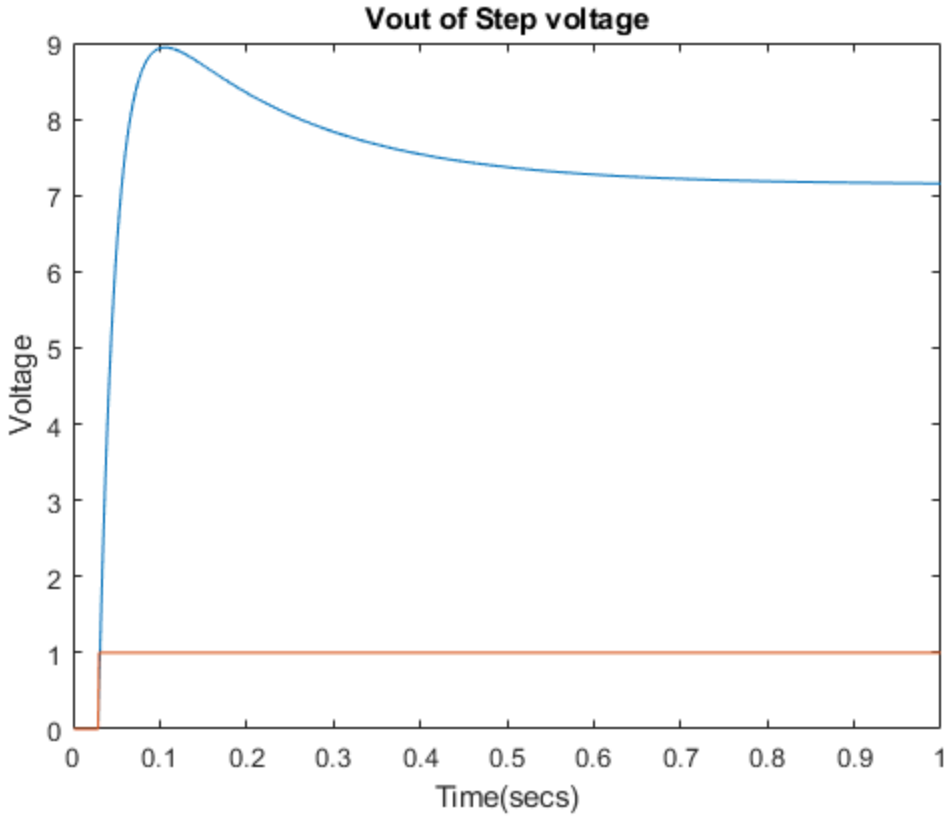
```
% Patrobas Adewumi
% 100963608
% ELEC 4700
% assignment4

disp('Question 2(a) It can be seen from the frequency response plot
 that this is a low pass filter circuit.')
disp('Increase in the frequency increases the inductance making the
 capacitor to cause a parallel resistance')
disp('with the resistor')

disp('Question 2(b) The expected frequency response would be a pass
 band during the low frequencies')
disp(' and a 2nd order drop off at its respective frequency')

clear all

runTime = 1;
timecuts = 1000;
dt = runTime/timecuts;

R1 = 1;
C1 = 0.25;
R2 = 2;
L1 = 0.2;
R3 = 10;
a = 100;
R4 = 0.1;
Ro = 1000;

C = [  0, 0,   0, 0, 0, 0, 0; ...
     -C1,C1,   0, 0, 0, 0, 0; ...
       0, 0, -L1, 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; ...
      -1/R1, (1/R2 + 1/R1), -1,    0,  0,     0,            0; ...
          0,              1,  0,   -1,  0,     0,            0; ...
          0,              0, -1, 1/R3,  0,     0,            0; ...
          0,              0,  0,    0, -a,     1,            0; ...
          0,              0,  0, 1/R3, -1,     0,            0; ...
