Matlab Code

```
% Hunter Phillips
% Homework 7
% MAE 488
% 03/12/19

clc
clear
format compact

%% Header
d_bullets = repmat('*', 50, 1); % concise way to make a lot of chars
fprintf('%c',d_bullets)
fprintf('\nMAE 488, Homework #7, Spring 2019, Hunter Phillips\n')
fprintf('%c',d_bullets)
fprintf('\n\n')

clear

%% Problem 50M

su_bullets = repmat('*', 25, 1); % setting up cmd line output
fprintf('\n')
fprintf('%c',su_bullets)
fprintf('\nProblem 50M\n')
fprintf('%c',su_bullets)
fprintf('\n\n')

% Part A
fprintf('Part A\n------\n\n')
sys=tf(5000,[1,26,269,1524,4680]);
using_equation = stepinfo(sys,'RiseTimeLimits',[0,1])

% Part B
fprintf('\nPart B\n------\n\n')
root1 = -3.0000 + 6.0000*j;
root2 = -3.0000 - 6.0000*j;
po = poly([root1 root2]);
sys=tf(5000,po); % 5000 comes from unit step
using_dom_root = stepinfo(sys,'RiseTimeLimits',[0,1])

% comparison
fprintf('\nIt can be seen that using the dominant roots provides a decently reasonable\nestimate of the qualities derived: Percent Overshoot, Peak Time, and 100%% Rise Time.\n')
fprintf('\nUsing the given equation, the overshoot of %.2f%% was smaller than the dominant root estimation of %.2f%%.\n'...
        , using_equation.Overshoot, using_dom_root.Overshoot)
fprintf('\nUsing the given equation, the peak time of %.2f seconds was larger than the dominant root estimation of %.2f seconds.\n'...
        , using_equation.PeakTime, using_dom_root.PeakTime)
fprintf('\nUsing the given equation, the 100%% rise time of %.2f seconds which was larger than the dominant root estimation of %.2f seconds.\n\n'...
        , using_equation.SettlingTime, using_dom_root.SettlingTime)

%% Problem 52S

f1 = figure(1);

su_bullets = repmat('*', 25, 1); % setting up cmd line output
fprintf('\n')
fprintf('%c',su_bullets)
fprintf('\nProblem 52S\n')
fprintf('%c',su_bullets)
fprintf('\n\n')

poly_block_52M = [-27/800, 27/80, 0,0]
LTI_52M = tf(1,[0.125, 0.75, 1])

sim('Problem_52S.slx')

plot(simout.time, simout.data)
legend('x(t)','y(t)','location', 'northeast','FontSize',16,'interpreter','latex')
ylabel('Function')
xlabel('Time')
title({'MAE 488, Homework 7, Problem 8.52S'},'interpreter','latex','FontSize',16)
```

```
fprintf('Results Plotted in Figure 1\n')
% print(f1,'..\results\problem_8_52S.png','-dpng','-r1200');


%% Problem 54S

f2 = figure(2);

su_bullets = repmat('*', 25, 1); % setting up cmd line output
fprintf('\n')
fprintf('%c',su_bullets)
fprintf('\nProblem 54S k = 4\n')
fprintf('%c',su_bullets)
fprintf('\n\n')

% For k = 4
k=4;
LTI_54M = tf(1,[5,3,7,k])
sim('Problem_54S.slx')

plot(simout.time, simout.data)
legend('x(t)','location', 'northeast','FontSize',16,'interpreter','latex')
ylabel('Function')
xlabel('Time')
title({'MAE 488, Homework 7, Problem 8.54S'},'interpreter','latex','FontSize',16)

fprintf('Results Plotted in Figure 2\n')
% print(f2,'..\results\problem_8_54S_1.png','-dpng','-r1200');

% Experimenting with k

su_bullets = repmat('*', 25, 1); % setting up cmd line output
fprintf('\n')
fprintf('%c',su_bullets)
fprintf('\nProblem 54S varying k\n')
fprintf('%c',su_bullets)
fprintf('\n\n')

f3 = figure(3);
n=5;
for k = 1:n
    subplot(n,1,k);
    LTI_54M = tf(1,[5,3,7,k]);
    sim('Problem_54S.slx')
    plot(simout.time, simout.data)
    if k == 1
        title({'MAE 488, Homework 7, Problem 8.54S'},'interpreter','latex','FontSize',16)
    end
    kpr = sprintf('%d',k);
    ylabel(strcat('k = ',kpr))
end
xlabel('Time')

fprintf('Results Plotted in Figure 3\n')
% print(f3,'..\results\problem_8_54S_2.png','-dpng','-r1200');
```

