```
%ELEC4700 Assignment 4

% Part 2

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clear

clc

% parameters

R1=1;

c=0.25;

R2=2;

L=0.2;

R3=10;

alpha=100;

R4=0.1;

Ro=1000;

% G function and C function

% G*V+jwC*V=F

% G=[R3 -1 0 0;R3 0 -1 0;alpha*Ro/(R4+Ro) 0 0 -1;1 0 (1/R1+1/R2) 0];

G=[R3 -1 0 0 0;R3 0 -1 0 0;alpha*Ro/(R4+Ro) 0 0 -1 0;1 0 (1/R1+1/R2) 0 0;0 0 0 0 1];

% C=[0 0 0 0;L 0 0 0;0 0 0 0;0 0 c 0];

C=[0 0 0 0 0;L 0 0 0 0;0 0 0 0 0;0 0 c 0 -c/R1;0 0 0 0 0];

dt=1/1000; % time interval
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A=C/dt+G; % prepare for time stepping



% a: step input

t=0; % initial time

Vina=zeros(1,1000); % initialize size for input

Voa=zeros(1,1000); % initialize size for output

for j=1:1:1000

    if t<0.03

        Vina(j)=0;

    else

        Vina(j)=1;

    end

    FDC=[0;0;0;Vina(j)/R1;Vina(j)]; % corresponding F

    if j==1

        DC=zeros(5,1); % V(0)

    else

        DC=A\(C*oldV/dt+FDC); % A*V(n)=C*V(n-1)/dt+F

    end



    Voa(j)=DC(4);

    oldV=DC; % update V(n-1)

    t=t+dt;
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end

figure(1)

t=linspace(0,1,1000);

subplot(1,2,1),plot(t,Vina);

title('Vin(a) vs. t');