          0,              0,  0,    0,  0, -1/R4, (1/R4 +1/Ro)];

disp('Question 2: G and C matrices:')
disp(G)
disp(C)

V1 = 0;
F = zeros(7,1);
```

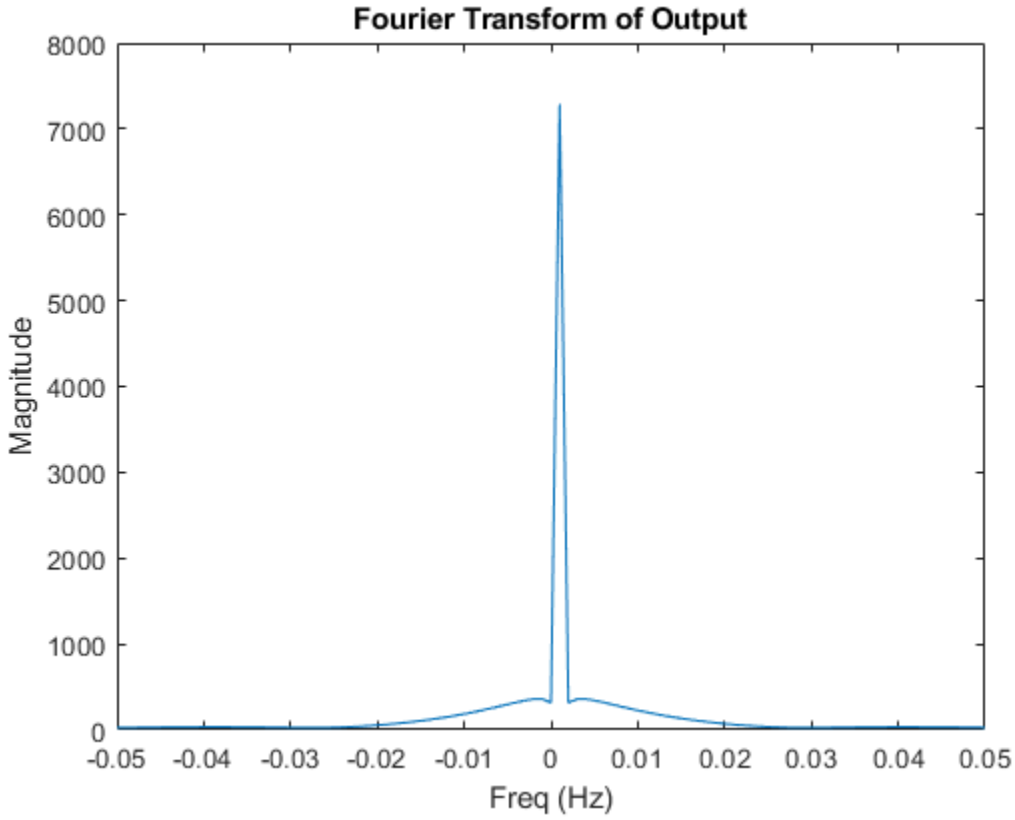
```
Flist = zeros(7,1,timecuts);
Flist(1,1,30:timecuts) = 1;
Vlist = zeros(7,1,timecuts);

for count  = 2:1:timecuts
    A = C/dt +G;
    Vlist(:,:,count) = A\(C*Vlist(:,:,count-1)/dt +Flist(:,:,count));
end

V1list(1,:) = Vlist(1,1,:);
V2list(1,:) = Vlist(2,1,:);
ILlist(1,:) = Vlist(3,1,:);
I3list(1,:) = Vlist(4,1,:);
V4list(1,:) = Vlist(5,1,:);
Volist(1,:) = Vlist(7,1,:);


figure(1)
plot((1:timecuts).*dt,Volist(1,:))
xlabel('Time(secs)')
ylabel('Voltage')
title('Vout of Step voltage')
hold on
plot((1:timecuts).*dt,V1list(1,:))
hold off

figure(2)
g = abs(fftshift(fft(Volist(1,:))));
plot(((1:length(g))/timecuts)-0.5,g)
xlim([-0.05 0.05])
xlabel('Freq (Hz)')
ylabel('Magnitude')
title('Fourier Transform of Output')