Matlab Output

```
************************************************
MAE 488, Homework #7, Spring 2019, Hunter Phillips
************************************************



************************
Problem 50M
************************


Part A
------


using_equation =
  struct with fields:


        RiseTime: 0.5736
    SettlingTime: 1.3950
     SettlingMin: 1.0402
     SettlingMax: 1.2028
       Overshoot: 12.5811
      Undershoot: 0
            Peak: 1.2028
        PeakTime: 0.7552
```

Part B

```
using_dom_root =
  struct with fields:

        RiseTime: 0.3391
    SettlingTime: 1.2451
     SettlingMin: 106.3108
     SettlingMax: 134.2074
       Overshoot: 20.7866
      Undershoot: 0
            Peak: 134.2074
        PeakTime: 0.5219
```

It can be seen that using the dominant roots provides a decently reasonable estimate of the qualities derived: Percent Overshoot, Peak Time, and 100% Rise Time.

Using the given equation, the overshoot of 12.58% was smaller than the dominant root estimation of 20.79%.

Using the given equation, the peak time of 0.76 seconds was larger than the dominant root estimation of 0.52 seconds.

Using the given equation, the 100% rise time of 1.39 seconds which was larger than the dominant root estimation of 1.25 seconds.

****

Problem 52S

****

```
poly_block_52M =
   -0.0338    0.3375         0         0

LTI_52M =

           1
  ----------------------
  0.125 s^2 + 0.75 s + 1
```

Continuous-time transfer function.

Results Plotted in Figure 1

****

Problem 54S k = 4

****

LTI_54M =

```
           1
  ----------------------
  5 s^3 + 3 s^2 + 7 s + 4
```

Continuous-time transfer function.

