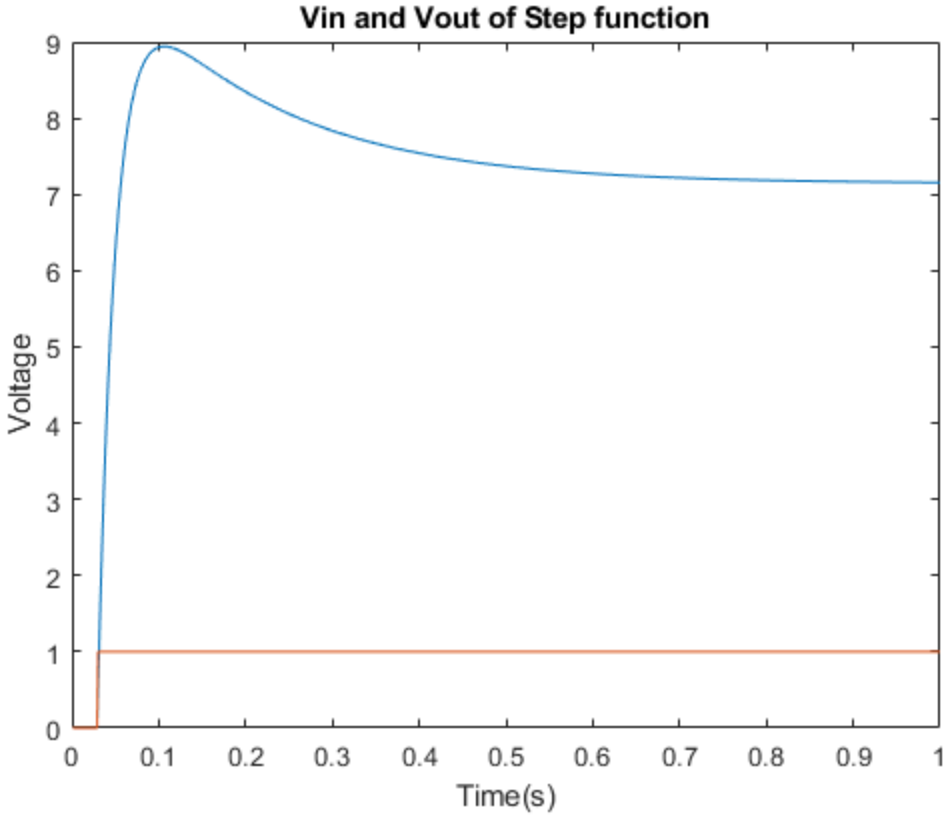
```
disp('A. The circuit behaves like a low pass filter')
disp('B. I would expext that the circuit has a passband at lower
 frequency and a 2nd order drop off will happen at cut-off frequency')

clear all

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

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


%    V1    V2     V3          V5       IL3
% G = [-1/R1, 0,     0,          0,      0; ...%N1
%      1/R1 , -1/R2, 0,          0,      0; ...%N2
%      0,     0,     -1/R3,      0,      0; ...%N3
%      0,     0,     -a/(R3*R4), -1/R4,  0; ...%N4


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)];


%Time Step function
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
```

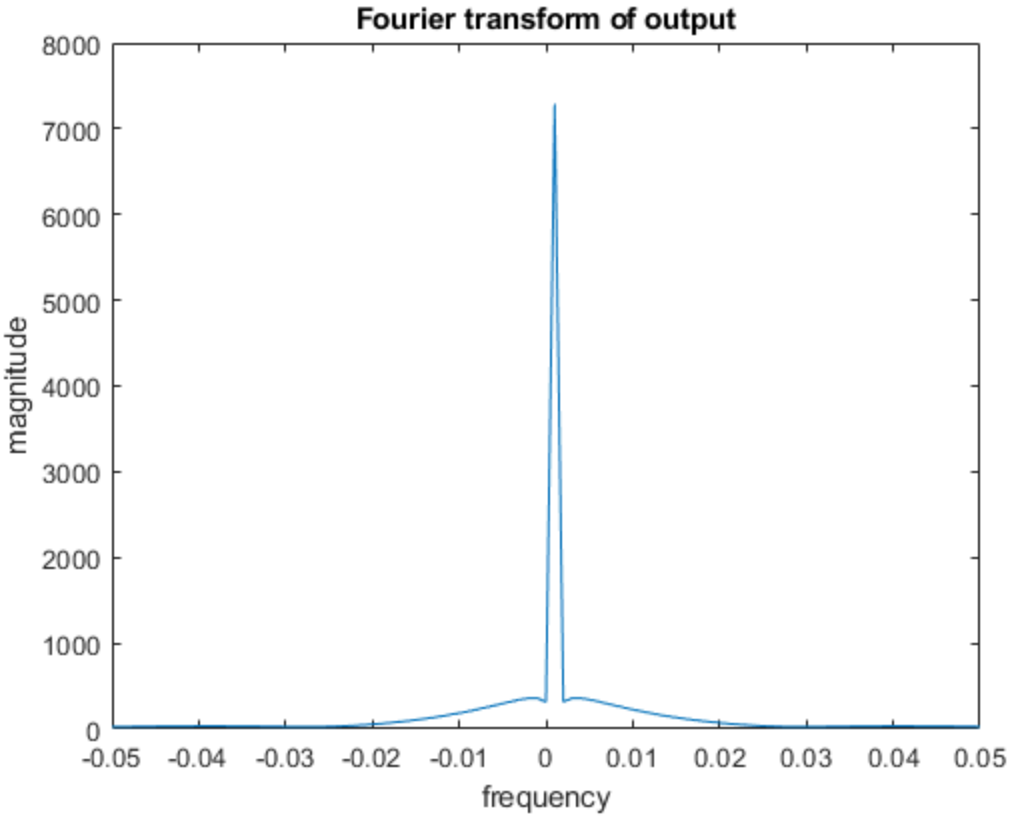
```
    A = C/dt +G;

    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(s)')
ylabel('Voltage')
title('Vin and Vout of Step function')
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('frequency')
ylabel('magnitude')
title('Fourier transform of output')

%Sine(2*pi*f*t)function with f = 1/(0.03)HZ
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)
```

