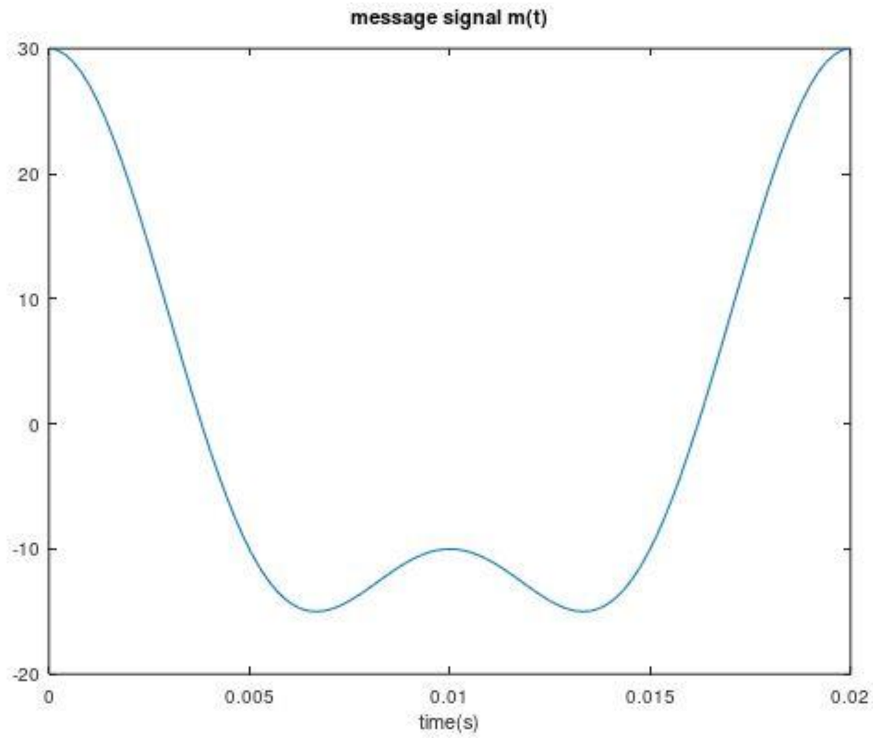
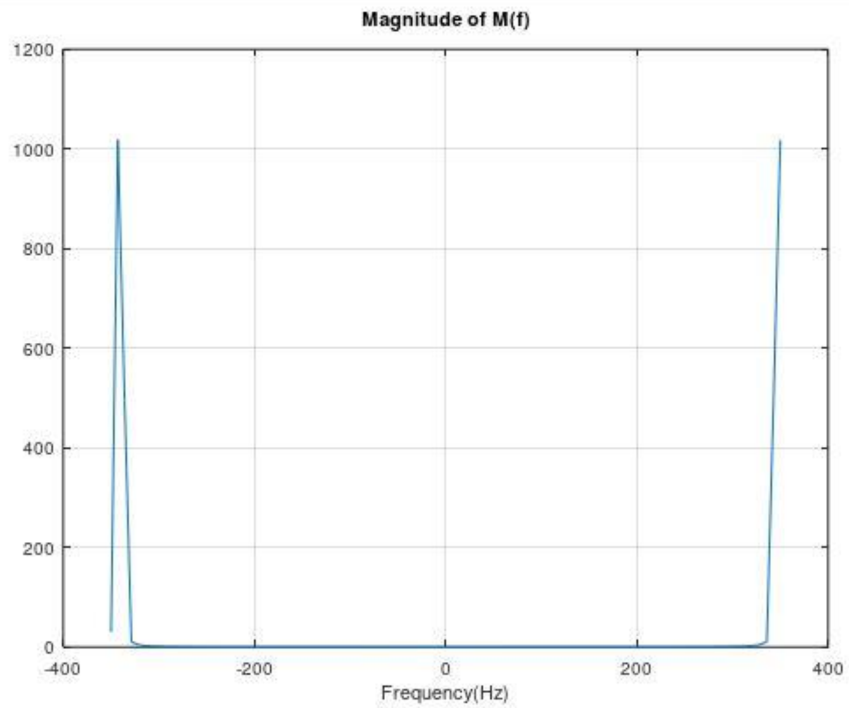
ELM361 – MATLAB PROJESI

Abdürrahim Deniz Kumbaracı

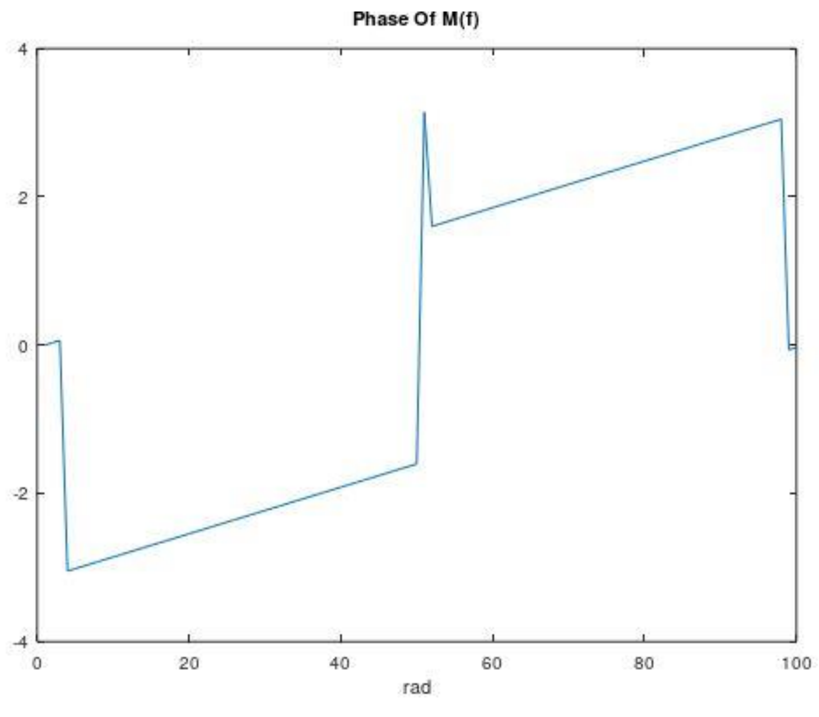
151024008

1)



