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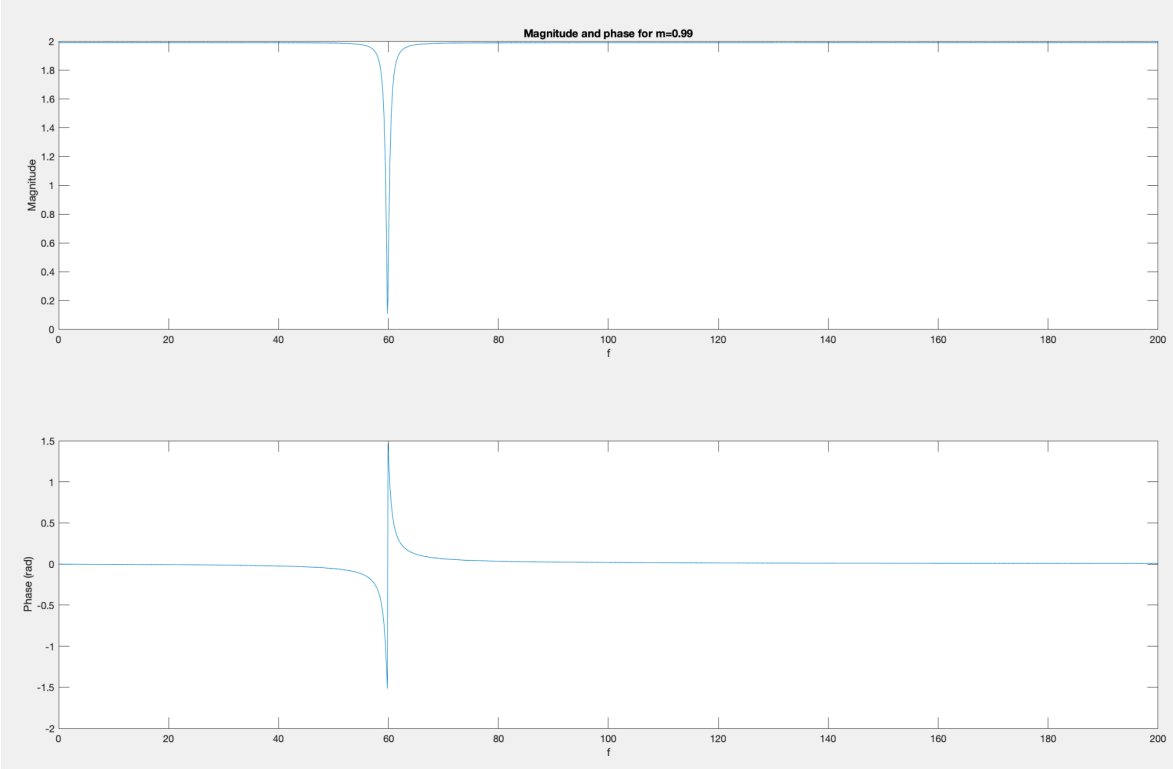
ece103L Thursday Section
Lab 7 report
Due: 6/8/2023