xlabel('t');

ylabel('Vin(a)');

grid on

subplot(1,2,2),plot(t,Voa);

title('Vo(a) vs. t');

xlabel('t');

ylabel('Vo(a)');

grid on



n1=2^nextpow2(1000);

m1=fftshift(fft(Vina,n1+1));

m2=fftshift(fft(Voa,n1+1));

f1=1/0.03*((-n1/2):(n1/2))/n1;



figure(2)

subplot(1,2,1),semilogy(f1,abs(m1/n1));

title('Vin(a) in frequency domain');
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xlabel('freq');

grid on

subplot(1,2,2),semilogy(f1,abs(m2/n1));

title('Vo(a) in frequency domain');

xlabel('freq');

grid on



% b

t=0;

f=1/0.03;

w=2*pi*f;

Vinb=zeros(1,1000);

Vob=zeros(1,1000);

for j=1:1:1000

    Vinb(j)=sin(2*pi*f*t);

    F=[0;0;0;Vinb(j)/R1+c*w*1i*Vinb(j);Vinb(j)];

    if j==1

        V=zeros(5,1);

    else

        V=A\(C*oldVb/dt+F);

    end

    Vob(j)=abs(V(4));
```

```
    oldVb=V;

    t=t+dt;

end

figure(3)

t=linspace(0,1,1000);

subplot(1,2,1),plot(t,sin(2*pi*f*t),'g');

title('Vin(b) vs. t');

xlabel('t');

ylabel('Vin(b)');

grid on

subplot(1,2,2),plot(t,Vob,'b');

title('Vo(b) vs. t');

xlabel('t');

ylabel('Vo(b)');

grid on



n2=2^nextpow2(1000);

dim=2;

m3=fftshift(fft(Vinb,n2-1,dim));

m4=fftshift(fft(Vob,n2-1,dim));

f2=(f/n2-f/2):f/n2:(f/2-f/n2);