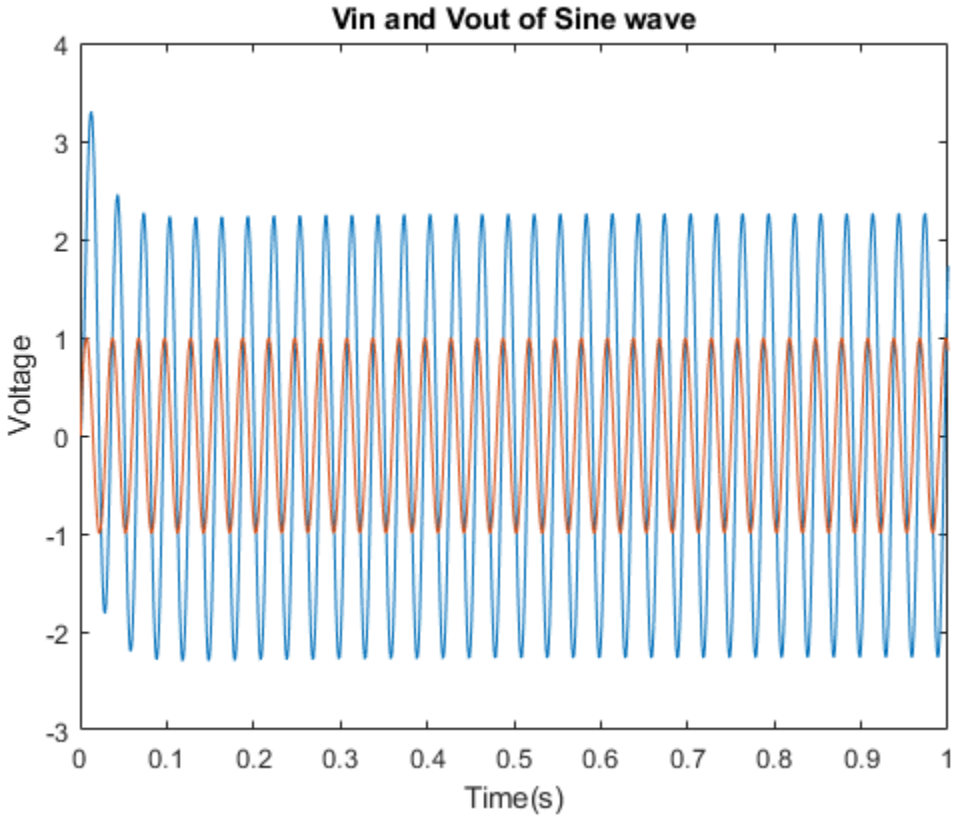
```
plot((1:timecuts).*dt,Volist(1,:))
xlabel('Time(s)')
ylabel('Voltage')
title('Vin and Vout of Sine wave')
hold on
plot((1:timecuts).*dt,V1list(1,:))
hold off

figure(4)
g = abs(fftshift(fft(Volist(1,:))));
plot(((1:length(g))/timecuts)-0.5,g)
xlim([-0.05 0.05])
xlabel('frequency')
ylabel('magnitude')
title('Fourier transform of output')

%Gaussian pulse with magnitude of 1 std dev of 0.03s and delay of
 0.06s
%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(s)')
ylabel('Voltage')
title('Vin and Vout of Gaussian Pulse')
hold on
plot((1:timecuts).*dt,V1list(1,:))
hold off

figure(6)
g = abs(fftshift(fft(Volist(1,:))));
```

