

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
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