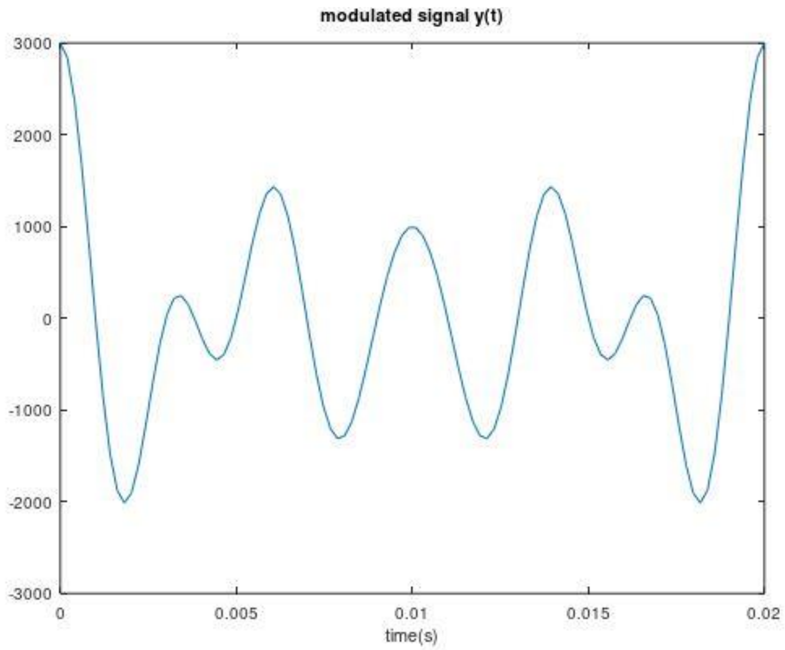


Magnitude of M(f)
1200
1000
800
600
400
200
0
-400
-200
0
200
400
Frequency(Hz)

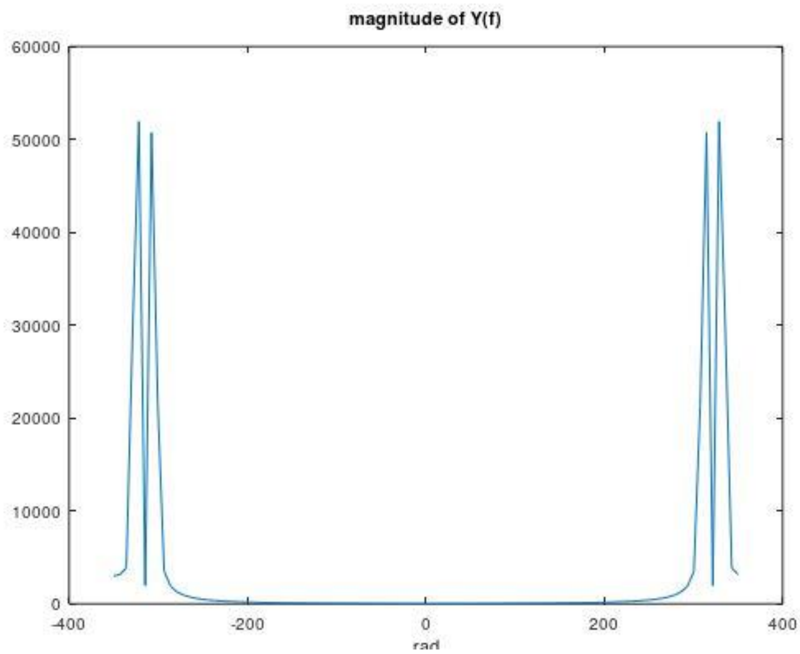


Phase Of M(f)
4
2
0
-2
-4
0
20
40
60
80
100
rad

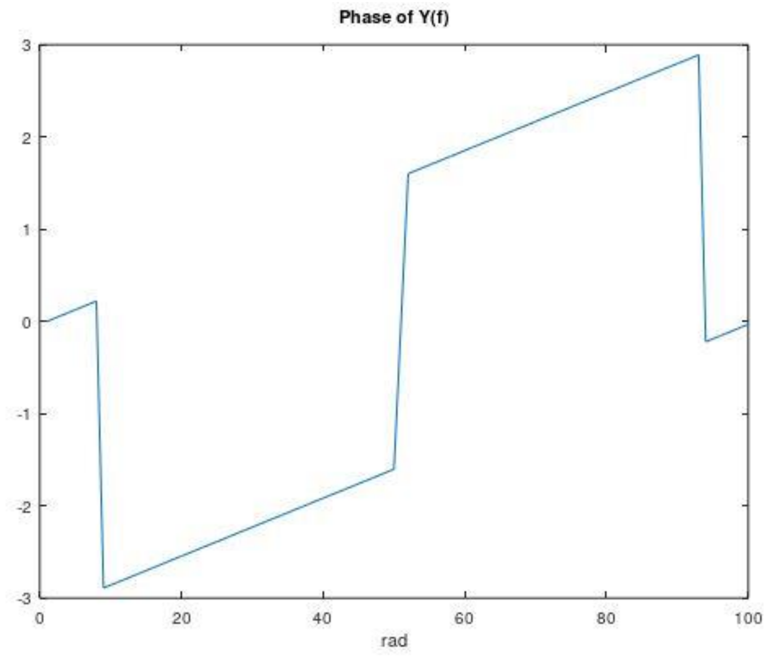
2)