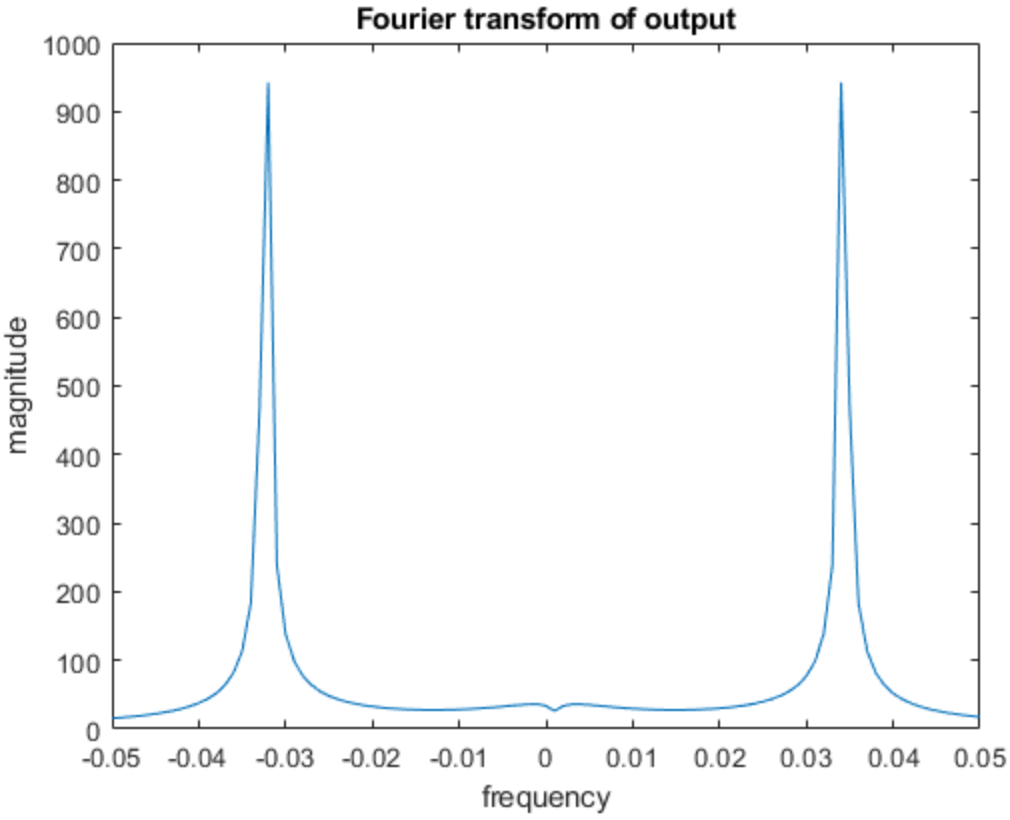
```
plot(((1:length(g))/timecuts)-0.5,g)
xlim([-0.05 0.05])
xlabel('frequency')
ylabel('magnitude')
title('Fourier transform of output')

disp('Comment on what happens when time step is increased')
disp('By increasing the time step it will make the model less
 accurate.')
```

