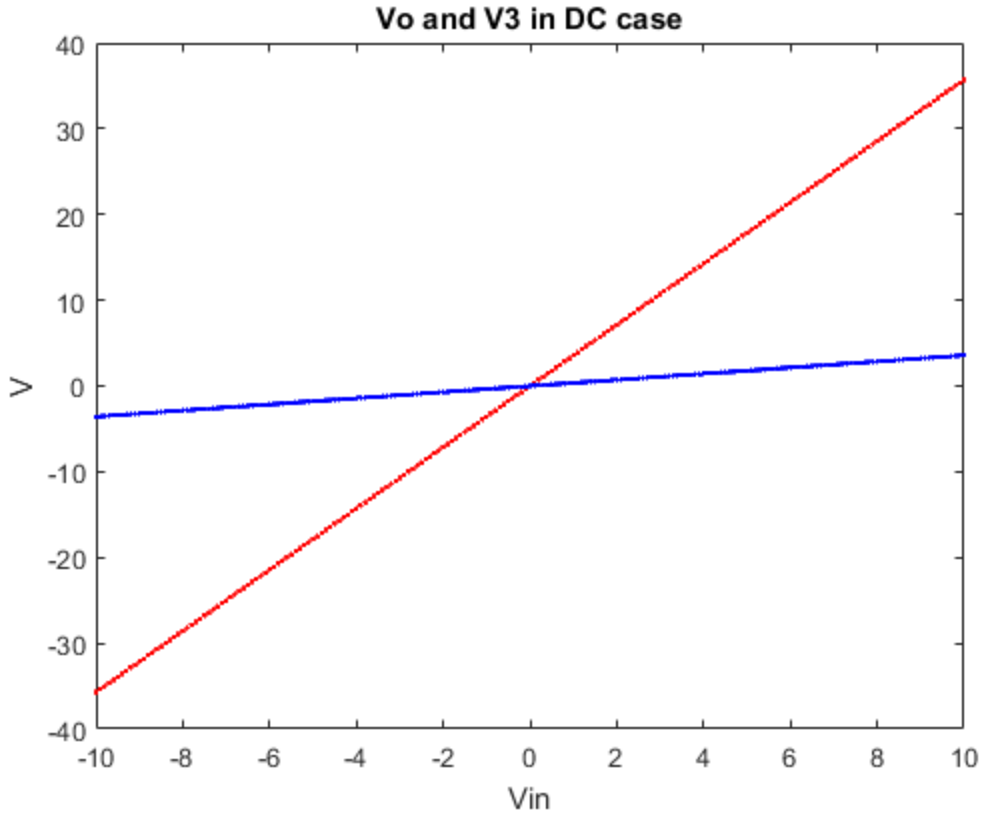
Assignment 4

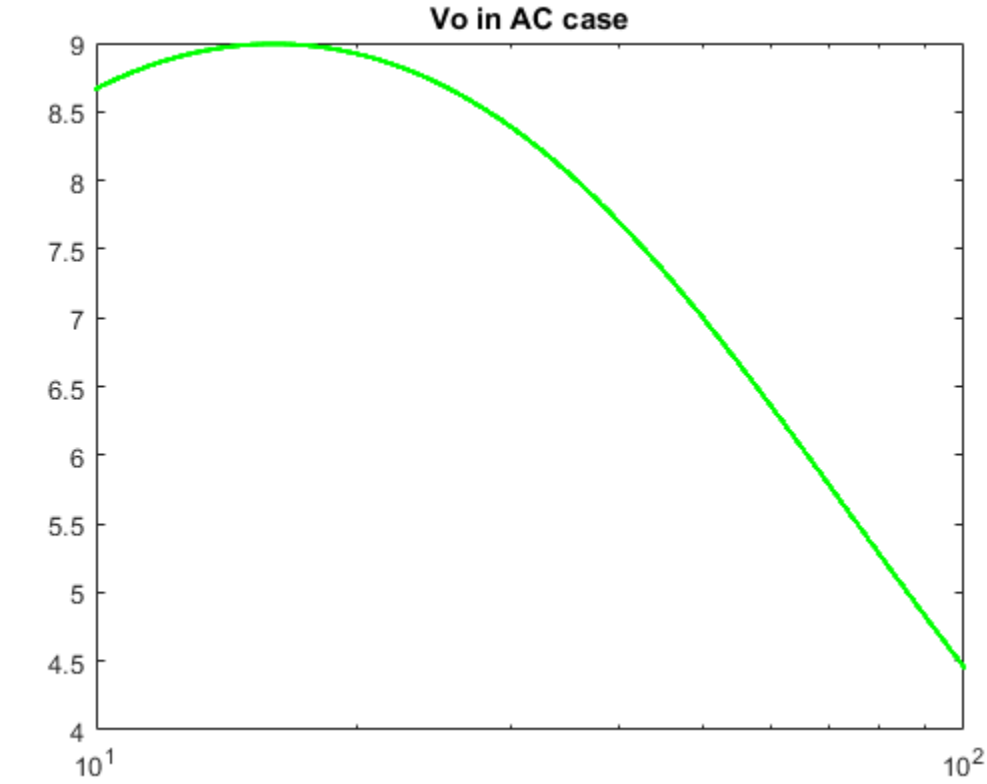
Part 1

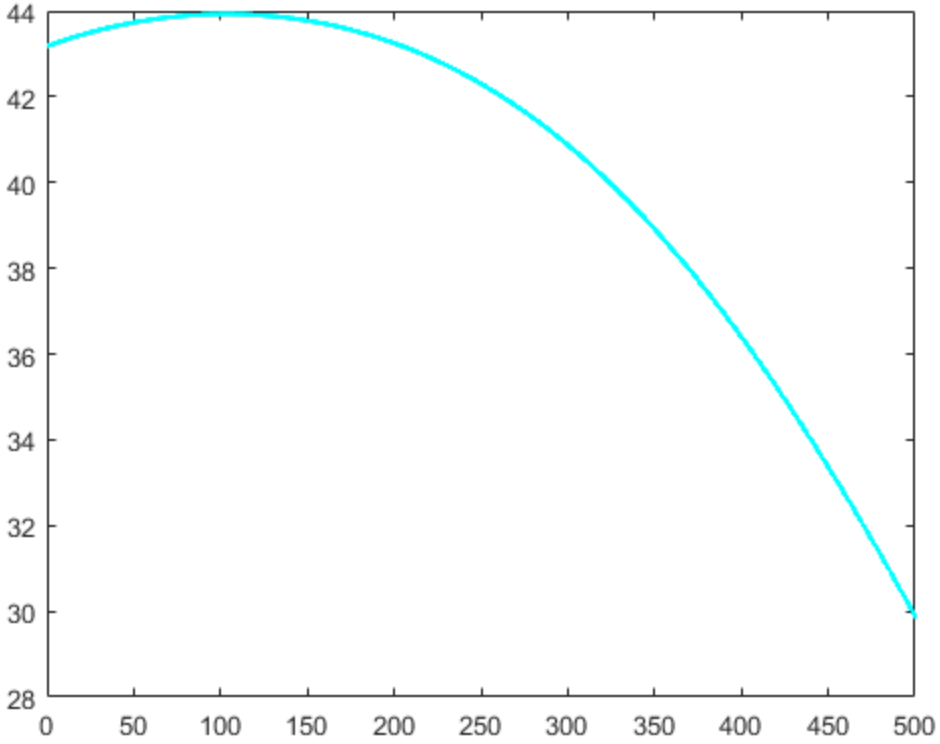
In this assignment, we are simulating a circuit through matlab and see how the circuit would react when different types of inputs are going into the circuit. For the first part, we are just creating matrices and plotting basic output with basic input to see if our defined differential equations are correct for more complicated input in later part.

