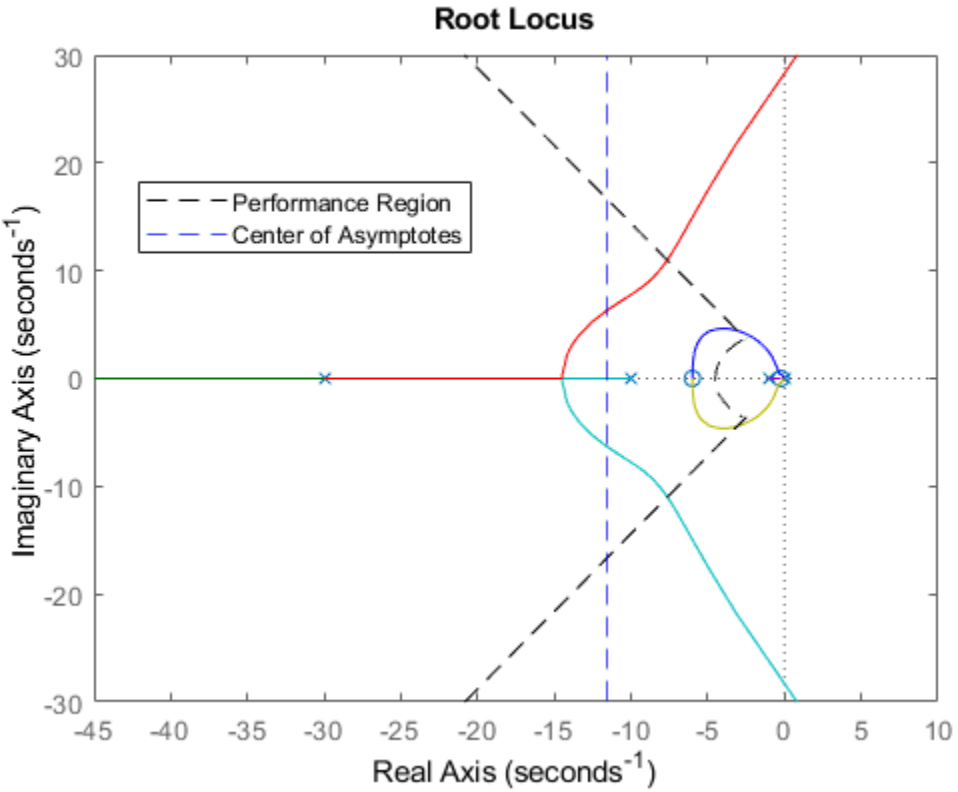
```
zeta = 0.607;
theta = (pi/2 + asin(zeta):0.001:(3*pi/2)-asin(zeta));

wn = 4.5; % rad/s

t = -100:0.001:-wn*sqrt(1-zeta^2)*tan(zeta);

% Lead compensator
z1 = 6;
p1 = 5*z1;
K = 700;

% Lag compensator
z2 = 0.24;
p2 = 0.01;

alpha = (-1-10-p1-p2+z1+z2)/3;
```

Define L(s)

```
s = tf('s');

G = 10/(s*(s+1)*(s+10));
C = ((s+z1)^2*(s+z2))/((s+p1)^2*(s+p2));

% L1 = (10*(s+z1)^2*(s+z2))/(s*(s+1)*(s+10)*(s+p1)^2*(s+p2)); % L(s) for 5.20
L1 = G*C;

L = L1; % Choose root locus
```