Results Plotted in Figure 2

****

Problem 54S varying k

****

Results Plotted in Figure 3

<u>Matlab Figures</u>

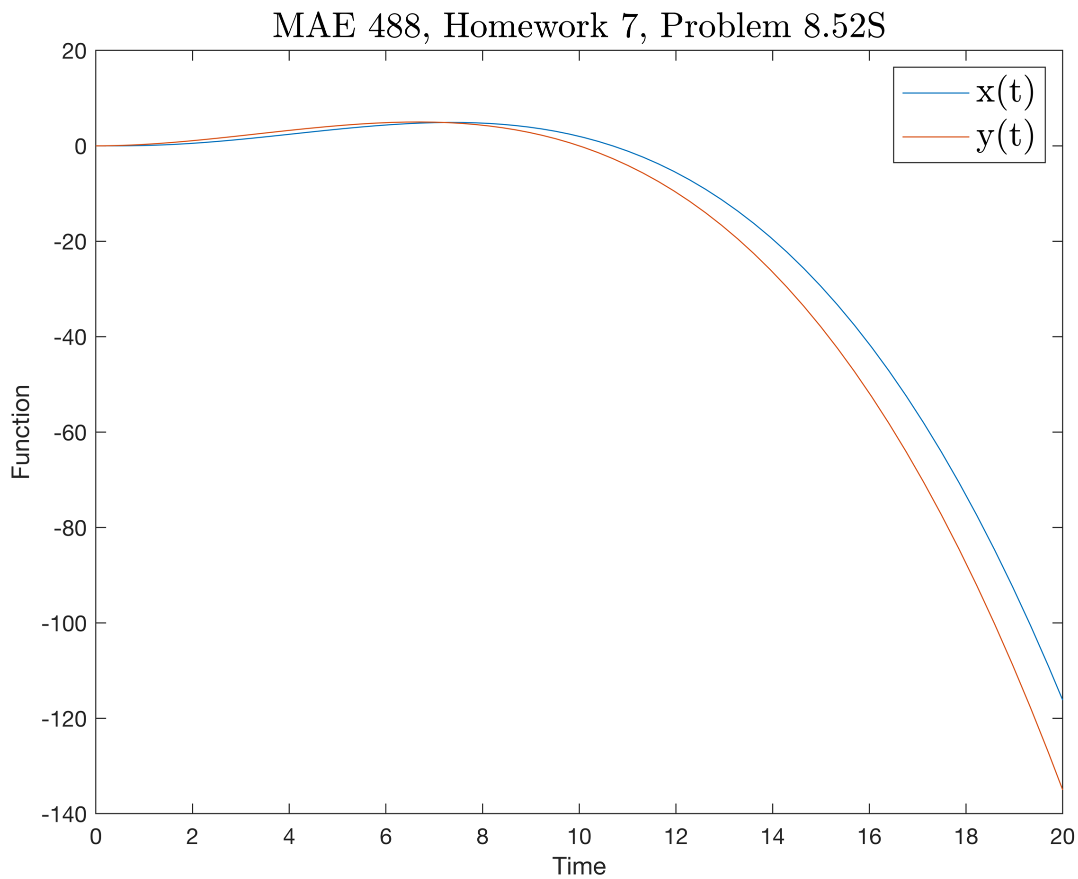


Figure 1: Problem 8.52S

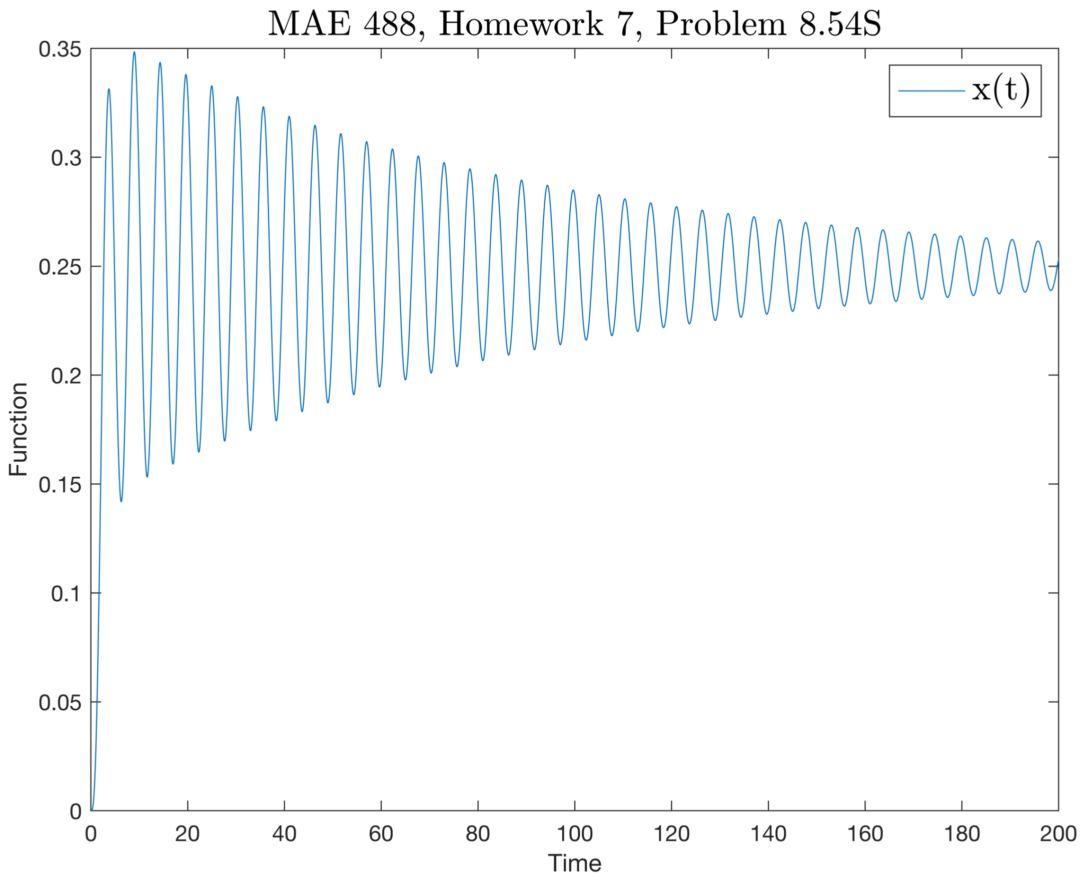