% Sine function
f = 1/0.03;
Flist = zeros(7,1,timecuts);
for count = 1:1:timecuts
    Flist(1,1,count) = sin(2*pi*f*count*dt);
end
Vlist = zeros(7,1,timecuts);

for count  = 2:1:timecuts
    A = C/dt +G;
    Vlist(:,:,count) = A\(C*Vlist(:,:,count-1)/dt +Flist(:,:,count));
end

V1list(1,:) = Vlist(1,1,:);
V2list(1,:) = Vlist(2,1,:);
ILlist(1,:) = Vlist(3,1,:);
I3list(1,:) = Vlist(4,1,:);
V4list(1,:) = Vlist(5,1,:);
Volist(1,:) = Vlist(7,1,:);
```

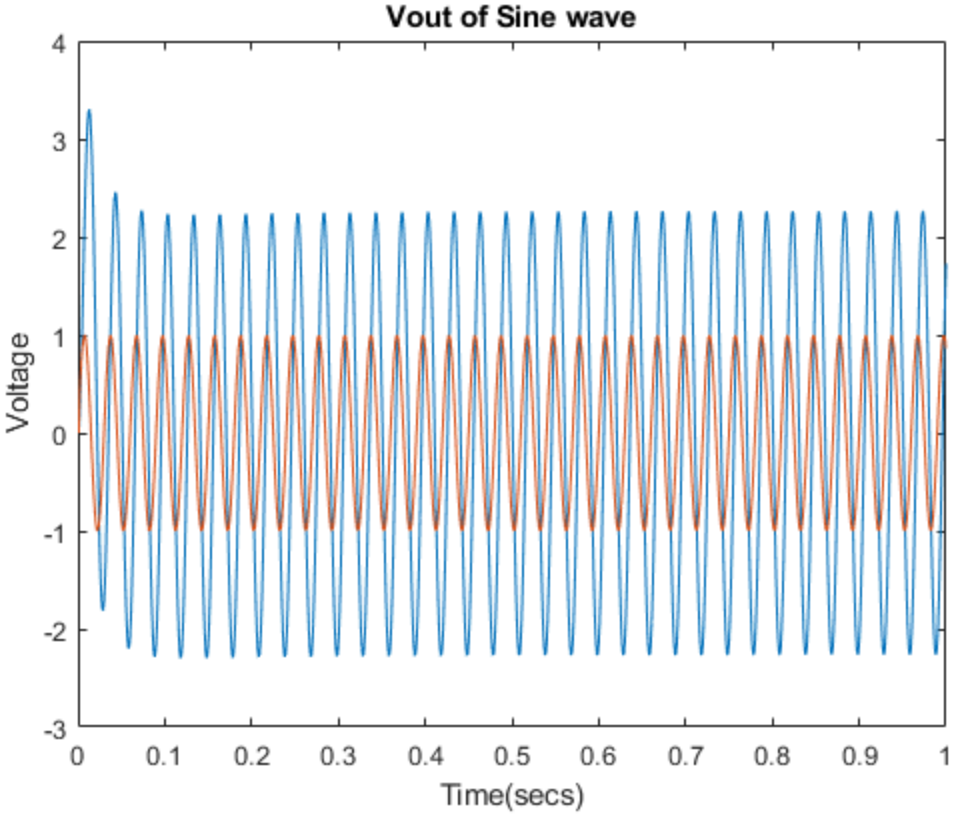
```
figure(3)
plot((1:timecuts).*dt,Volist(1,:))
xlabel('Time(secs)')
ylabel('Voltage')
title('Vout of Sine wave')
hold on
plot((1:timecuts).*dt,V1list(1,:))
hold off

figure(4)
g = abs(fftshift(fft(Volist(1,:))));
plot(((1:length(g))/timecuts)-0.5,g)
xlim([-0.05 0.05])
xlabel('Freq (Hz)')
ylabel('Magnitude')
title('Fourier Transform of Output')

% Gaussian pulse
% Vgauss = exp(-1/2*((k/ts-0.06)/(0.03))^2)
mag = 1;
dev = 0.03;
