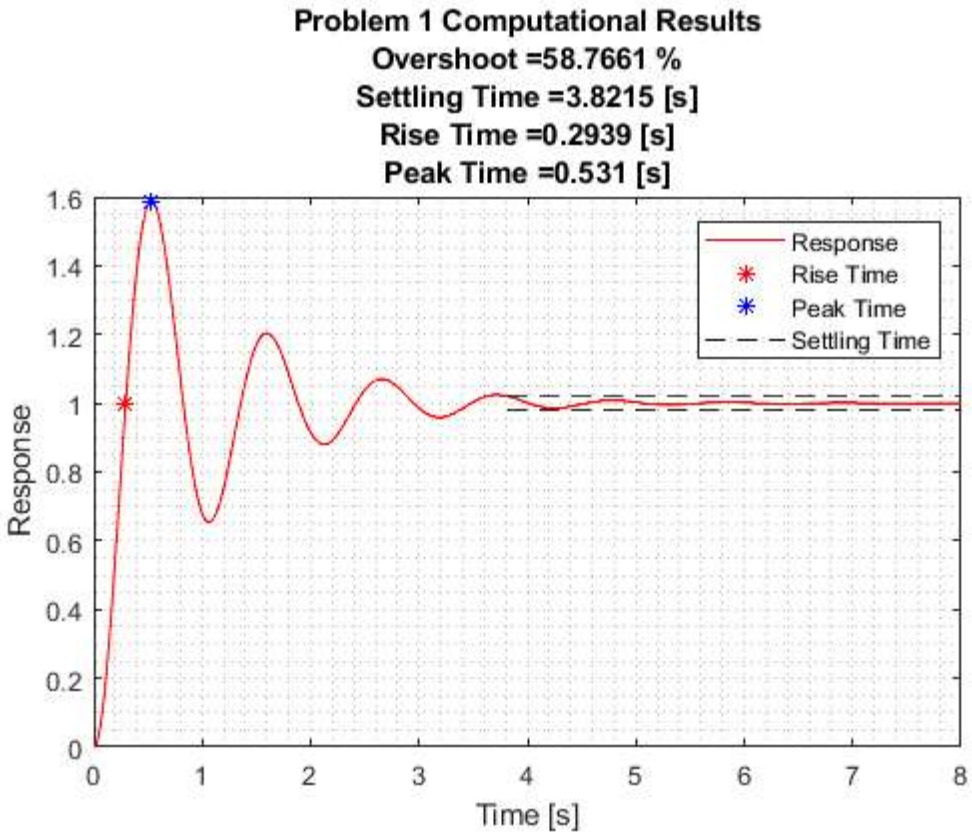
Contents

MAE 543 HW3 Gabriel Colangelo

```
clear
clc
close all

% Transfer Function
s               = tf('s');
G               = 36/(s^2 + 2*s + 36);

% Simulation
time            = (0:.0001:8);                          % Time vector for sim
opt             = stepDataOptions('StepAmplitude',1);   % Unit Step Input
[y,t]           = step(G,time,opt);

% Find input step response characteristics
RiseTime        = t(find(y >= y(end),1));               % Find time of when y(inf) is first reached
PeakTime        = t(find(y == max(y),1));               % Find time when peak(y) is achieved
Overshoot       = ((max(y) - y(end))/(y(end)))*100;     % Mp = [peak(y) - y(inf)]/ y(inf) X 100

% Settling Time routine, 2% bounds on unit step input
indsettle       = find(y <= 1.02 & y >= 0.98);
filtind         = diff(indsettle)==1;
indzero         = find(filtind == 0);
SettlingTime    = t(indsettle(indzero(end)+1));

% plot results
plot(t,y,'-r',RiseTime,y(end),'*r',PeakTime,max(y),'*b')
line([SettlingTime, t(end)],[1.02, 1.02],'Color','black','LineStyle','--')
line([SettlingTime, t(end)],[.98, .98],'Color','black','LineStyle','--')
xlabel('Time [s]')
ylabel('Response')
grid minor
legend('Response','Rise Time','Peak Time','Settling Time')
titlestring     = strcat('Overshoot = ', num2str((max(y) - y(end))*100),' %');
titlestring2    = strcat('Settling Time = ', num2str(SettlingTime),' [s]');
titlestring3    = strcat('Rise Time = ', num2str(RiseTime),' [s]');
titlestring4    = strcat('Peak Time = ', num2str(PeakTime),' [s]');
title({'Problem 1 Computational Results';titlestring;titlestring2;titlestring3;titlestring4})

% Analytical Solutions
wn              = 6;                                    % wn^2 = 36
zeta            = 1/6;                                  % 2*zeta*wn = 2

sigma           = wn*zeta;
wd              = wn*sqrt(1 - zeta^2);

tr              = (1/wd)*atan2(wd,-sigma)               % tr = wd*invtan(wd/-sigma)
tp              = pi/wd                                 % tp = pi/wd
Mp              = exp(-zeta*pi/sqrt(1 - zeta^2)) *100   % MP = e^(-zeta*pi/(sqrt(1 - zeta^2))
ts              = 4/sigma                               % ts = 4/zeta*wn
```