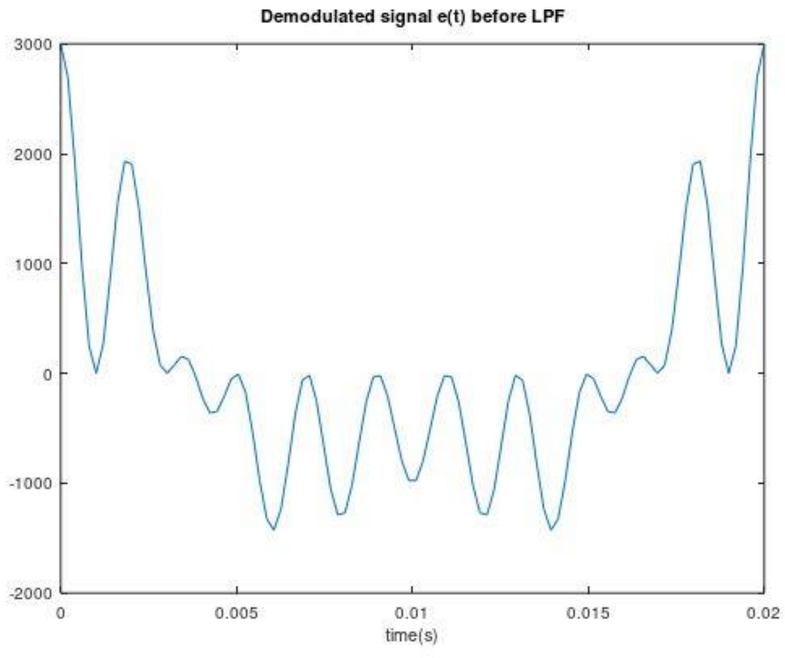
modulated signal y(t)
3000
2000
1000
0
-1000
-2000
-3000
0
0.005
0.01
0.015
0.02
time(s)

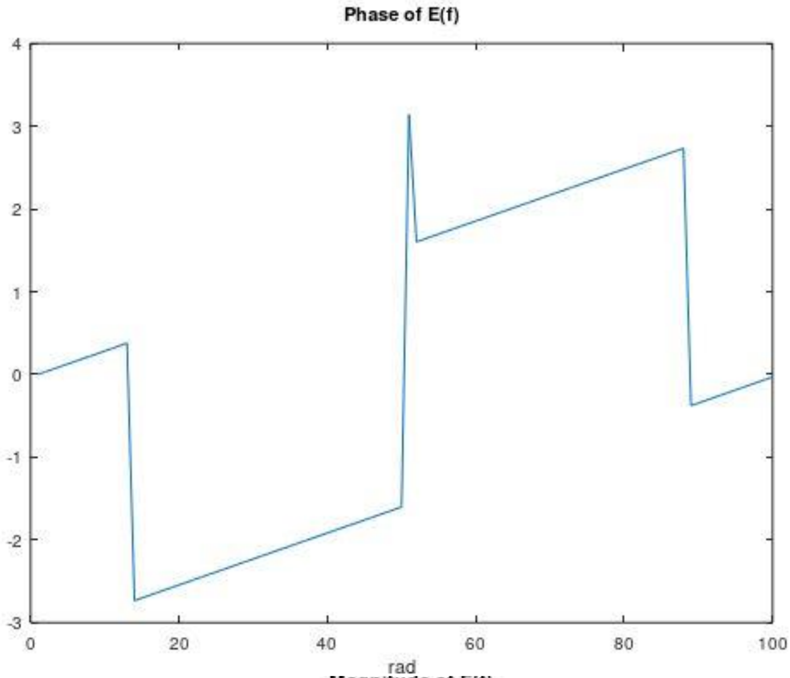


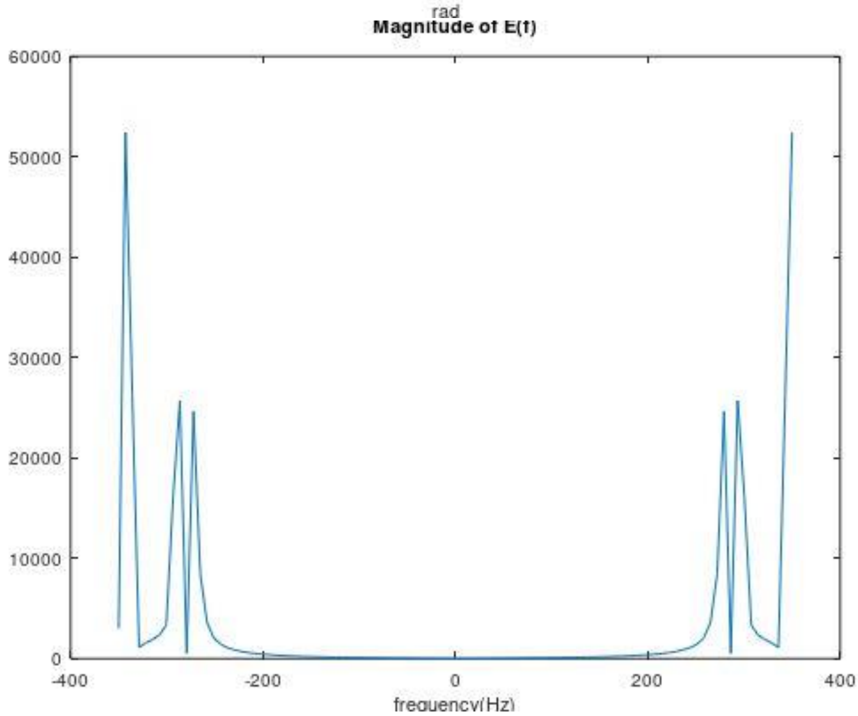
magnitude of Y(f)
60000
50000
40000
30000
20000
10000
0
-400
-200
0
200
400
rad