delay = 0.06;
Flist = zeros(7,1,timecuts);
for count = 1:1:timecuts
    Flist(1,1,count) = exp(-((count*dt-0.06)/0.03)^2);
end
Vlist = zeros(7,1,timecuts);

for count  = 2:1:timecuts
    A = C/dt +G;

    Vlist(:,:,count) = A\(C*Vlist(:,:,count-1)/dt +Flist(:,:,count));
end

V1list(1,:) = Vlist(1,1,:);
V2list(1,:) = Vlist(2,1,:);
ILlist(1,:) = Vlist(3,1,:);
I3list(1,:) = Vlist(4,1,:);
V4list(1,:) = Vlist(5,1,:);
Volist(1,:) = Vlist(7,1,:);



figure(5)
plot((1:timecuts).*dt,Volist(1,:))
xlabel('Time(secs)')
ylabel('Voltage')
title('Vout of Gaussian Pulse')
hold on
plot((1:timecuts).*dt,V1list(1,:))
hold off
```

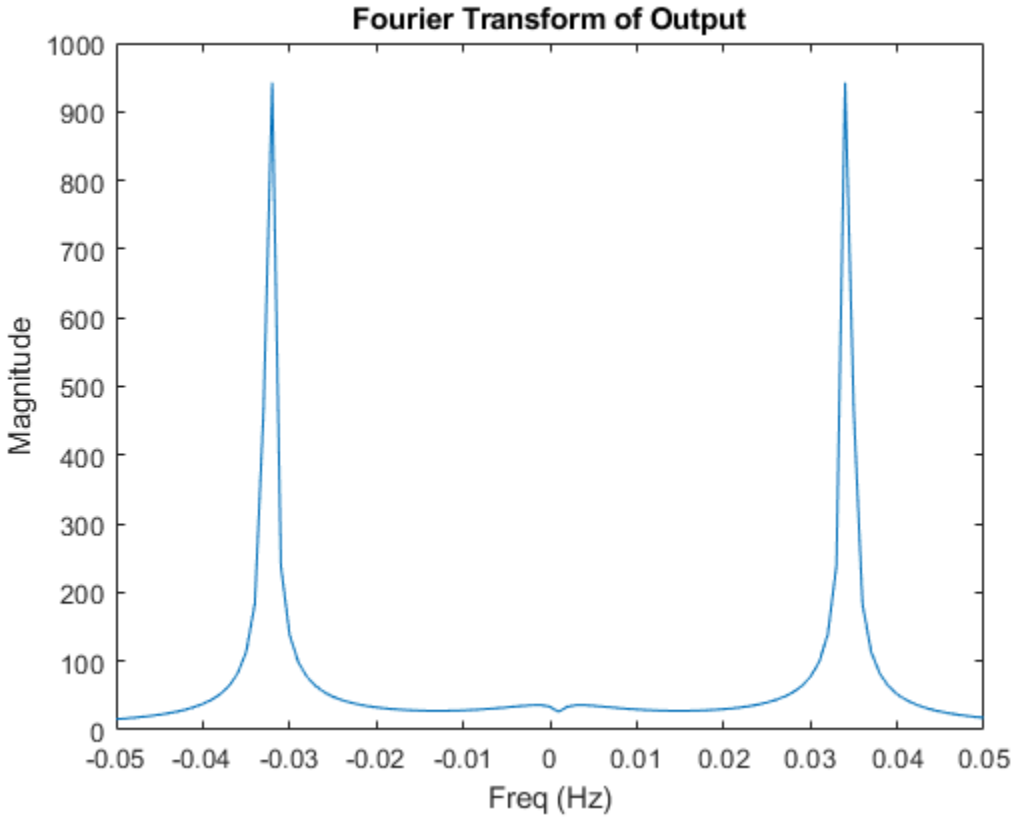
```
figure(6)
g = abs(fftshift(fft(Volist(1,:))));
plot(((1:length(g))/timecuts)-0.5,g)
xlim([-0.05 0.05])
xlabel('Freq (Hz)')
ylabel('Magnitude')
title('Q2: Fourier Transform of Output')

disp('A change in the timecut changes the accuracy of the simulation.