figure(4)
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```
subplot(1,2,1),semilogy(f2,abs(m3/1000));

title('Vin(b) in frequency domain');

xlabel('freq');

grid on

subplot(1,2,2),semilogy(f2,abs(m4/1000));

title('Vo(b) in frequency domain');

xlabel('freq');

grid on



% c

t=0;

Vinc=zeros(1,1000);

Voc=zeros(1,1000);

Vinc(1:30)=normpdf(0.001:0.001:0.03,0.015,0.03);

[index,m]=max(Vinc(1:30));

M=m/0.06;

Vinc(1:30)=Vinc(1:30)/M;

for k=91:1000

    z=mod(k,90);

    if z==0

        Vinc(k)=0;

    else
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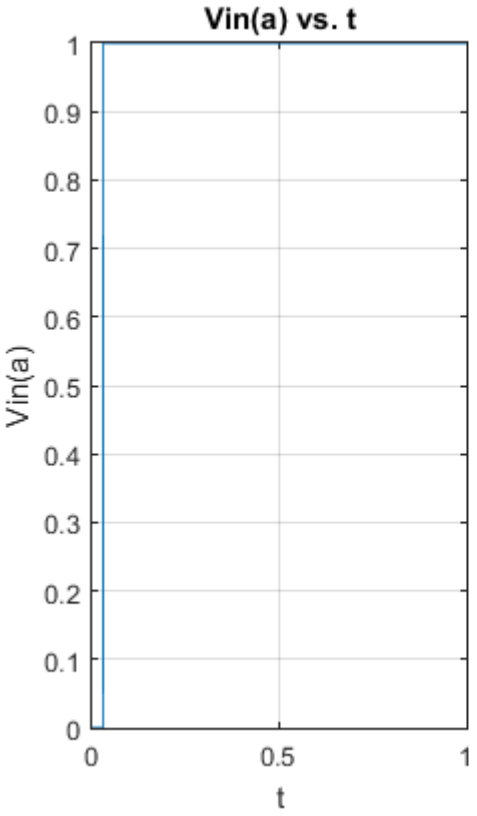
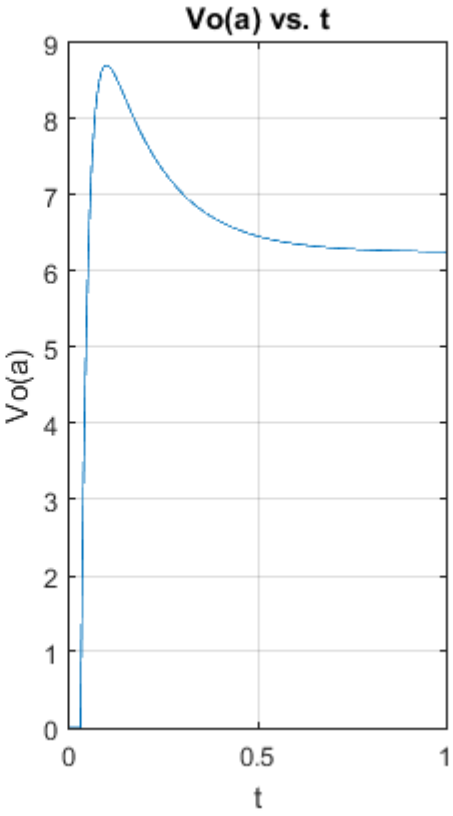
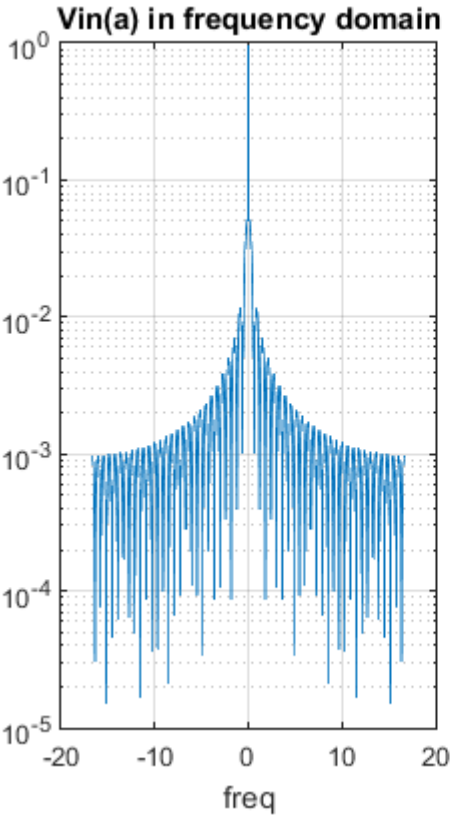
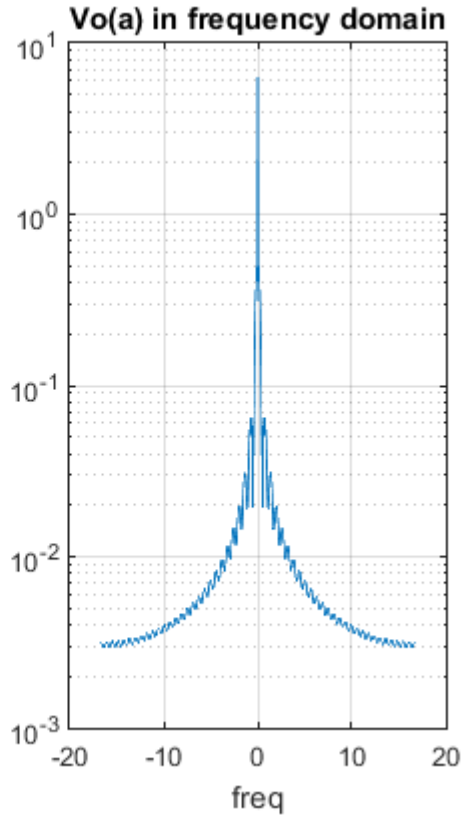
```
        Vinc(k)=Vinc(z);
    end
end
for j=1:1:1000
    FGa=[0;0;0;Vinc(j)/R1+c*w*1i*Vinc(j);Vinc(j)];
    if j==1
        VDC=zeros(5,1);
    else
        VDC=A\(C*oldVc/dt+FGa);
    end
    Voc(j)=abs(VDC(4));
    oldVc=VDC;
    t=t+dt;
end
figure(5)
t=linspace(0,1,1000);
subplot(1,2,1),plot(t,Vinc);
title('Vin(c) vs. t');
xlabel('t');
ylabel('Vin(c)');
grid on
subplot(1,2,2),plot(t,Voc);
```

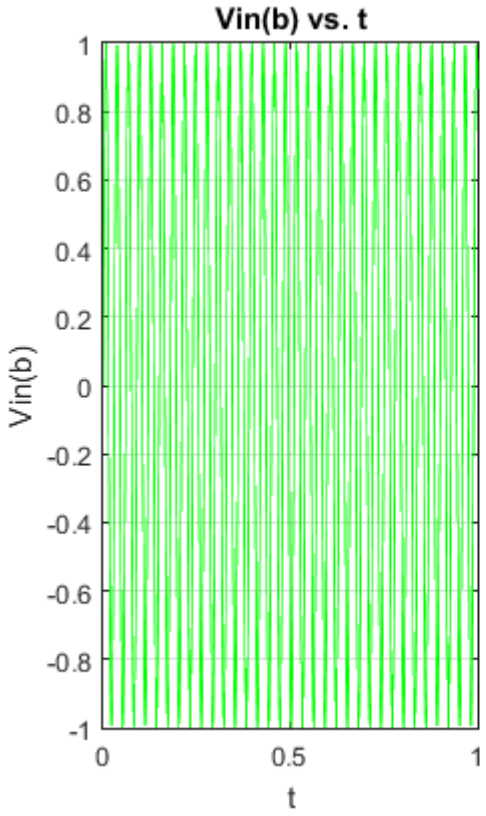
```
title('Vo(c) vs. t');