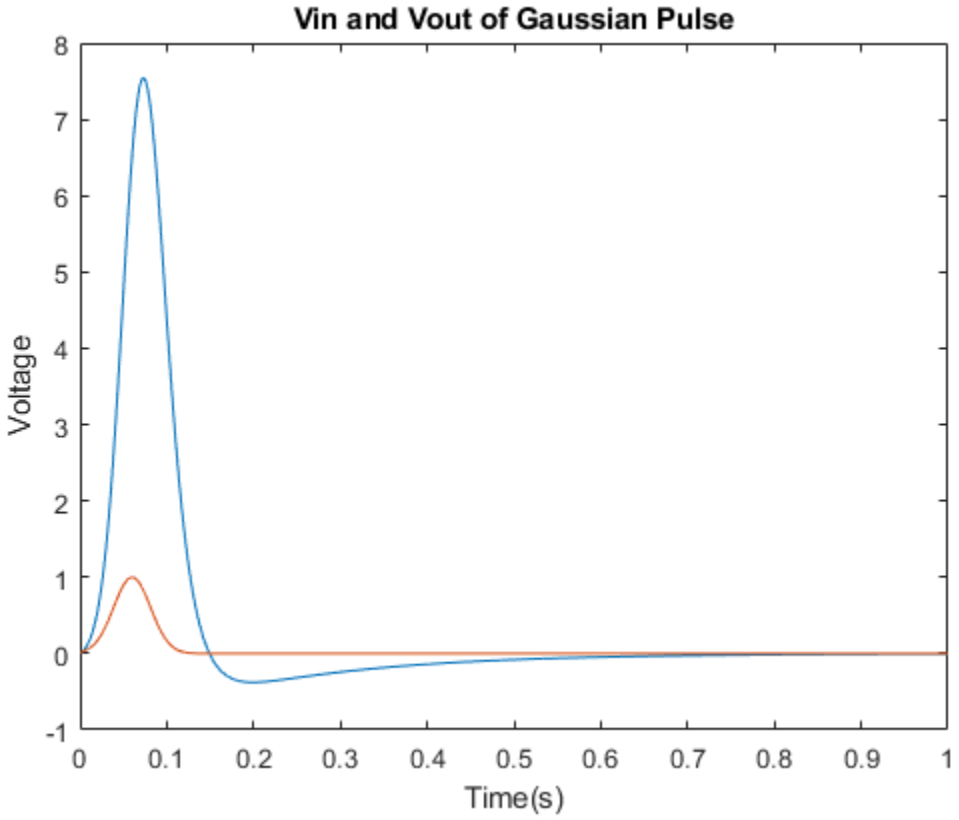
A. The circuit behaves like a low pass filter
B. I would expext that the circuit has a passband at lower frequency and a 2nd order drop off will happen at cut-off frequency
Comment on what happens when time step is increased
By increasing the time step it will make the model less accurate.

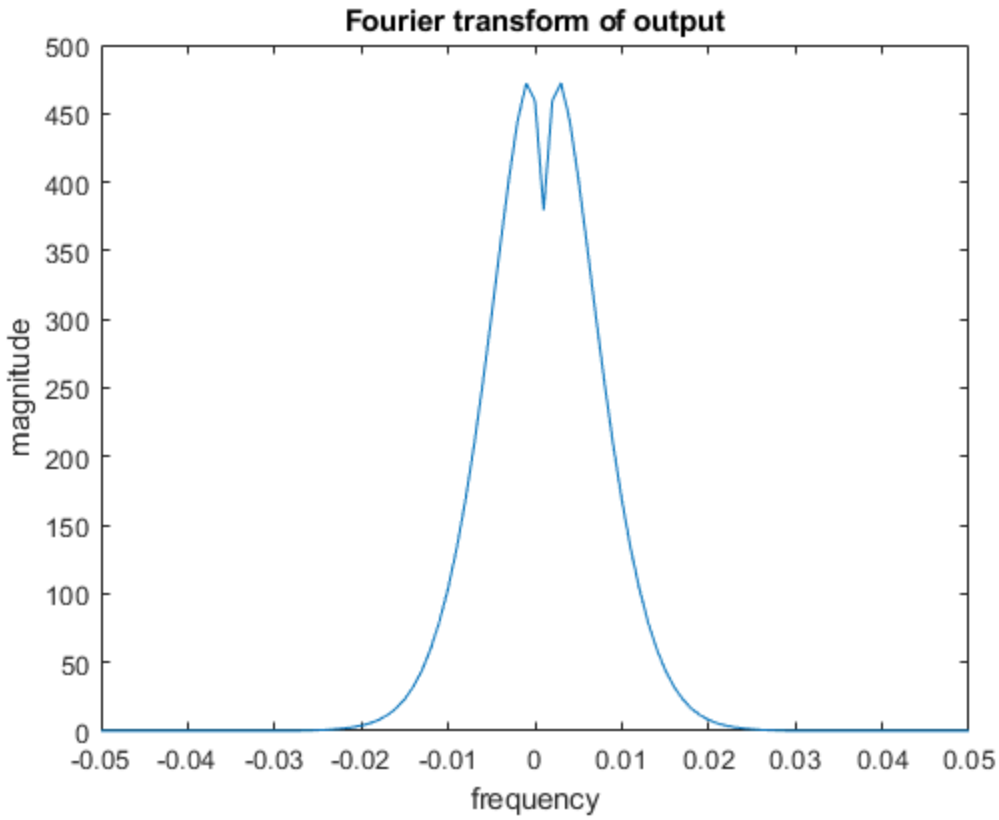



Fourier transform of output
magnitude
frequency
8000
7000
6000
5000
4000
3000
2000
1000
0
-0.05
-0.04
-0.03
-0.02
-0.01
0
0.01
0.02
0.03
0.04
0.05


Vin and Vout of Sine wave
Voltage
Time(s)
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
frequency
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


Vin and Vout of Gaussian Pulse
Voltage
Time(s)
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



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