 Hence, a larger timecut results in less accurate sims')
```

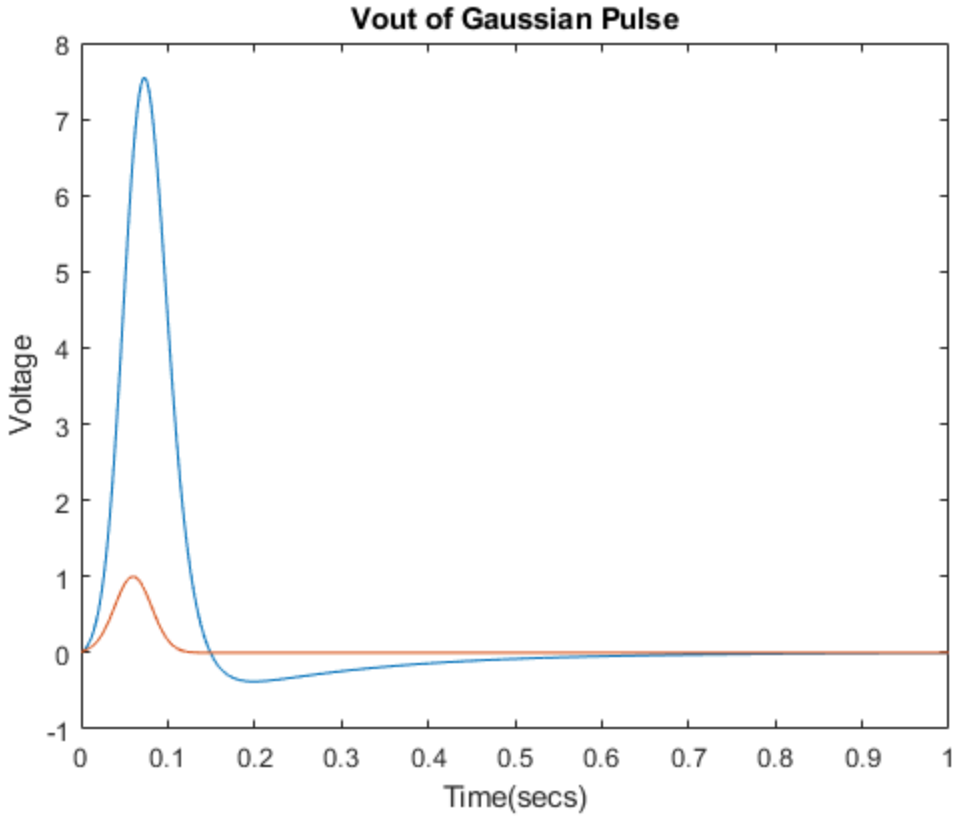
```
Question 2(a) It can be seen from the frequency response plot that
 this is a low pass filter circuit.