Phase of Y(f)
3
2
1
0
-1
-2
-3
0
20
40
60
80
100
rad

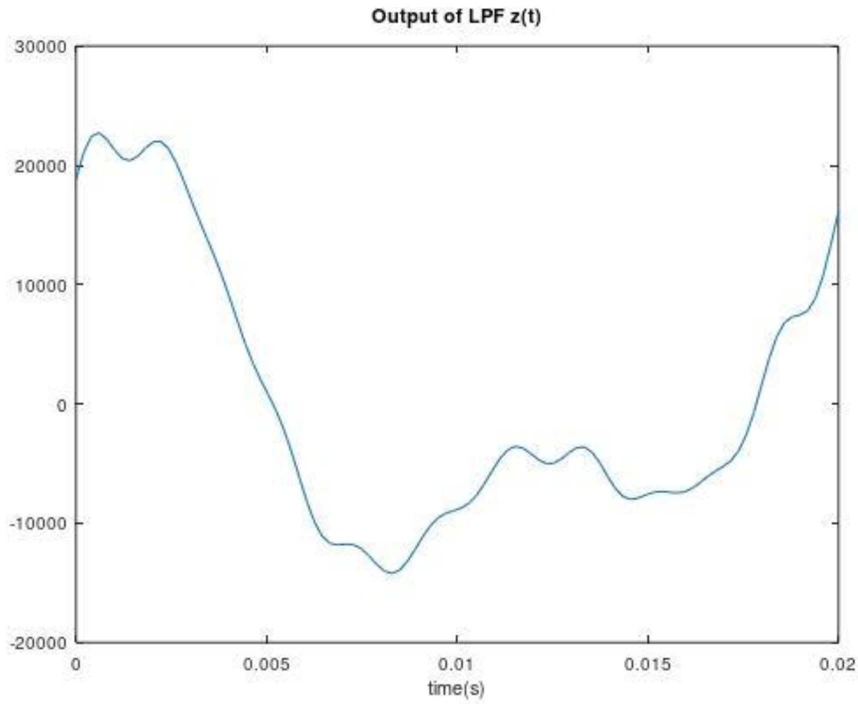
3)

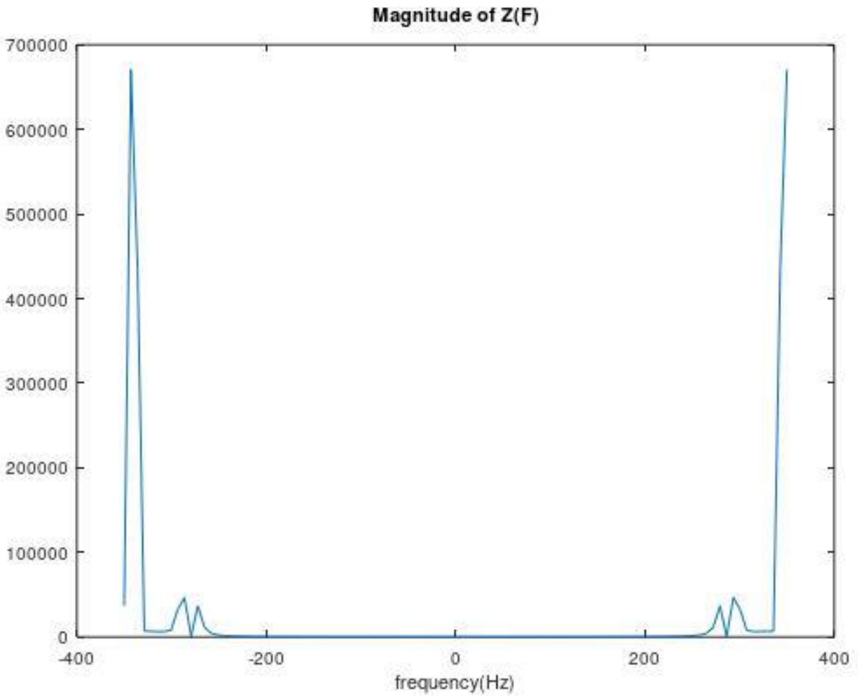

Demodulated signal e(t) before LPF
3000
2000
1000
0
-1000
-2000
0
0.005
0.01
0.015
0.02
time(s)

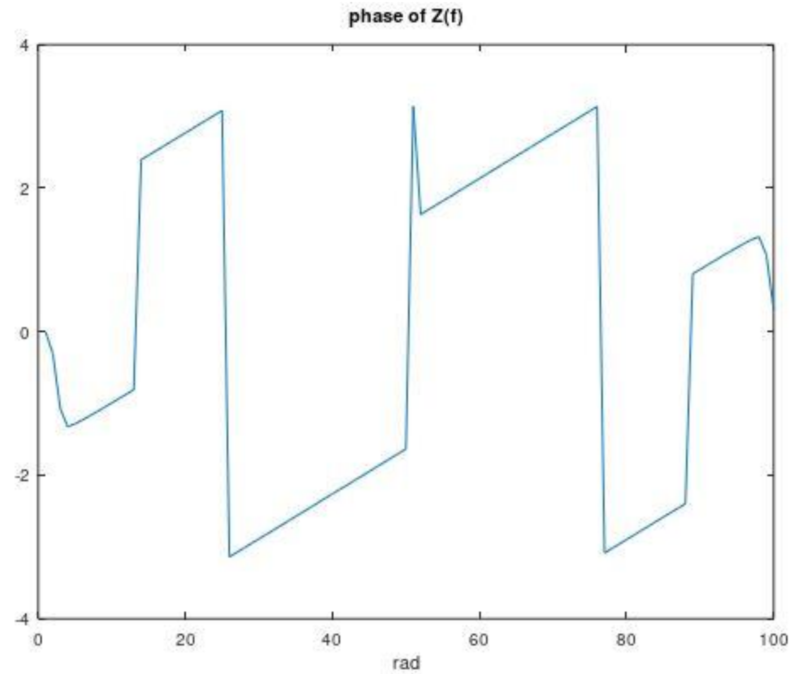

Phase of E(f)
4
3
2
1
0
-1
-2
-3
0
20
40
60
80
100
rad


Magnitude of E(f)
60000
50000
40000
30000
20000
10000
0
-400
-200
0
200
400
frequency(Hz)