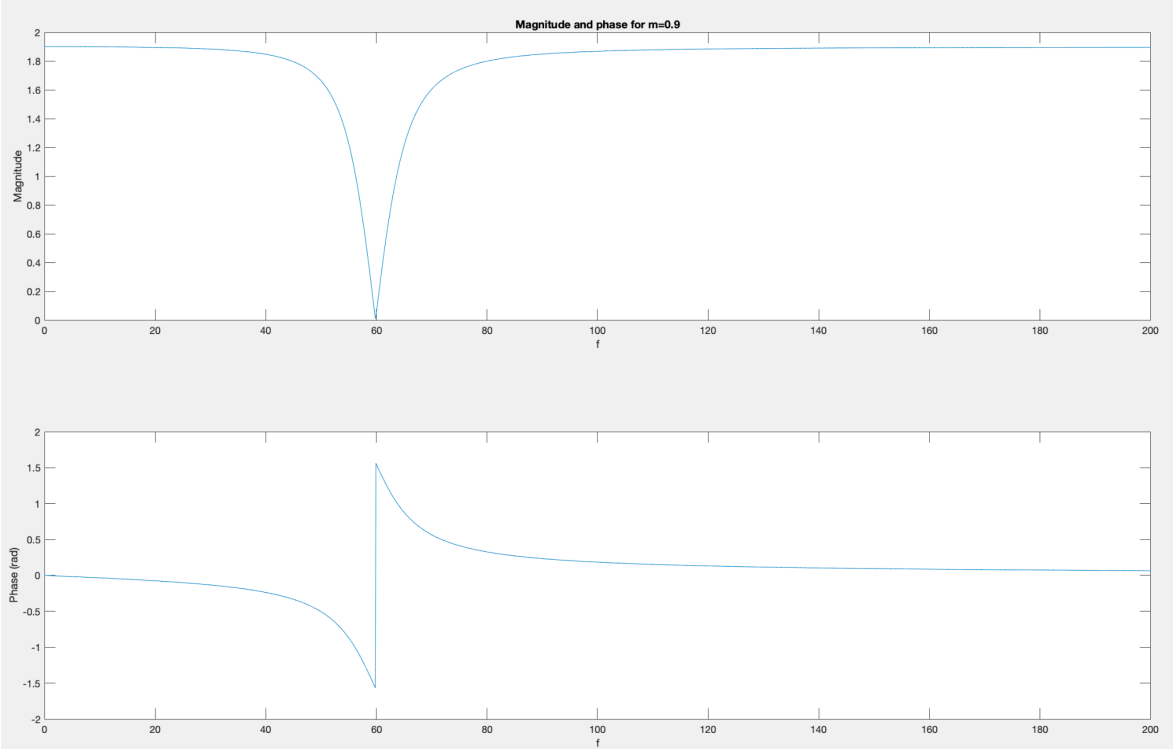
Part 1a)

Code:

```
m=[0.9,0.99];
R=10000;
C=133*10^(-9);
f=0:0.1:200;
w=2*pi*f;
H1=((1+m(1))*((2*i*w*R*C).^2+1))./((2*i*w*R*C).^2+4*(1-m(1))*i*w*R*C+1);
H2=((1+m(2))*((2*i*w*R*C).^2+1))./((2*i*w*R*C).^2+4*(1-m(2))*i*w*R*C+1);
figure
subplot(2,1,1)
plot(f,abs(H1))
title('Magnitude and phase for m=0.9')
xlabel('f')
ylabel('Magnitude')
subplot(2,1,2)
plot(f,angle(H1))
xlabel('f')
ylabel('Phase (rad)')
figure
subplot(2,1,1)
plot(f,abs(H2))
title('Magnitude and phase for m=0.99')
xlabel('f')
ylabel('Magnitude')
subplot(2,1,2)
plot(f,angle(H2))
xlabel('f')
ylabel('Phase (rad)')
```

Output:


Magnitude and phase for m=0.99
Magnitude
f
Phase (rad)
f

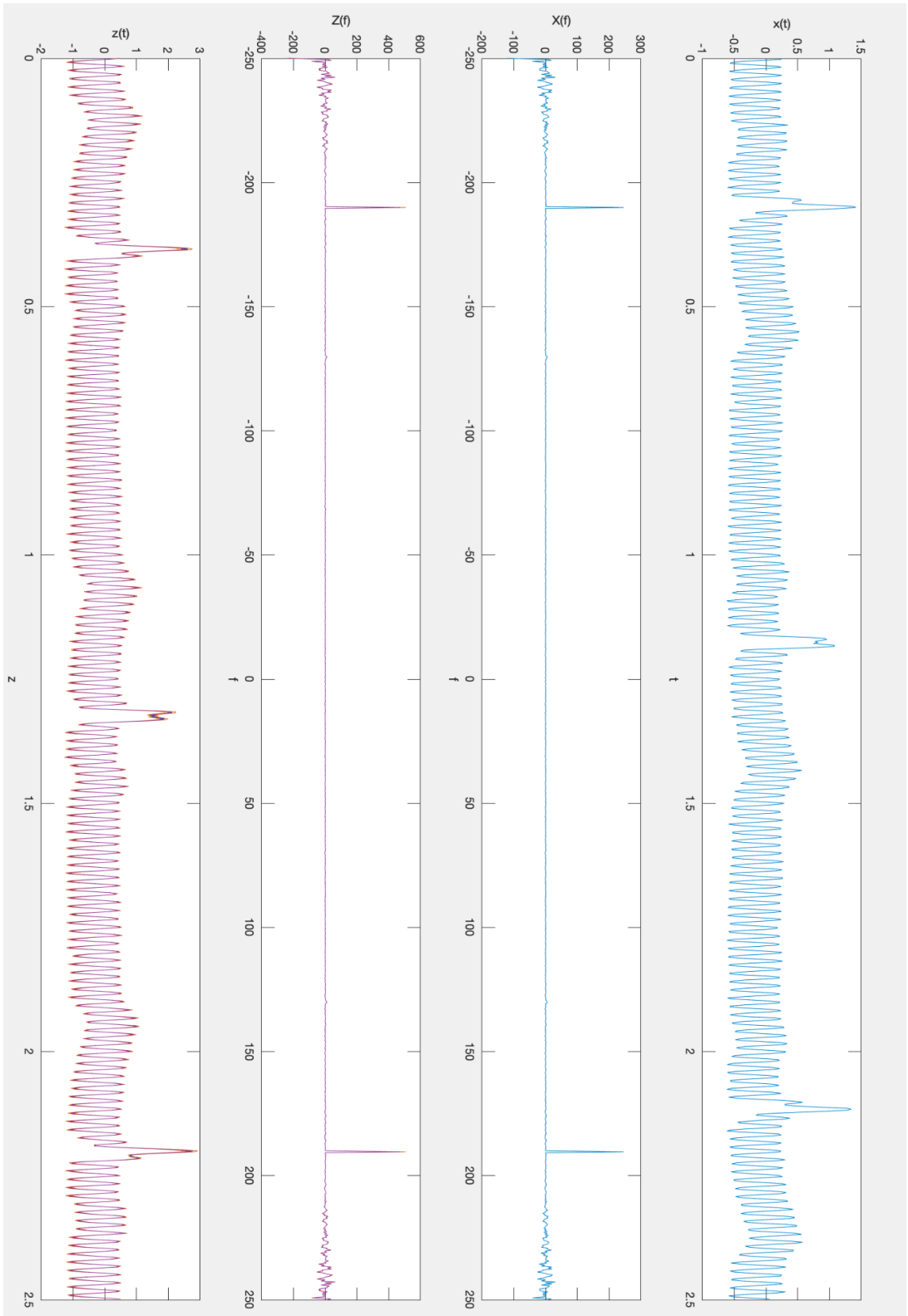

Magnitude and phase for m=0.9
Magnitude
f
Phase (rad)
f

Part 1b)

Code:

```
ecg_signal=load("ecg_signal.mat");
x=ecg_signal.ecg;
t=ecg_signal.t;
m=[0.8,0.9];
C=133*10^(-9);
R=10000;
N=length(x);
f= linspace(-250, 250, N);
w=2*pi*f;
H=((1+m(2))*((2*i*w*R*C).^2+1))./((2*i*w*R*C).^2+4*(1-m(2))*i*w*R*C+1);
X=fft(x);
Z=X'.*H;
z=ifft(Z);
subplot(4,1,1)
plot(t,x)
xlabel('t')
ylabel('x(t)')
subplot(4,1,2)
plot(f,X)
xlabel('f')
ylabel('X(f)')
subplot(4,1,3)
plot(f,Z)
xlabel('f')
ylabel('Z(f)')
subplot(4,1,4)
plot(t,z)
xlabel('z')
ylabel('z(t)')
```

Output:

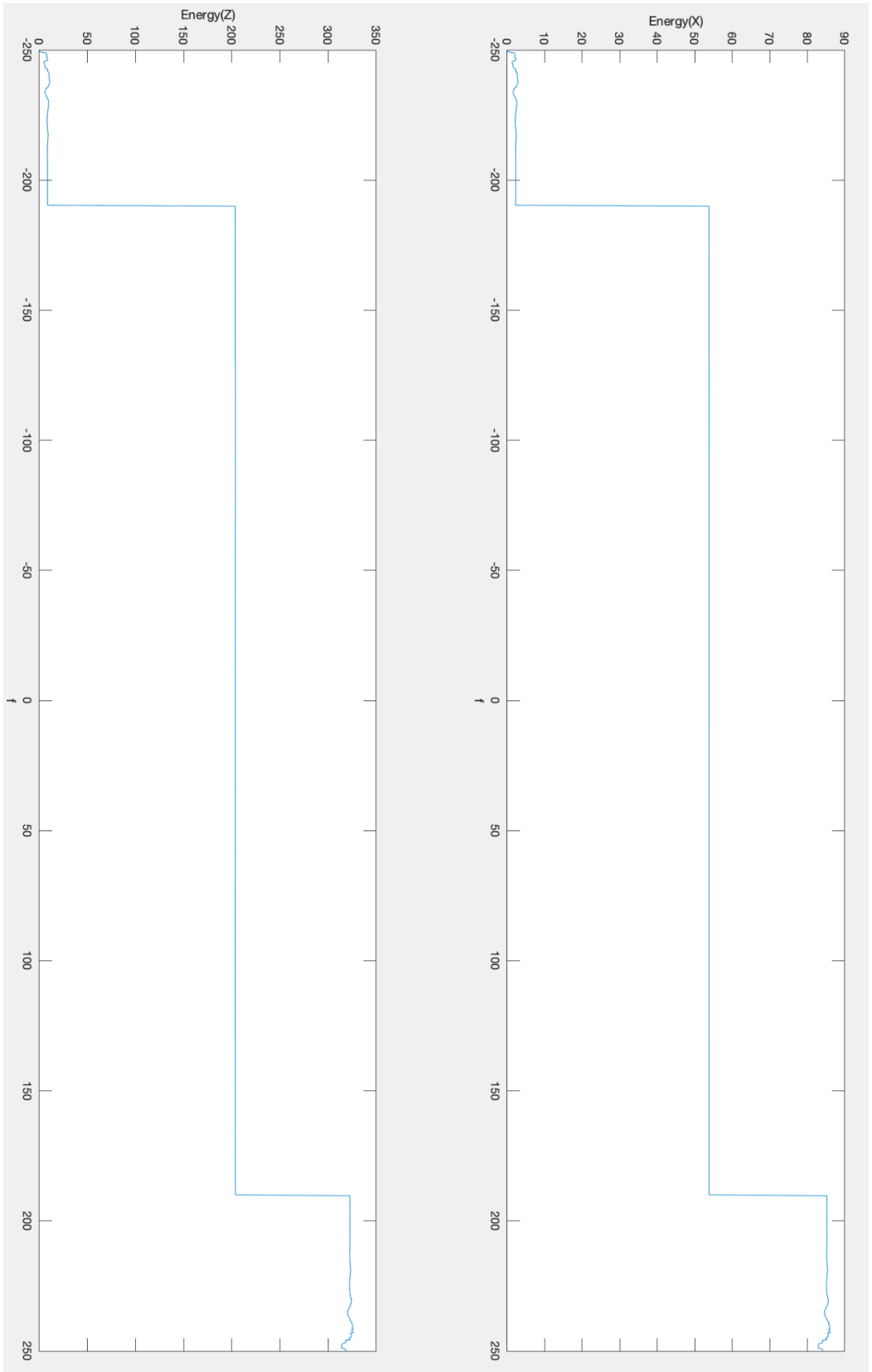


Part 2)

Code:

```
ecg_signal=load("ecg_signal.mat");
x=ecg_signal.ecg;
t=ecg_signal.t;
m=[0.8,0.9];
C=133*10^(-9);
R=10000;
N=length(x);
f= linspace(-250, 250, N);
w=2*pi*f;
H2=((1+m(2))*((2*i*w*R*C).^2+1))./((2*i*w*R*C).^2+4*(1-m(2))*i*w*R*C+1);
X=fft(x);
Z=X'.*H2;
z=ifft(Z);
Energyx(1)=0;
Energyz(1)=0;
for i=2:N
Energyx(i)=Energyx(i-1)+(X(i))^2;
Energyz(i)=Energyz(i-1)+(Z(i))^2;
end
subplot(2,1,1)
plot(f,abs(Energyx/N))
xlabel('f')
ylabel('Energy(X)')
subplot(2,1,2)
plot(f,abs(Energyz/N))
xlabel('f')
ylabel('Energy(Z)')
```

Output:

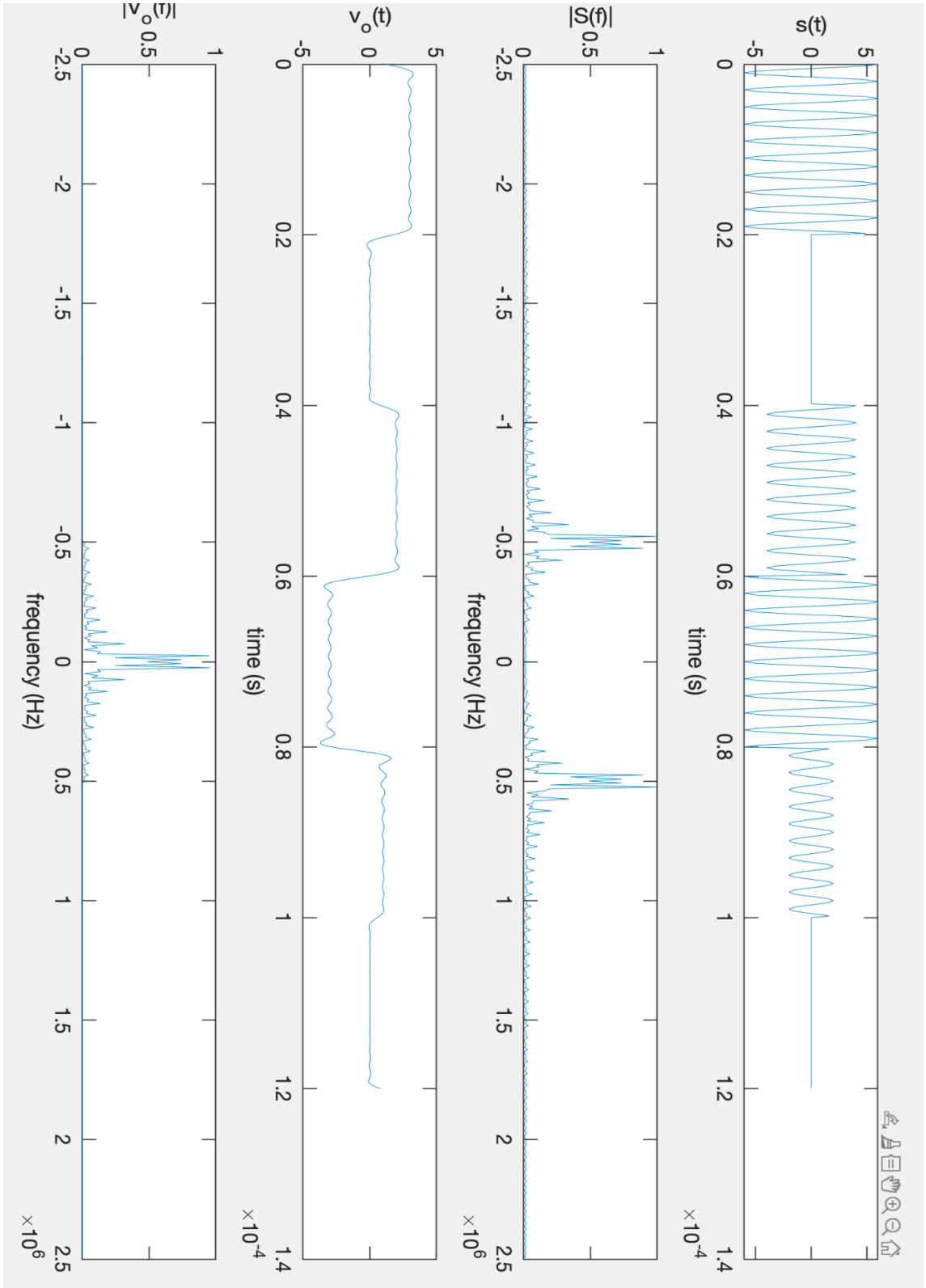


Part 3)

Code:

```
fm  = 5e4;
fc = 5e5;
tc = 1/10/fc;
t = 0:tc:6/fm;
m_key = [6, 0, 4, -6, 2];
m = zeros(size(t));
for i = 1:length(m_key)
m(find((t>=(i-1)/fm) & (t<i/fm))) = m_key(i) ;
end
s = m.*cos(2*pi*fc*t);
v = s.*cos(2*pi*fc*t+pi/3);
N = length(t);
frequency = (-(N-1)/2:N/2)*1/tc/N;
v_fft = zeros(size(v));
w_fft = fftshift(fft(v));
for i = 1:length(frequency)
 if(abs(frequency(i))<5e5)
 v_fft(i) = 2*w_fft(i);
 end
end
vo = ifft(ifftshift(v_fft));
figure
subplot(4, 1, 1)
plot(t, s)
xlabel('time (s)')
ylabel('s(t)')
set(gca, "linewidth", 1, "fontsize", 18);
subplot(4, 1, 2)
plot(frequency,fftshift(abs(fft(s)) )/N)
xlabel('frequency (Hz)')
ylabel('|S(f)|')
set(gca, "linewidth", 1, "fontsize", 18);
S  = axes( 'visible', 'off', 'title', 'Modulated signal');
```

Output:


s(t)
time (s)
×10^-4
|S(f)|
frequency (Hz)
×10^6
v_o(t)
time (s)
×10^-4
|V_o(f)|
frequency (Hz)
×10^6