ME EN 6200
Homework 4
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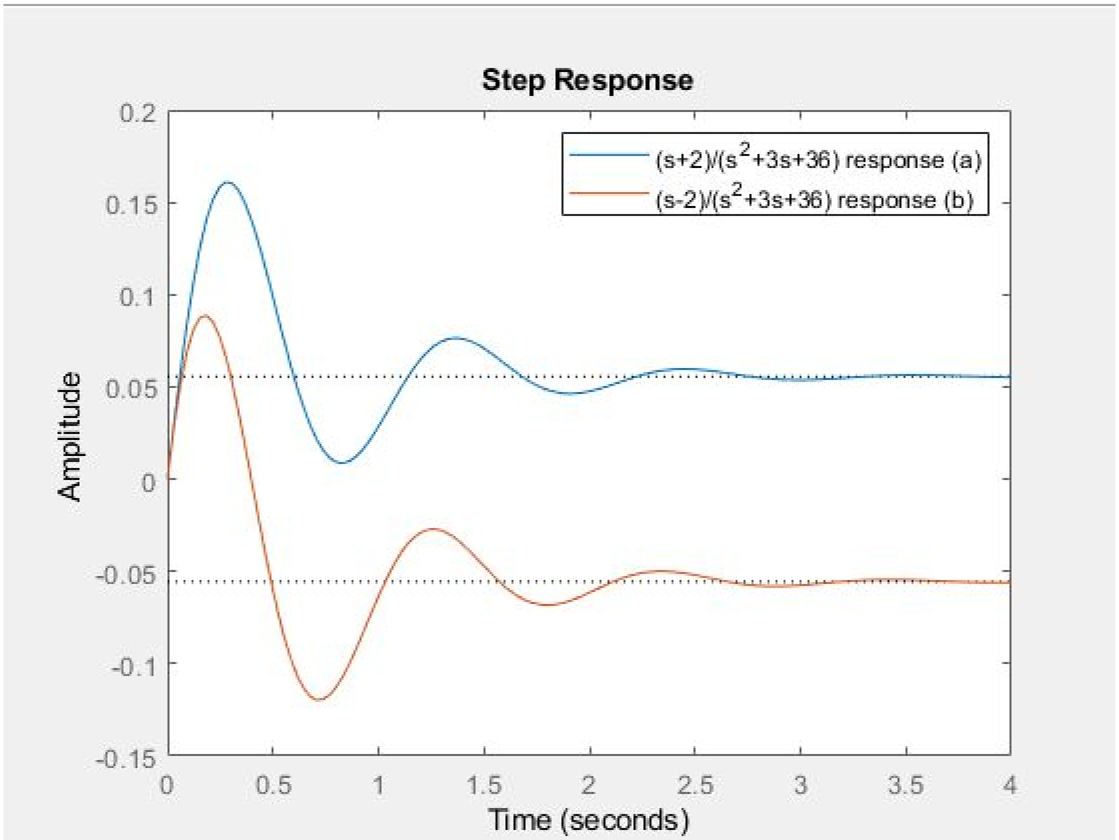
Problem 1