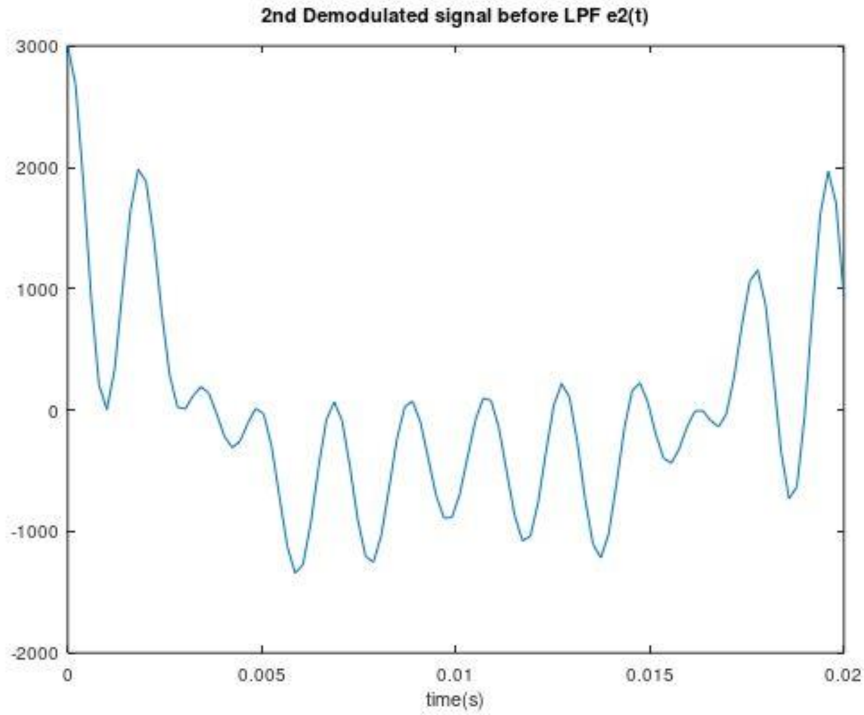
4)

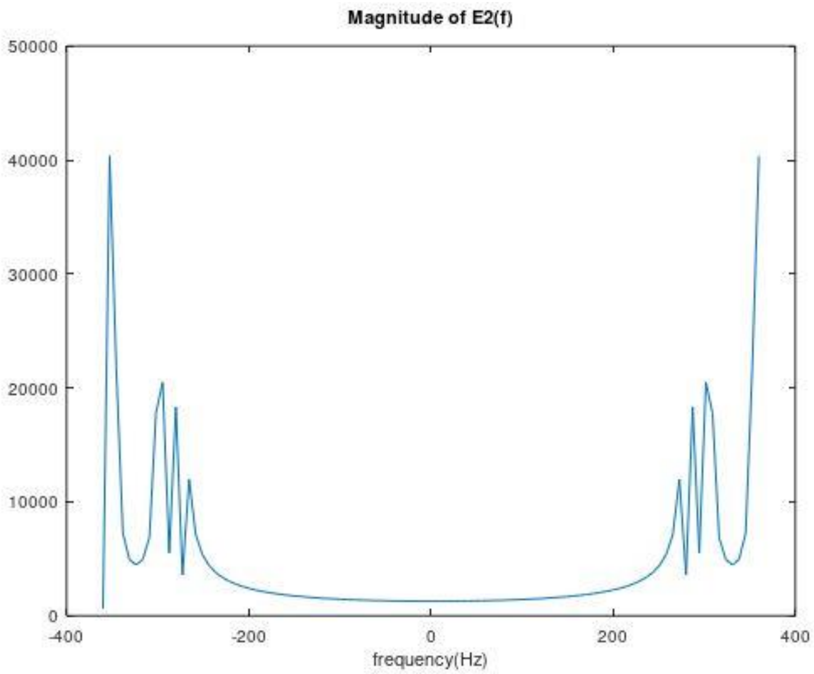

Output of LPF z(t)
30000
20000
10000
0
-10000
-20000
0
0.005
0.01
0.015
0.02
time(s)


Magnitude of Z(F)
700000
600000
500000
400000
300000
200000
100000
0
-400
-200
0
200
400
frequency(Hz)

