```m
%Almog Dobrescu
clc;
format long

%Q2

%defining constants and variabels
run_time = 100;
A = 1;
w1 = logspace(-1,0,10);
w2 = logspace(0, 1.2,100);
w3 = logspace(1.2,2,10);
w = [w1  w2(2:end) w3(2:end)];
% w_for_tests = logspace(-1,2,20);
% w = w_for_tests;
index_after_zero_output = 0;
Magnitudes = zeros(1, length(w));
Phases = zeros(1, length(w));
delta_ts = zeros(1, length(w));
outputs_y = cell(length(w), 1);
outputs_t = cell(length(w), 1);
inputs_y = cell(length(w), 1);
inputs_t = cell(length(w), 1);


%runing the simulations
for i = 1:length(w)
    w_run = w(i);
    sim("DSPrelab3.slx")
    outputs_t{i,1} = Output.time;
    outputs_y{i,1} = Output.signals.values;
    inputs_t{i,1} = Input.time;
    inputs_y{i,1} = Input.signals.values;
end

%% data processing
for i = 1:length(w)
    %removing transitioin phenomenas
    outputs_t_half{i,1} = outputs_t{i,1}(length(outputs_t{i,1})/2:end);
    outputs_y_half{i,1} = outputs_y{i,1}(length(outputs_y{i,1})/2:end);
    inputs_t_half{i,1} = inputs_t{i,1}(length(inputs_t{i,1})/2:end);
    inputs_y_half{i,1} = inputs_y{i,1}(length(inputs_y{i,1})/2:end);


    %finding the magnutide after removing transitioin phenomenas
    Magnitudes(i) = max(outputs_y_half{i,1})/A;
    %finding zeros
    for j=2:length(outputs_t_half{i,1})
        y_before = outputs_y_half{i,1}(j-1);
        y_now = outputs_y_half{i,1}(j);
```

```
 51         if (y_now < 0 && y_before > 0)
 52             index_after_zero_output = j;
 53             break
 54         end
 55     end
 56     for j=2:length(outputs_t{i,1})
 57         y_before = inputs_y_half{i,1}(j-1);
 58         y_now = inputs_y_half{i,1}(j);
 59         if (y_now < 0 && y_before > 0)
 60             index_after_zero_input = j;
 61             break
 62         end
 63     end
 64     delta_ts(i) = inputs_t_half{i,1}(index_after_zero_input)-outputs_t_half{i,1}↙
(index_after_zero_output);
 65 end
 66
 67 %% ploting the bode plots
 68 Phases = mod(delta_ts.*w,2*pi)-2*pi;
 69 Phases_deg = Phases*180/pi;
 70 Magnitudes_dB = 20*log10(Magnitudes);
 71 fig1 = figure ("Name",'Bode Plots of G(s)','Position',[800 200 900 500]);
 72 tiledlayout(2,1);
 73 nexttile
 74 semilogx(w,Magnitudes_dB,'LineWidth',1.5,'Color',[0 0.4470 0.7410])
 75 title (["Bode Plots of G(s)", "Almog Dobrescu 214254252"])
 76 xlabel('Omega [rad/s]')
 77 ylabel('Magnitude [dB]')
 78 grid on
 79 grid minor
 80 legend({'Magnitude'},'FontSize',14 ,'Location','northeast')
 81 nexttile
 82 semilogx(w,Phases_deg,'LineWidth',1.5,'Color',[0 0.4470 0.7410])
 83 xlabel('Omega [rad/s]')
 84 ylabel('Phase [dB]')
 85 grid on
 86 grid minor
 87 legend({'Phase'},'FontSize',14 ,'Location','northeast')
 88 %exportgraphics(fig1, 'Q2_graph.png','Resolution',1200); %export the fig to a png↙
file
 89
 90 %% creating the table
 91 name_for_tabel_colloms = {'ω, [rad/sec]', '|G(jω)| [dB]', '/arg(G(jw)) [deg]'};
 92 Table = table(transpose(w), transpose(Magnitudes_dB), transpose(Phases_deg),↙
'VariableNames', name_for_tabel_colloms);
 93
 94 %% ploting exampel plots
 95
 96 fig2 = figure ("Name",'Plot of The Input and Output of The System','Position',[800↙
200 900 500]);
```

```
 97 tiledlayout(4,1);
 98 nexttile
 99 i = 5;
100 hold all
101 semilogx(outputs_t{i,1},outputs_y{i,1},'LineWidth',1.5,'Color',[0 0.4470 0.7410])
102 semilogx(inputs_t{i,1},inputs_y{i,1},'LineWidth',1.5,'Color',[0.8500 0.3250↙
0.0980])
103 title (["Plot of the Output and Input for Omega = " + w(i) + " [rad/s]", "Almog↙
Dobrescu 214254252"])
104 xlabel('t [s]')
105 ylabel('y(t) or u(t) [-]')
106 grid on
107 grid minor
108 legend({'Output','Input'},'FontSize',10 ,'Location','northeast')
109
110 nexttile
111 i = 40;
112 hold all