Figure 2: Problem 8.54S for k = 4

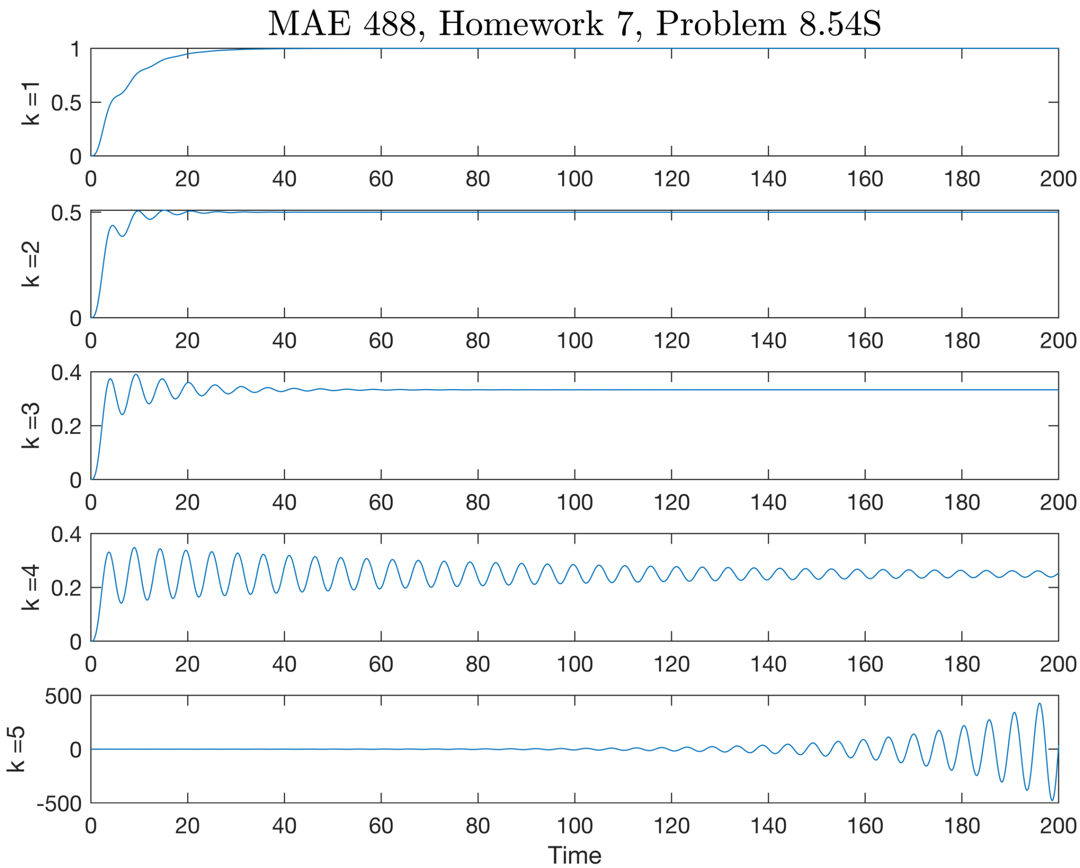
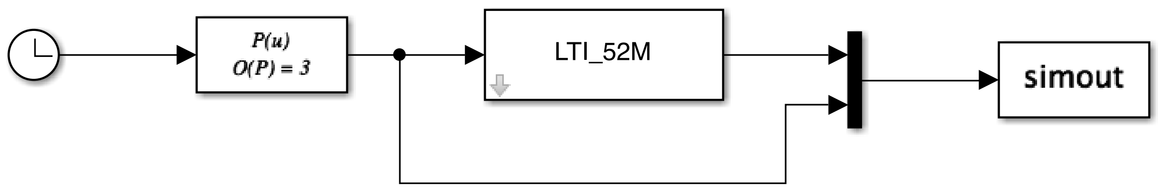


Figure 3: Problem 8.54S for varying k

Simulink Models



Problem 52.S

Problem 54.S