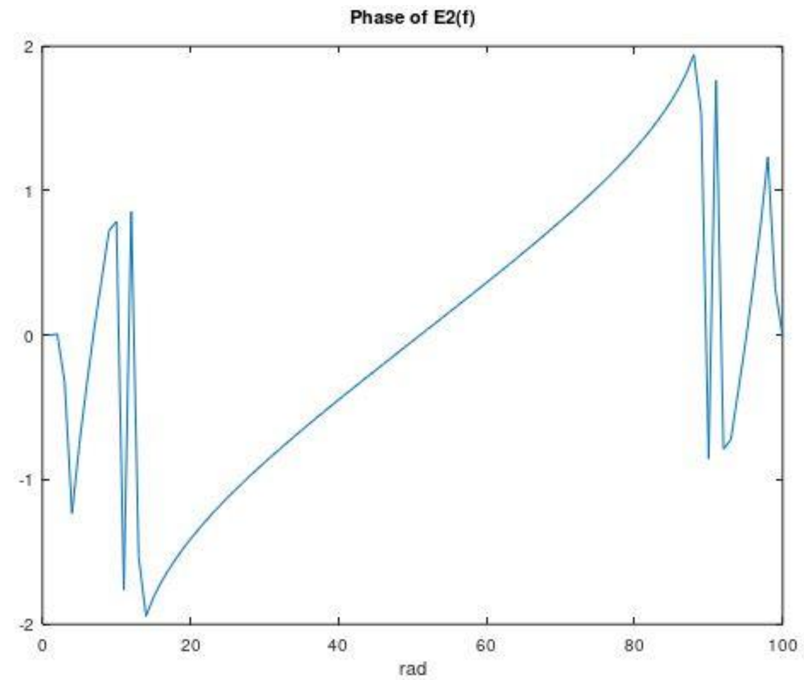

phase of Z(f)
4
2
0
-2
-4
0
20
40
60
80
100
rad

5)

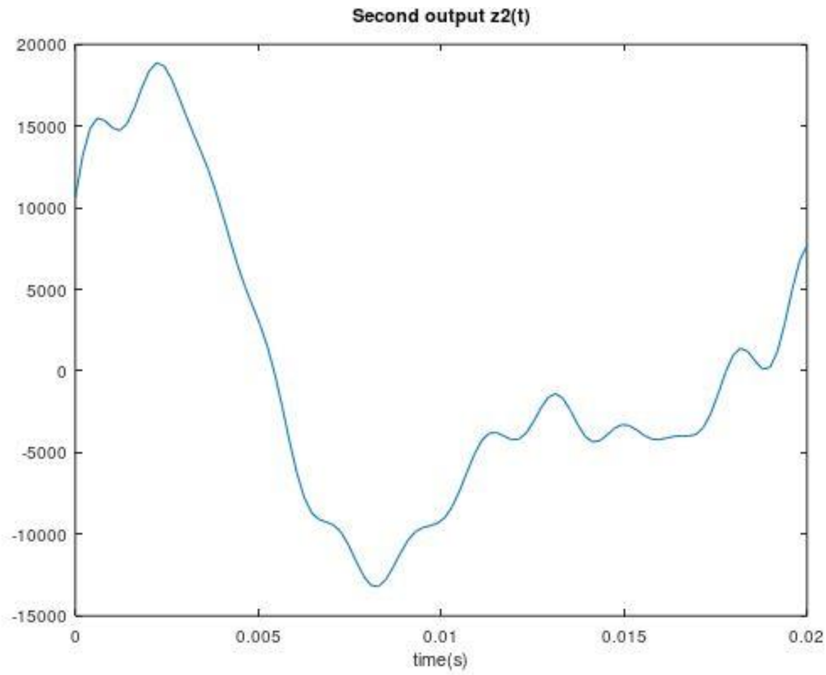

2nd Demodulated signal before LPF e2(t)
3000
2000
1000
0
-1000
-2000
0
0.005
0.01
0.015
0.02
time(s)