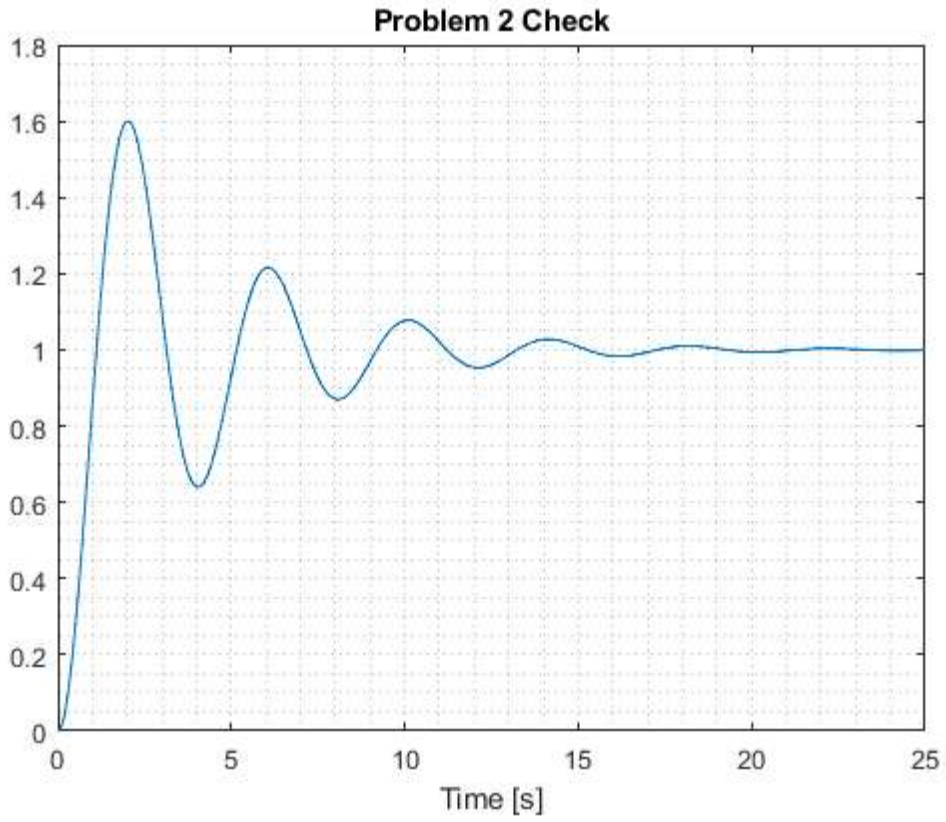
```
tr =

    0.2938

tp =

    0.5310

Mp =

   58.8001

ts =

     4
```



Problem 2 Check

```
zeta            = sqrt(log(0.6)^2/(log(0.6)^2 + pi^2));

HalfT           = 4.05 - 2.03;
T               = 2*HalfT;

wd              = 2*pi/T;

wn              = wd/sqrt(1 - zeta^2);
```

```
m               = 1;

k               = wn^2;
c               = 2*zeta*wn;

s               = tf('s');

sys             = k/(m*s^2 + c*s + k);

[X,T]           = step(sys,0:.01:25,opt);

figure
plot(T,X)
xlabel('Time [s]')
title('Problem 2 Check')
grid minor
```



Published with MATLAB® R2021b