xlabel('t');

ylabel('Vo(c)');

grid on



n3=2^nextpow2(1000);

m5=fftshift(fft(Vinc,n3+1));

m6=fftshift(fft(Voc,n3+1));

f3=1/0.03*(-n3/2:n3/2)/n3;

figure(6)

subplot(1,2,1),semilogy(f3,abs(m5/n3));

title('Vin(c) in frequency domain');

xlabel('freq');

grid on

subplot(1,2,2),semilogy(f3,abs(m6/n3));

title('Vo(c) in frequency domain');

xlabel('freq');

grid on
```

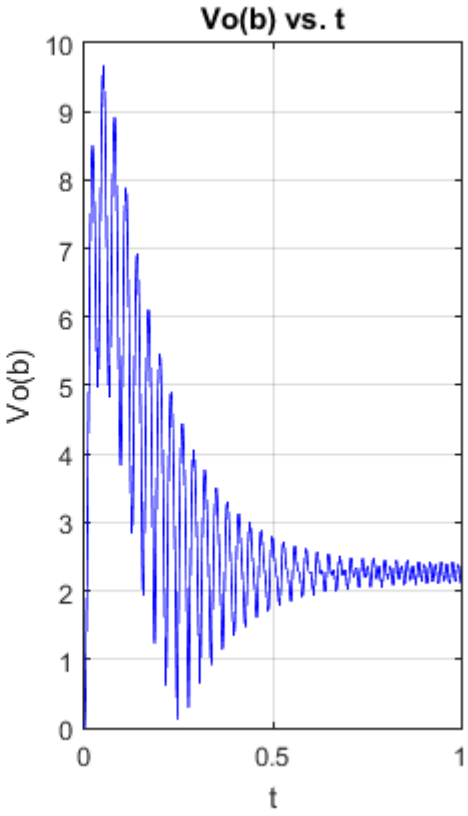

Vin(a) vs. t
Vin(a)
t
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.5
1

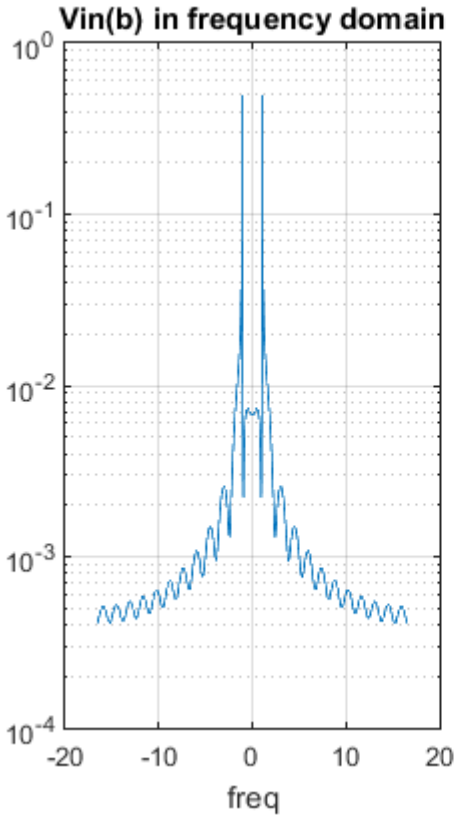

Vo(a) vs. t
Vo(a)
t
0
1
2
3
4
5
6
7
8
9
0
0.5
1

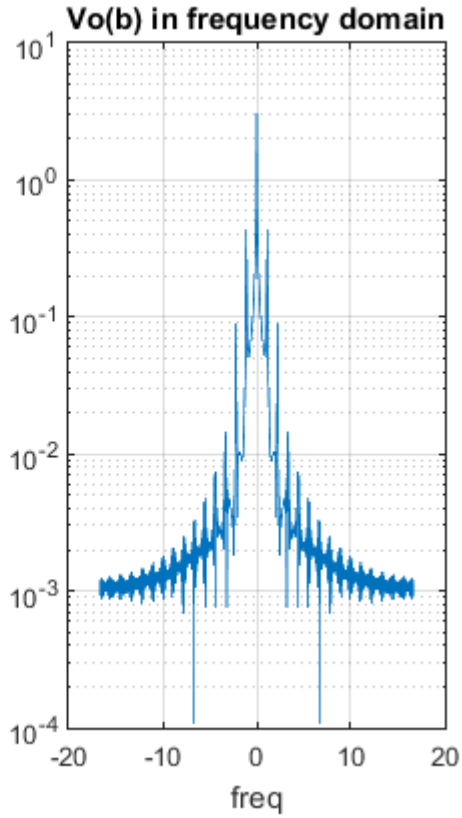