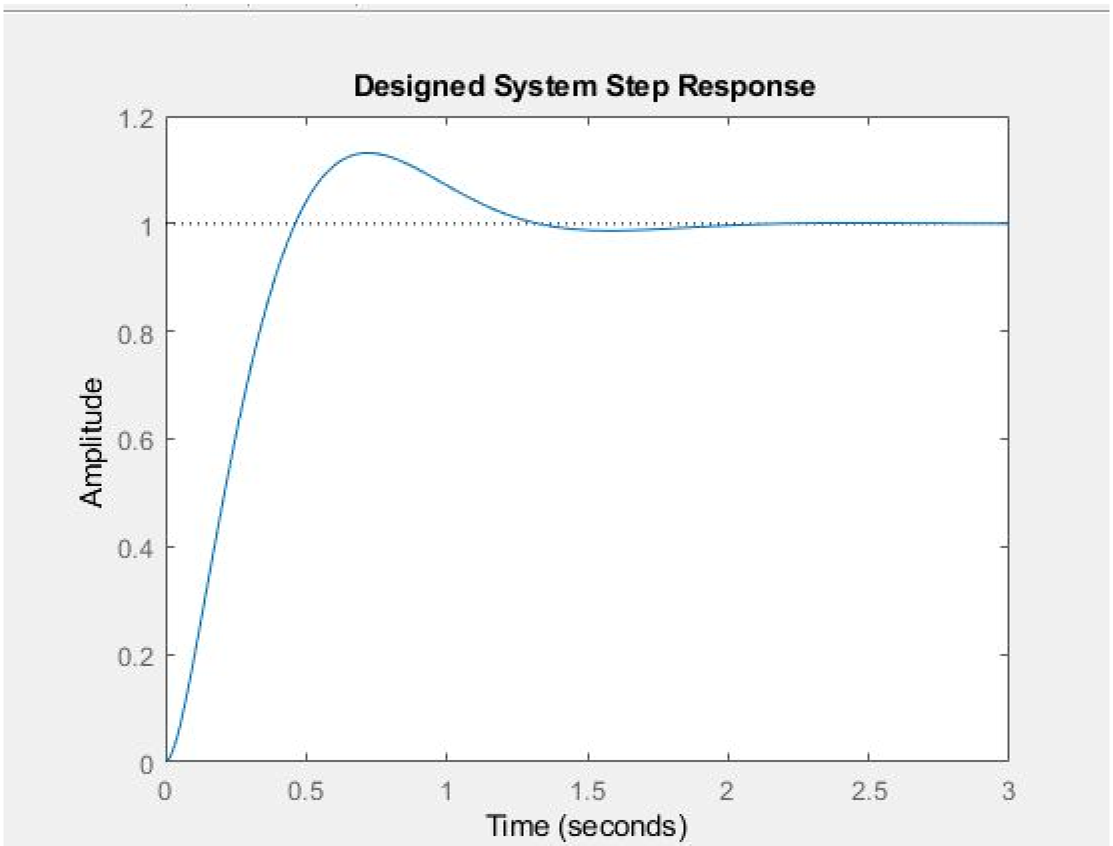

```
%% 1

G1 = tf([1,2],[1,3,36]); % a
G2 = tf([1,-2],[1,3,36]); % b

figure;
step(G1);
hold on;
step(G2);
legend('(s+2)/(s^2+3s+36) response (a)' , '(s-2)/(s^2+3s+36) response (b)');
```

Comparing and contrasting response a and b we see that both a and b have similar shapes (settling times and time of each oscillation) but different amplitudes for each oscillation (notice the different final values). Response a peaks higher but settles to a positive value while response b peaks lower (still positive peak) and yet settles to a negative value.

Response a has a zero at s = -2 while response b has a zero at s = 2. The poles for both are equivalent with s=0, -3/2 (+/-) i * sqrt(15). From the text, page 191, we note that we can represent the transfer functions for a and b as (s+a)/((s+b)(s+c)) where for transfer function a the value a is equal to 2 while for transfer function b the value a is equal to -2. Thus we note that system b is a non minimum-phase system. The zero is in the right half plane and the response for b "turns" toward the negative direction even though it initially increased.

This behavior can also be realized for these specific responses by looking at the partial fraction expansion for the step response of both polynomials as shown above. We notice for response b the sin and cos terms will both have the same signs but the final constant term is negative, this is why we get the initial positive behavior then settling behavior at a negative constant term.

Problem 4




```
      RiseTime: 0.3240
  SettlingTime: 1.1987
   SettlingMin: 0.9118
   SettlingMax: 1.1312
     Overshoot: 13.1199
    Undershoot: 0
          Peak: 1.1312
      PeakTime: 0.7253
```

```
%% 4
k = 71.68;
p = 27.33;
z = 7.097;

G = tf(1,[1, 3, 0]);
D = tf([k,k*z],[1,p]);
sys = feedback(G*D, 1);

figure;
step(sys);
title('Designed System Step Response');
```

```
% Expected: 10% OS and 1.5 second(+/-2%) settling time
sys_inf = stepinfo(sys);
disp(sys_inf);
```