Increase in the frequency increases the inductance making the
 capacitor to cause a parallel resistance
with the resistor
Question 2(b) The expected frequency response would be a pass band
 during the low frequencies
 and a 2nd order drop off at its respective frequency
Question 2: G and C matrices:
    1.0000         0         0         0         0         0         0
   -1.0000    1.5000   -1.0000         0         0         0         0
         0    1.0000         0   -1.0000         0         0         0
         0         0   -1.0000    0.1000         0         0         0
         0         0         0         0 -100.0000    1.0000         0
         0         0         0    0.1000   -1.0000         0         0
         0         0         0         0         0  -10.0000   10.0010

         0         0         0         0         0         0         0
   -0.2500    0.2500         0         0         0         0         0
         0         0   -0.2000         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

A change in the timecut changes the accuracy of the simulation. Hence,
 a larger timecut results in less accurate sims
```

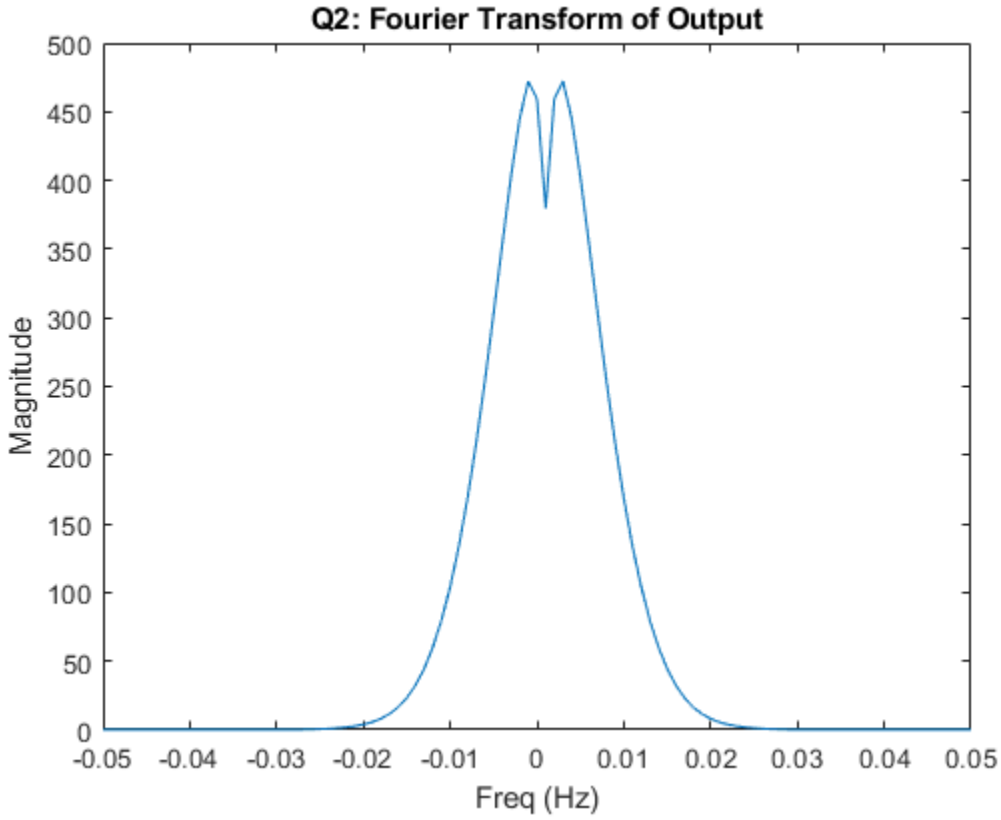

Vout of Step voltage
Voltage
Time(secs)
0
1
2
3
4
5
6
7
8
9
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Fourier Transform of Output
Magnitude
Freq (Hz)
0
1000
2000
3000
4000
5000
6000
7000
8000
-0.05
-0.04
-0.03
-0.02
-0.01
0
0.01
0.02
0.03
0.04
0.05


Vout of Sine wave
Voltage
Time(secs)
4
3
2
1
0
-1
-2
-3
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Fourier Transform of Output
Magnitude
Freq (Hz)
1000
900
800
700
600
500
400
300
200
100
0
-0.05
-0.04
-0.03
-0.02
-0.01
0
0.01
0.02
0.03
0.04
0.05


Vout of Gaussian Pulse
Voltage
Time(secs)
8
7
6
5
4
3
2
1
0
-1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Q2: Fourier Transform of Output
Magnitude
Freq (Hz)
500
450
400
350
300
250
200
150
100
50
0
-0.05
-0.04
-0.03
-0.02
-0.01
0
0.01
0.02
0.03
0.04
0.05

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