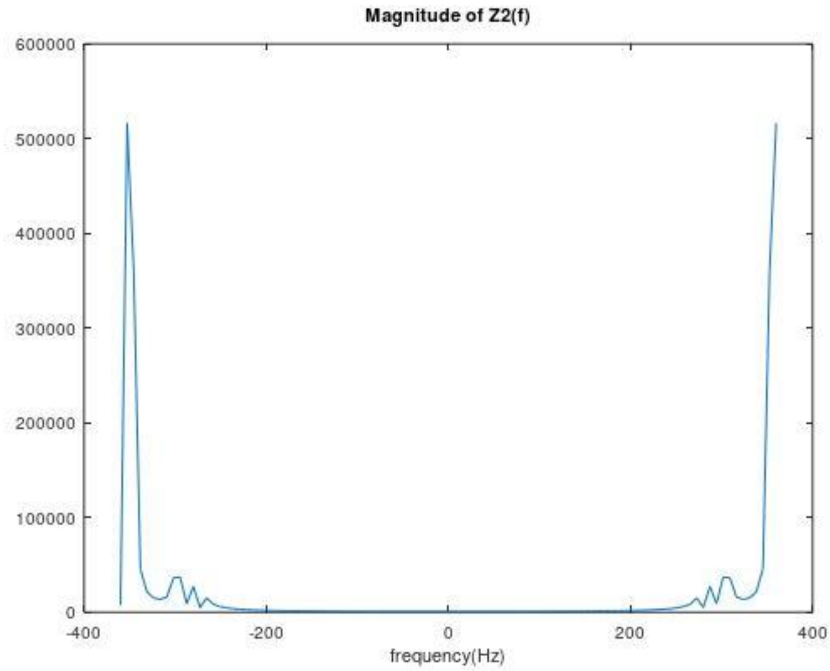


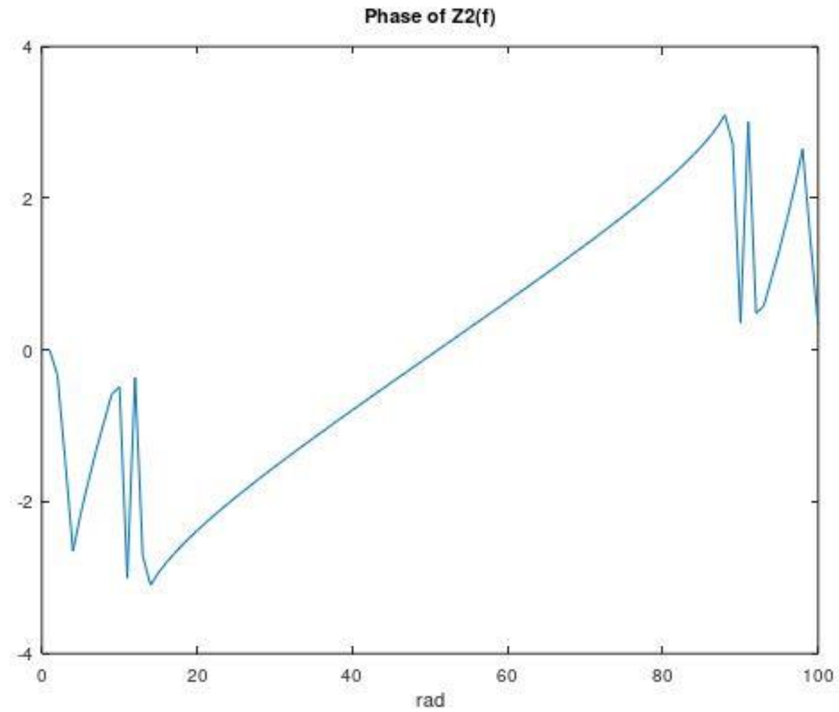
Magnitude of E2(f)
50000
40000
30000
20000
10000
0
-400
-200
0
200
400
frequency(Hz)



Phase of E2(f)
2
1
0
-1
-2
0
20
40
60
80
100
rad


Second output z2(t)
20000
15000
10000
5000
0
-5000
-10000
-15000
0
0.005
0.01
0.015
0.02
time(s)


Magnitude of Z2(f)
600000
500000
400000
300000
200000
100000
0
-400
-200
0
200
400
frequency(Hz)



Note that on the graphs,fft algorithms roughly assigned large values to estimate dirac functions and made so with actual rising continious values.So it resulted both in amplitude and frequency shift and affected the results dramatically.

6)

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$m(t) = 20\cos(100\pi t) + 10\cos(200\pi t)$, $c(t) = 100\cos(500\pi t)$

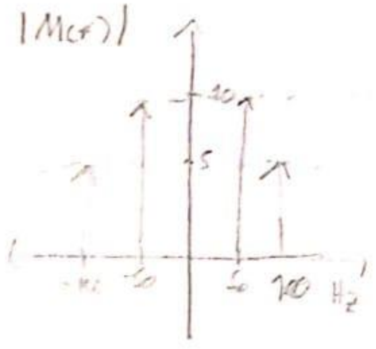
$\Rightarrow y(t) = m(t)\cdot c(t) \Rightarrow Y(f) = M(f) \circledast C(f)$

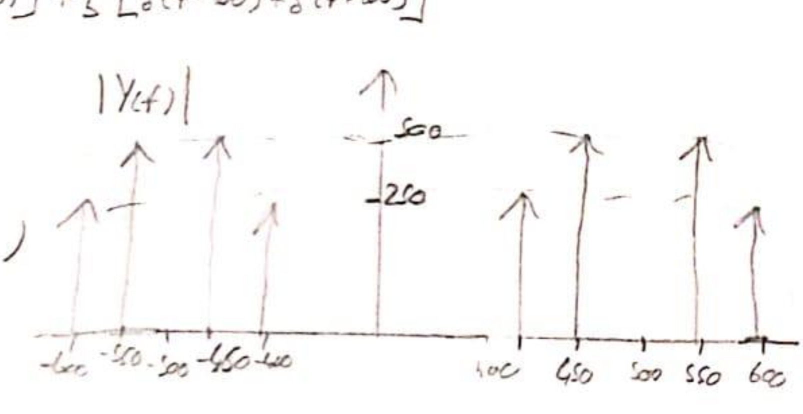
modulator; $m(t) \rightarrow \otimes \xrightarrow{y(t)}$, $c(t)$ demodulator; $\xrightarrow{y(t)} \otimes \xrightarrow{e(t)} \boxed{LPF} \xrightarrow{z(t)}$, $\tilde{c}(t)$

due to modulation property of fourier transform;

$$Y(f) = \frac{1}{2}\cdot 100\cdot\left[M(f-500) + M(f+500)\right]$$

$$M(f) = 10\left[\delta(f-50) + \delta(f+50)\right] + 5\left[\delta(f-100) + \delta(f+100)\right]$$



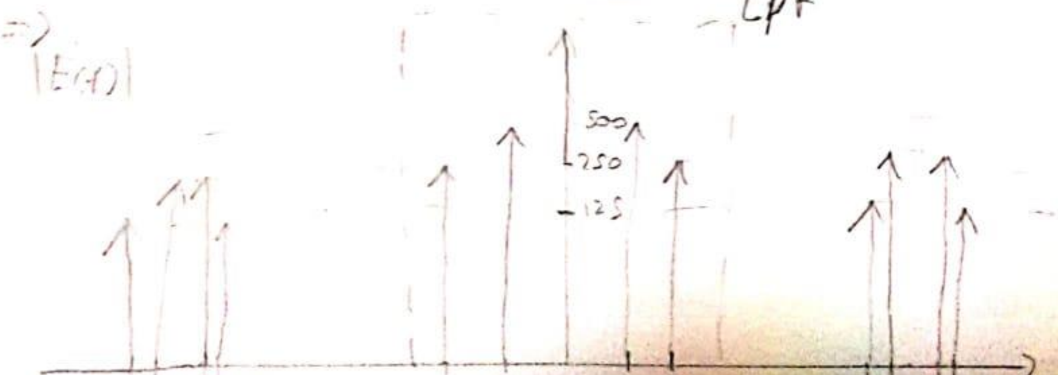


Let's look at the case $\tilde{c}(t) = \cos(500\pi t)$;
Again, due to modulation property of fourier transformation;

$$E(f) = \frac{1}{2}\left[Y(f-500) + Y(f+500)\right] = \frac{50}{2}\left[M(f-1000) + M(f) + M(f) + M(f+1000)\right] \quad \text{eq. } (1)$$