113 semilogx(outputs_t{i,1},outputs_y{i,1},'LineWidth',1.5,'Color',[0 0.4470 0.7410])
114 semilogx(inputs_t{i,1},inputs_y{i,1},'LineWidth',1.5,'Color',[0.8500 0.3250↙
0.0980])
115 title (["Plot of the Output and Input for Omega = " + w(i) + " [rad/s]", "Almog↙
Dobrescu 214254252"])
116 xlabel('t [s]')
117 ylabel('y(t) or u(t) [-]')
118 grid on
119 grid minor
120 legend({'Output','Input'},'FontSize',10 ,'Location','northeast')
121
122 nexttile
123 i = 70;
124 hold all
125 semilogx(outputs_t{i,1},outputs_y{i,1},'LineWidth',1.5,'Color',[0 0.4470 0.7410])
126 semilogx(inputs_t{i,1},inputs_y{i,1},'LineWidth',1.5,'Color',[0.8500 0.3250↙
0.0980])
127 title (["Plot of the Output and Input for Omega = " + w(i) + " [rad/s]", "Almog↙
Dobrescu 214254252"])
128 xlabel('t [s]')
129 ylabel('y(t) or u(t) [-]')
130 grid on
131 grid minor
132 legend({'Output','Input'},'FontSize',10 ,'Location','northeast')
133
134 nexttile
135 i = 100;
136 hold all
137 semilogx(outputs_t{i,1},outputs_y{i,1},'LineWidth',1,'Color',[0 0.4470 0.7410])
138 semilogx(inputs_t{i,1},inputs_y{i,1},'LineWidth',1.5,'Color',[0.8500 0.3250↙
0.0980])
139 title (["Plot of the Output and Input for Omega = " + w(i) + " [rad/s]", "Almog↙
```

```
Dobrescu 214254252"])
xlabel('t [s]')
ylabel('y(t) or u(t) [-]')
grid on
grid minor
legend({'Output','Input'},'FontSize',10 ,'Location','northeast')
%exportgraphics(fig2, 'Q2_2graph.png','Resolution',1800); %export the fig to a png file

%% Q3

%ploting the magnitude to take mesuerment
fig3 = figure ("Name",'Plot of The Magnitude of G(s)','Position',[800 200 900 500]);
semilogx(w,Magnitudes_dB,'LineWidth',1.5,'Color',[0 0.4470 0.7410])
title (["Plot of The Magnitude of G(s)", "Almog Dobrescu 214254252"])
xlabel('Omega [rad/s]')
ylabel('Magnitude [dB]')
grid on
grid minor
legend({'Magnitude'},'FontSize',14 ,'Location','northeast')
%exportgraphics(fig3, 'Q3_graph.png','Resolution',1200); %export the fig to a png file

%% Q4

%defining the constants
zeta = 0.202;
omega_n = 2.37949;
A = 1;

sys = tf(omega_n^2, [1 2*zeta*omega_n omega_n^2]);

%extracting the vectors of the plots form the bode function
[Magnitude_3d, Phase_3d, Omega] = bode(sys);

%they came out as a matrix so I will convert them to a vector
Magnitude_1d = zeros(1,length(Magnitude_3d));
Phase_1d_in_deg = zeros(1,length(Phase_3d));
for i = 1:length(Magnitude_3d)
    Magnitude_1d(i) = Magnitude_3d(1,1,i);
    Phase_1d_in_deg(i) = Phase_3d(1,1,i);
end

Magnitude_in_dB = zeros(1,length(Magnitude_3d));
for i = 1:length(Magnitude_3d)
    Magnitude_in_dB(i) = 20*log10(Magnitude_1d(i));
end
Omega_log = log10(Omega);

```

```
186 %ploting the bode plots of the system and simulation
187 fig4 = figure ("Name",'Bode Plots of Simulated and Estimated G(s)','Position',[800
200 900 500]);
188 tiledlayout(2,1);
189 nexttile
190 hold all
191 semilogx(Omega_log,Magnitude_in_dB, 'LineWidth',1.5,'Color',[0 0.4470 0.7410])
192 semilogx(log10(w),Magnitudes_dB,'-.','LineWidth',1.5,'Color',[0.8500 0.3250
0.0980])
193 title (["Bode Plots of Simulated and Estimated G(s)", "Almog Dobrescu 214254252"])
194 xlabel('log10(Omega) [rad/s]')
195 ylabel('Magnitude [dB]')
196 grid on
197 grid minor
198 legend({'Estimated Magnitude', 'Simulated Magnitude'},'FontSize',14
,'Location','northeast')
199
200 nexttile
201 hold all
202 semilogx(Omega_log,Phase_1d_in_deg,'LineWidth',1.5,'Color',[0 0.4470 0.7410])
203 semilogx(log10(w),Phases_deg,'-.','LineWidth',1.5,'Color',[0.8500 0.3250 0.0980])
204 xlabel('log10(Omega) [rad/s]')
205 ylabel('Phase [dB]')
206 grid on
207 grid minor
208 legend({'Estimated Phase', 'Simulated Phase'},'FontSize',14
,'Location','northeast')
209 %exportgraphics(fig4, 'Q4_graph.png','Resolution',1200); %export the fig to a png
file
210
211
```