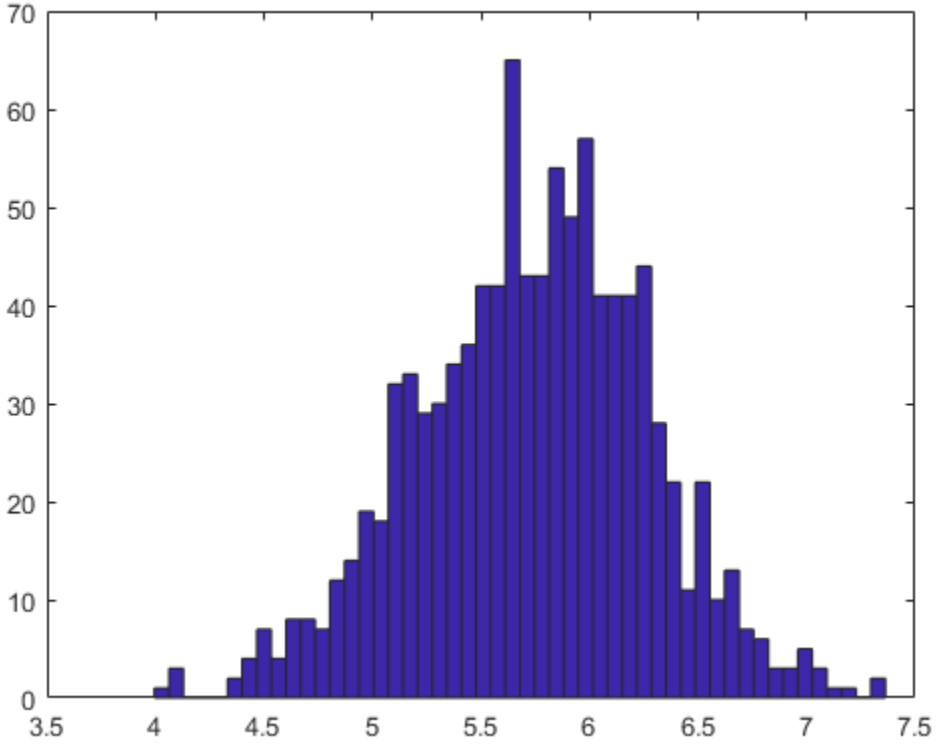
```
% Reset Everything
close all
clear

% Define Constant
R1 = 1;
G1 = 1/R1;
c = 0.25;
R2 = 2;
G2 = 1/R2;
L = 0.2;
R3 = 10;
G3 = 1/R3;
a = 100;
R4 = 0.1;
G4 = 1/R4;
Ro = 1000;
Go = 1/Ro;

% Define Matrices
C = [0 0 0 0 0 0 0;
    -c c 0 0 0 0 0;
    0 0 -L 0 0 0 0;
    0 0 0 0 0 0 0;
    0 0 0 0 0 0 0;
    0 0 0 0 0 0 0;
    0 0 0 0 0 0 0;];

G = [1 0 0 0 0 0 0;
    -G2 G1+G2 -1 0 0 0 0;
    0 1 0 -1 0 0 0;
    0 0 -1 G3 0 0 0;
    0 0 0 0 -a 1 0;
    0 0 0 G3 -1 0 0;
    0 0 0 0 0 -G4 G4+Go];

% Initialize matrices for future calculation
Vdc = zeros(7,1);       % Voltage in DC sweep
Vac = zeros(7,1);       % Voltage in AC sweep
F = zeros(7,1);

% Define figure for better simulation
f1 = figure;
```

```
f2 = figure;
f3 = figure;
f4 = figure;

% Calculating and plotting DC sweep
for v = -10:0.1: 10
    F(1,1) = v;
    Vdc = G\F;                          % DC sweep calculation

    set(0, 'CurrentFigure', f1)
    plot(v, Vdc(7,1), 'r.')
    hold on

    plot(v, Vdc(4,1), 'b.')
    hold on
    title('Vo and V3 in DC case')
    xlabel('Vin')
    ylabel('V')

end

% Calculating and plotting AC sweep and gain
w = logspace(1,2,500);                  % Creating a log graph
F(1) = 1;
for o = 1:length(w)

    Vac = (G+C*1j*w(o))\F;              % AC sweep calculation
    set(0, 'CurrentFigure', f2)
    semilogx(w(o), abs(Vac(7,1)), 'g.')
    hold on
    title('Vo in AC case')

    dB = 20*log(abs(Vac(7,1))/F(1));    % Gain calculation
    set(0, 'CurrentFigure', f3)
    plot(o, dB, 'c.')
    hold on

end

% Calculating and plotting AC sweep and gain with random perturbations
cs =  0.25 + 0.05.*randn(1,1000);
w = pi;
Vgain = zeros(1000,1);
for m = 1:length(Vgain)
    c = cs(m);
    C(2,1) = -c;
    C(2,2) = c;
    Vac = (G+C*1j*w)\F;                 % AC sweep calculation
    Vgain(m,1) = abs(Vac(7,1))/F(1);    % Gain calculation
end

% Histogram of the previous gain
set(0, 'CurrentFigure', f4)
hist(Vgain,50);
```


Vo and V3 in DC case
40
30
20
10
0
-10
-20
-30
-40
V
-10
-8
-6
-4
-2
0
2
4
6
8
10
Vin


Vo in AC case
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
10^1
10^2


44
42
40
38
36
34
32
30
28
0
50
100
150
200
250
300
350
400
450
500


70
60
50
40
30
20
10
0
3.5
4
4.5
5
5.5
6
6.5
7
7.5

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