cutoff = 100Hz LPF

$\Rightarrow$

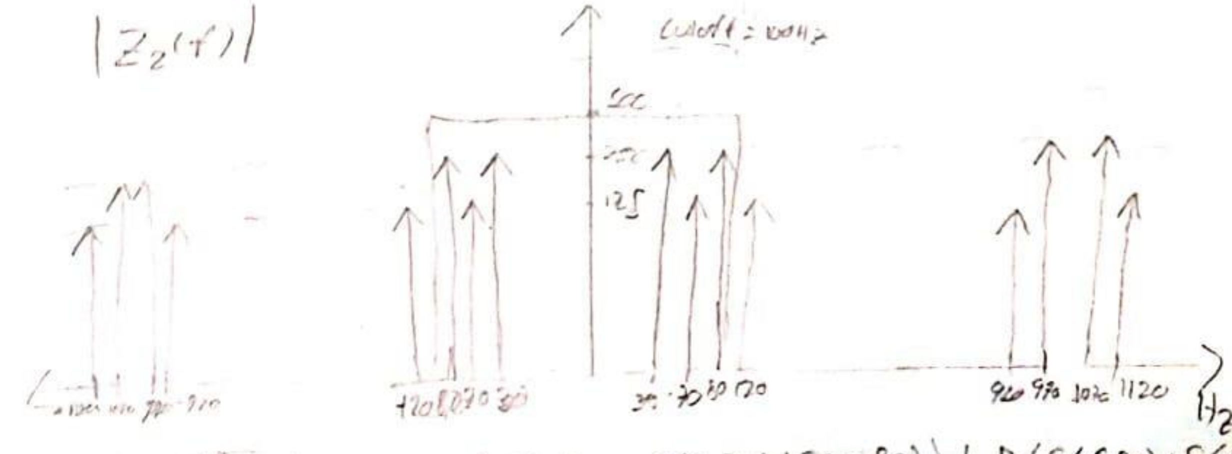


$\Rightarrow Z(f) = 50M(f) \Rightarrow z(t) = 50m(t)$ (due to linearity of fourier).

Now lets look at the case for $E(t) = \cos(520\pi t)$, if we replace the modulation values for eq(B);

$E_2(f) = \frac{50}{2}\left[M(f-1020) + M(f+970) + M(f-20) + M(f+1020)\right]$

Let's plot the spectrum again;



$Z_2(f) = 25\left[10(\delta(f+30) + \delta(f+80) + \delta(f-30) + \delta(f-80)) + 5(\delta(f-80) + \delta(f+80))\right]$

$Z_2(f) \neq A.M(f) \Rightarrow$ System is not distortionless

Comments: As we can see, wrong demodulation frequency caused whole message to be distorted, when we did this communication example at the MATLAB, fft algorithm also caused some shift in the frequency and we were not able to obtain m(t), distortionless also on MATLAB enviroment.

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KODLAR;

```
>> t=linspace(0,0.02);
>> mt=(20*cos(100*pi*t))+(10*cos(200*pi*t));
>> ct=100*cos(500*pi*t);
>> cpt=cos(500*pi*t);
>> cpt2=cos(520*pi*t);
>> f1=linspace(-350,350);
>> f2=linspace(-360,360);
>> yt=ct.*mt;
>> lpf=sinc(200*t);
>> et=yt.*cpt;
>> LPF=fft(lpf);
>> Ef=fft(et);
>> Zf=Ef.*LPF;
>> zt=ifft(Zf);
>> et2=yt.*cpt2;
>> Ef2=fft(et2);
>> Zf2=Ef2.*LPF;
>> zt2=ifft(Zf2);
>> Mf=fft(mt);
>> Cf=fft(ct);
>> Yf=fft(yt);
>> plot(f1,abs(Mf));
>> grid;
>> title('Magnitude of M(f)');
>> xlabel('Frequency(Hz)');
>> plot(t,yt);
>> title('modulated signal y(t)');
>> xlabel('time(s)');
>> plot(t,mt);
>> title('message signal m(t)');
```

```
>> xlabel('time(s)');
>> plot(angle(Yf));
>> title('Phase of Y(f)');
>> xlabel('rad');
>> plot(angle(Mf));
>> xlabel('rad');
>> title('Phase Of M(f)');
>> plot(f1,abs(Yf));
>> title('magnitude of Y(f)');
>> xlabel('frequency(Hz)');
>> plot(t,et);
>> title('Demodulated signal e(t) before LPF');
>> xlabel('time(s)');
>> plot(f1,abs(Ef));
>> title('Magnitude of E(f)');
>> xlabel('frequency(Hz)');
>> plot(f1,angle(Ef));
>> title('Phase of E(f)');
>> xlabel('rad');
>> plot(f2,abs(Ef2));
>> title('Magnitude of E2(f)');
>> xlabel('frequency(Hz)');
>> plot(angle(Ef2));
>> title('Phase of E2(f)');
>> xlabel('rad');
>> plot(angle(Ef));
>> title('Phase of E2(f)');
>> xlabel('rad');
>> title('Phase of E(f)');
>> plot(t,et2);
>> title('2nd Demodulated signal before LPF e2(t)');
```

```
>> xlabel('time(s)');

>> plot(t,zt);

>> title('Output of LPF z(t)');

>> xlabel('time(s)');

>> plot(f1,abs(Zf));

>> title('Magnitude of Z(F)');

>> xlabel('frequency(Hz)');

>> plot(angle(Zf));

>> title('phase of Z(f)');

>> xlabel('rad');

>> plot(t,zt2);

>> title('Second output z2(t)');

>> xlabel('time(s)');

>> plot(f2,abs(Zf2));

>> title('Magnitude of Z2(f)');

>> xlabel('frequency(Hz)');

>> plot(angle(Zf2));

>> title('Phase of Z2(f)');

>> xlabel('rad');
```