Vin(a) in frequency domain
freq
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
-20
-10
0
10
20

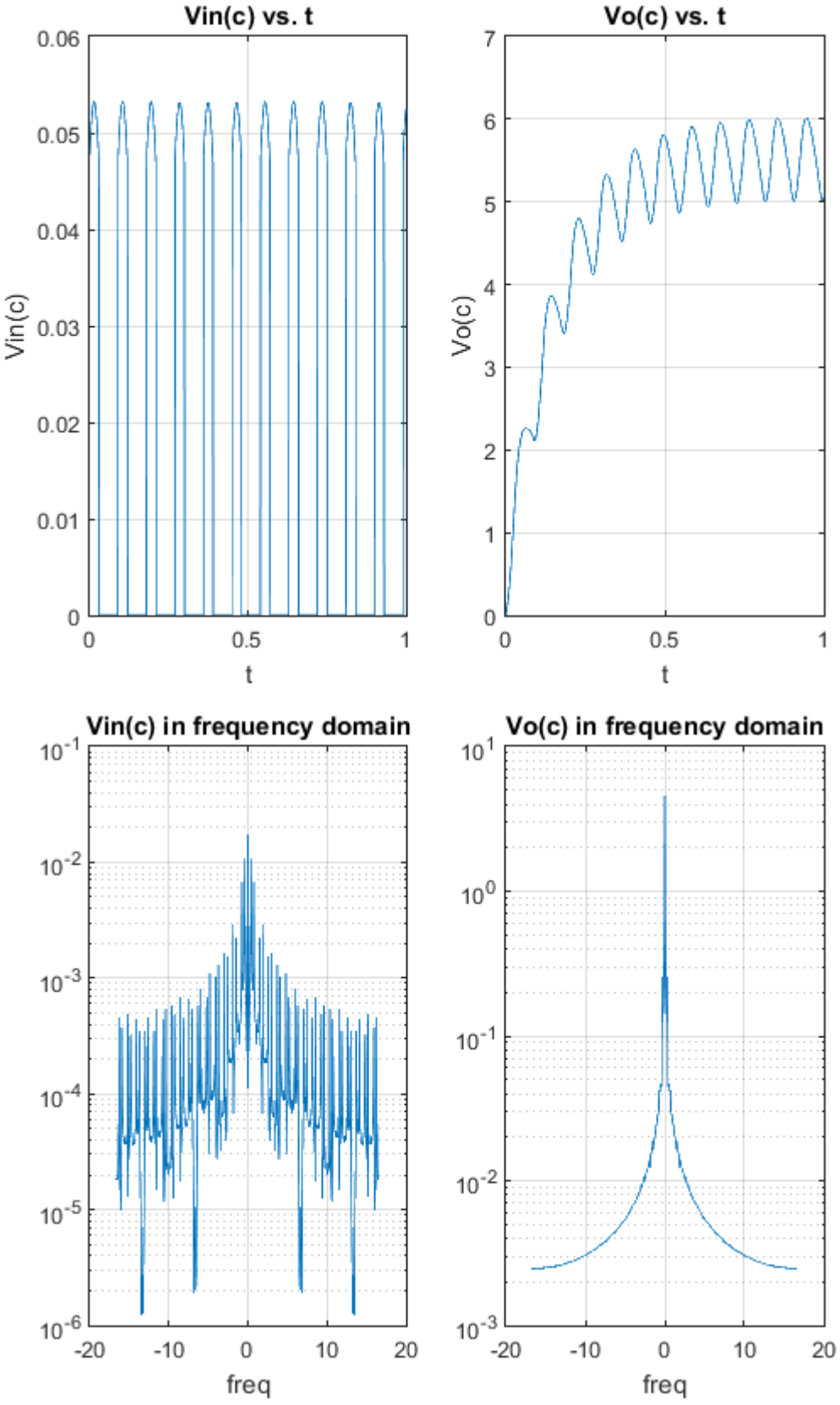

Vo(a) in frequency domain
freq
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
-20
-10
0
10
20


Vin(b) vs. t
Vin(b)
t
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.5
1


Vo(b) vs. t
Vo(b)
t
10
9
8
7
6
5
4
3
2
1
0
0
0.5
1


Vin(b) in frequency domain
freq
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
-20
-10
0
10
20


Vo(b) in frequency domain
freq
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
-20
-10
0
10
20



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