Exercise 5

```
clc:
close all;
clear;
s = tf('s');
System = 1/(s*(s+1)*(s+5));
W = logspace(-1,2,400);
for k = 1:50
    [magnitude,phase,W] = bode(k*System,W); % Bode Plot
    [GM, PM, Wgc, Wpc] = margin(magnitude, phase, w); % Margin Values
    if round(wgc,3) == round(wpc,3)
        fprintf('MARGINALLY STABLE CONDITION\n\n');
        fprintf('System Gain: %0.3f\n',k);
        fprintf('Gain Crossover Frequency: %0.3f\n',wgc);
        fprintf('Phase Crossover Frequency: %0.3f\n\n', wpc);
    end
end
fprintf('EXPERIMENT WITH GAIN VALUES\n\n');
k1 = str2double(inputdlg('Enter Stable K: ')); % K for which Wgc > Wpc
figure('Name','1. Bode Plot for Stable K','NumberTitle','off');
bode(k1*System,W);
System1 = feedback(k1*System,1);
figure('Name','2. Step Response for Stable K','NumberTitle','off');
step(System1);
[magnitude,phase,w] = bode(k1*System,w);
[GM,PM,Wgc,Wpc] = margin(magnitude,phase,W);
fprintf('Gain: %0.3f\n',k1);
fprintf('Gain Margin: %0.3f\n',GM);
fprintf('Phase Margin: %0.3f\n',PM);
fprintf('Gain Crossover Frequency: %0.3f\n',wgc);
fprintf('Phase Crossover Frequency: %0.3f\n\n', Wpc);
k2 = str2double(inputdlg('Enter Unstable K: ')); % K for which Wgc < Wpc</pre>
figure('Name','3. Bode Plot for Unstable K','NumberTitle','off');
bode(k2*System,W);
System2 = feedback(k2*System,1);
figure('Name','4. Step Response for Unstable K','NumberTitle','off');
step(System2);
[magnitude,phase,w] = bode(k2*System,w);
[GM,PM,Wgc,Wpc] = margin(magnitude,phase,W);
fprintf('Gain: %0.3f\n',k2);
fprintf('Gain Margin: %0.3f\n',GM);
fprintf('Phase Margin: %0.3f\n',PM);
fprintf('Gain Crossover Frequency: %0.3f\n',wgc);
fprintf('Phase Crossover Frequency: %0.3f\n\n',wpc);
k3 = str2double(inputdlg('Enter Marginally Stable K: ')); % K for which Wgc = Wpc
figure('Name','5. Bode Plot for Marginally Stable K','NumberTitle','off');
bode(k3*System,W);
System3 = feedback(k3*System,1);
figure('Name','6. Step Response for Marginally Stable K','NumberTitle','off');
```

```
step(System3);
[magnitude,phase,w] = bode(k3*System,w);
[GM,PM,Wgc,Wpc] = margin(magnitude,phase,w);
fprintf('Gain: %0.3f\n',k3);
fprintf('Gain Margin: %0.3f\n',GM);
fprintf('Phase Margin: %0.3f\n',PM);
fprintf('Gain Crossover Frequency: %0.3f\n',Wgc);
fprintf('Phase Crossover Frequency: %0.3f\n\n',Wpc);
```

MARGINALLY STABLE CONDITION

System Gain: 30.000

Gain Crossover Frequency: 2.236 Phase Crossover Frequency: 2.236

EXPERIMENT WITH GAIN VALUES

Gain: 10.000 Gain Margin: 3.000 Phase Margin: 25.390

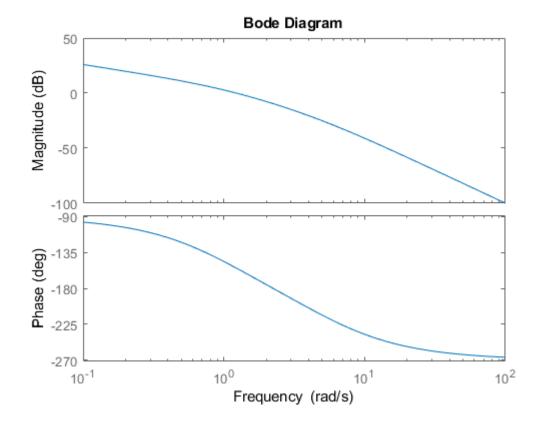
Gain Crossover Frequency: 2.236
Phase Crossover Frequency: 1.227