Plot root locus

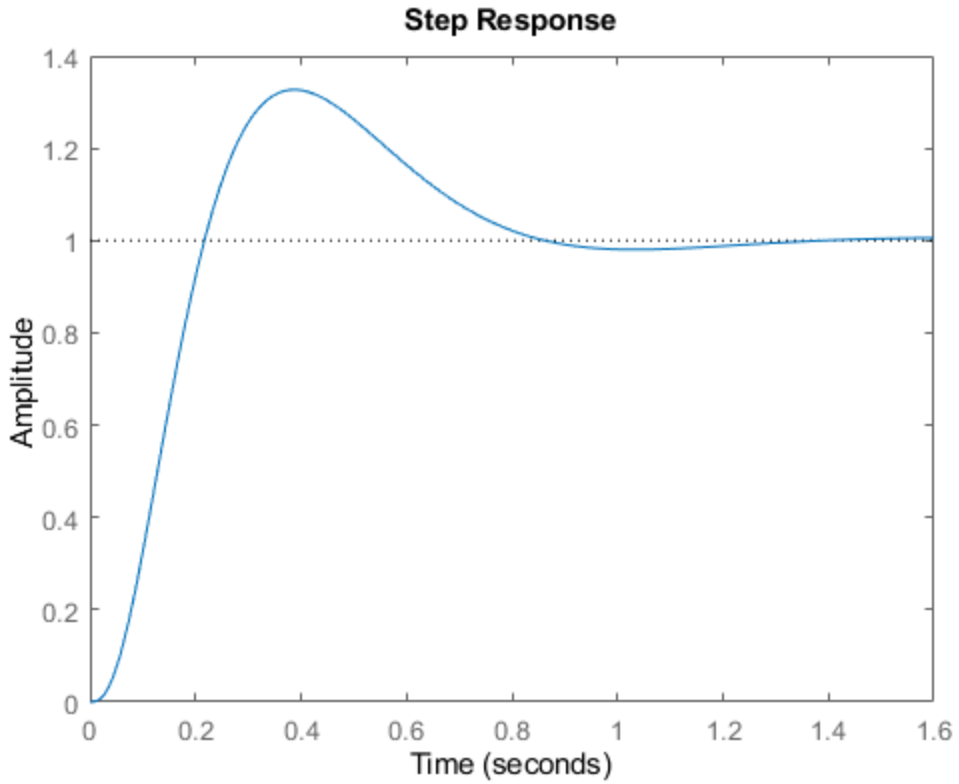
```
figure
hold on

rlocus(L)

% Rise time requirement
y = wn*sin(theta);
x = wn*cos(theta);
plot(x,y, 'k--');

% Overshoot requirement
z = tan(zeta)^-1*t;
a = plot(t,z, 'k--');
plot(t,-z,'k--')

b = xline(alpha, 'b--');

xlim([-1.5*p1, 10])
ylim([-30, 30])

legend([a,b], ["Performance Region", "Center of
 Asymptotes"], 'Location', 'best');
```

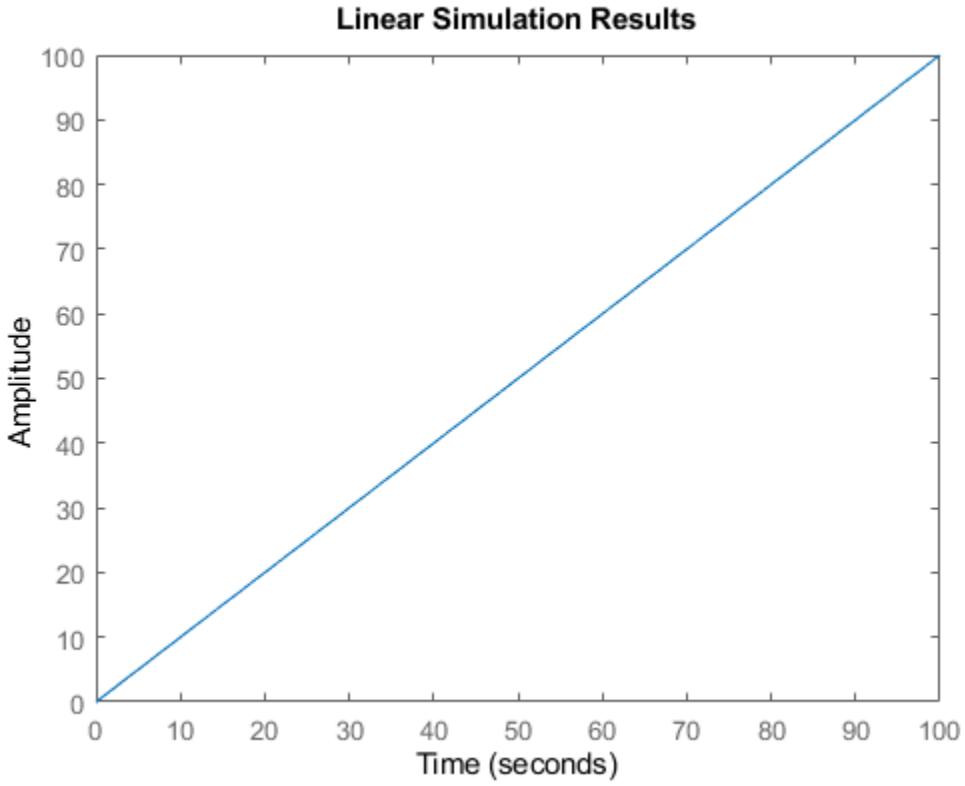


Simulate responses

```
C = K*C;
L = G*C;

T = minreal(feedback(L,1))

time = (0:0.001:100)';

figure
step(T); % Simulate step response

figure
resp = lsim(T, time, time); % Simulate ramp response
lsim(T, time, time)

disp(time(end) - resp(end));
```

```
T =


              7000 s^3 + 8.568e04 s^2 + 2.722e05 s + 6.048e04

  ---------------------------------------------------------------------

  s^6 + 71.01 s^5 + 1571 s^4 + 1.752e04 s^3 + 94785 s^2 + 2.723e05 s

                                                             + 6.048e04


Continuous-time transfer function.

    0.0015
```


Step Response
Amplitude
Time (seconds)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6


Linear Simulation Results
Amplitude
Time (seconds)
0
10
20
30
40
50
60
70
80
90
100

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