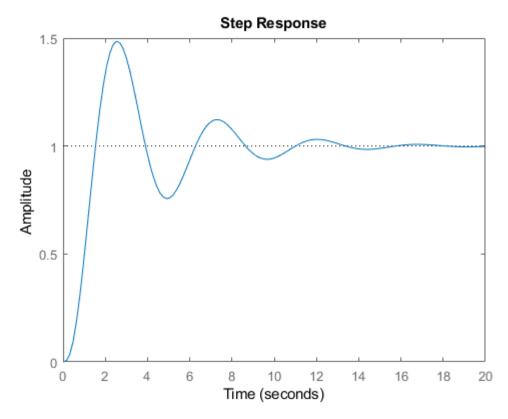
Gain: 50.000
Gain Margin: 0.600
Phase Margin: -10.532

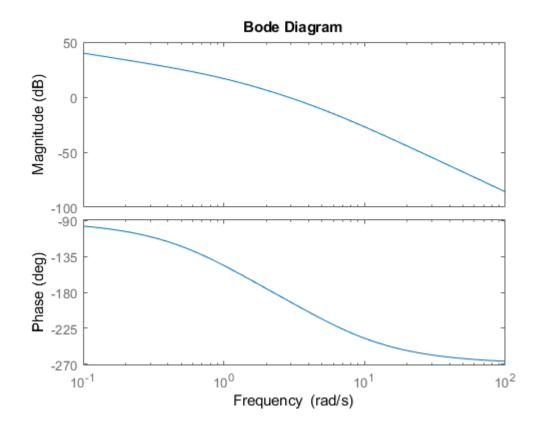
Gain Crossover Frequency: 2.236 Phase Crossover Frequency: 2.862

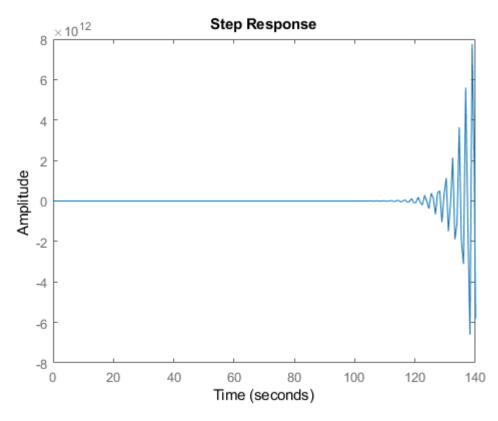
Gain: 30.000 Gain Margin: 1.000 Phase Margin: 0.000

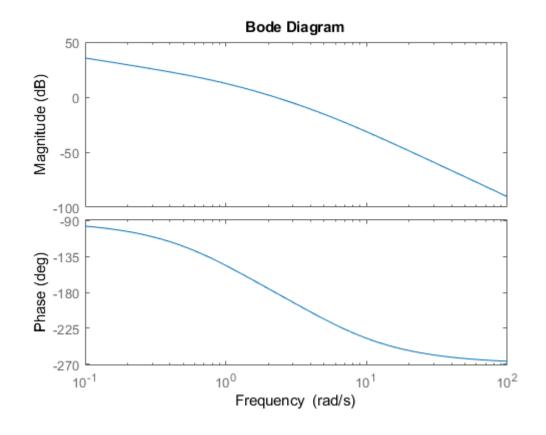
Gain Crossover Frequency: 2.236 Phase Crossover Frequency: 2.236

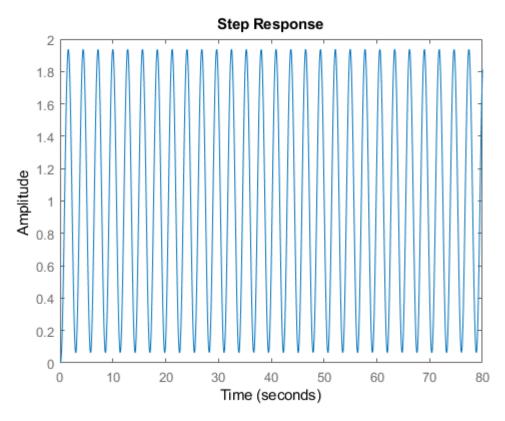












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