Communication Lab
Assignment2

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181EC155

Lab 6

Prelab questions

1)Why modulation is an essential process of communication system?

Modulation helps to transmit signals to long distances without interference, ease transmission of baseband signals, provide noise immunity, reduce antenna height. So, they are very essential for communication system.

2. Explain Block diagram of Communication system?

Information source produces the message to be sent. Input transducer is used to convert these signals into electrical signals. Transmitter does some signal processing like modulation and amplification to transmit the signal efficiently. Noises gets added in the channel. The received signal is processed by the receiver to recover original signal and converted to the format desired by the destination.

3. Explain need for modulation?

- Reduces size of antenna
- Provides noise immunity
- Helps to transmit signal over very long distance

4. Define Amplitude modulation?

Modulation of the amplitude of a carrier wave in accordance with the strength of the message signal.

5. How carrier is differing from message?

Carrier wave is of higher frequency than the message signal.

Post lab questions

1. What are the distortions that are likely to be present in the demodulated output when diode detector is used?

Saw tooth distortion

2. Explain how negative peak clipping occurs in the demodulated signal when diode detector is used?

When diode detector is used, since a diode conducts only during forward bias, negative peaks are automatically clipped off based the bias of the diode.

3. Explain under modulation, 100% modulation, over modulation?

Under modulation – Modulation index < 1 100% modulation - Modulation index $= 1$ Over modulation - Modulation index > 1

4. Explain High level modulation?

Modulation is done at higher power of carrier and modulating signals.

5. Write the formulae to calculate practical modulation index?

Modulation index = Modulation amplitude / Carrier amplitude

Lab6 DSB Modulation

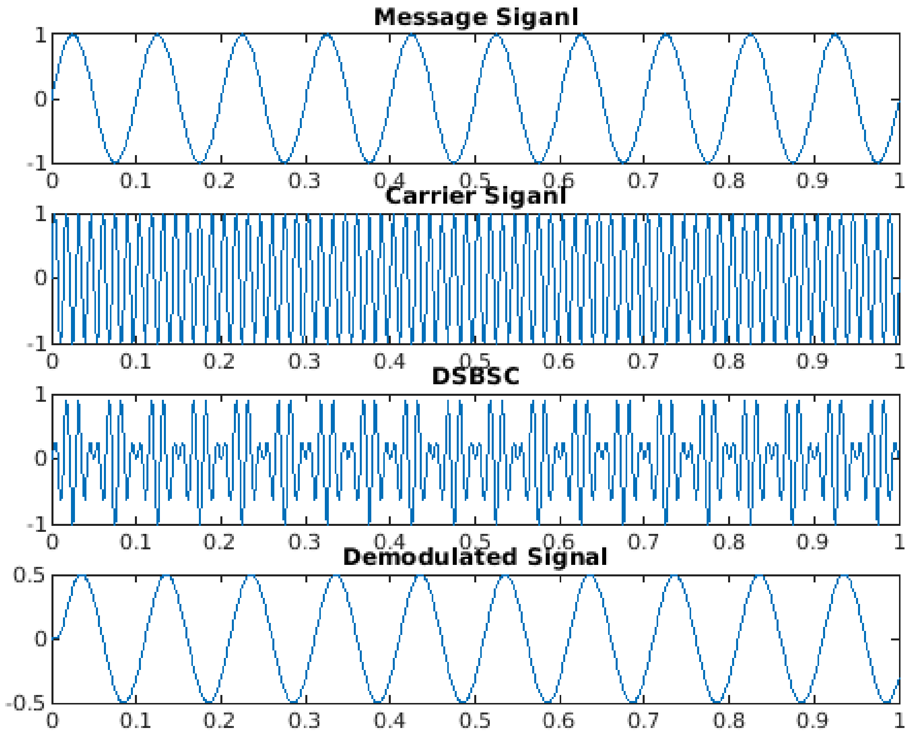
```
clc;
close all;
t=[0:0.001:1];

f1=10;
m=sin(2*pi*f1*t);
subplot(4,2,[1,2]);
plot(t,m);
title('Message Siganl');

f2=70;
c=sin(2*pi*f2*t);
subplot(4,2,[3,4]);
plot(t,c);
title('Carrier Siganl');

s=m.*c;
subplot(4,2,[5,6]);
plot(t,s);
title('DSBSC');

s1=s.*c;
[b,a]=butter(5,0.1);
s2=filter(b,a,s1);
subplot(4,2,[7,8]);
plot(t,s2);
title('Demodulated Signal');
```



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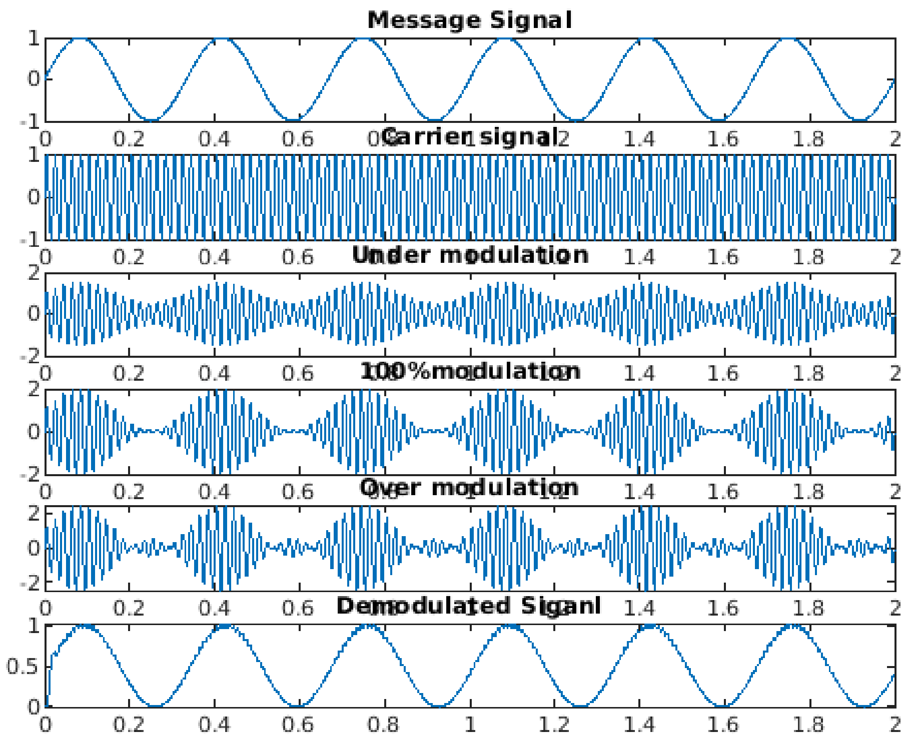
Lab6 Modulation

```
clc;
close all;

t=[0:0.001:2];
f1=3;
ms = sin(2*pi*f1*t);
subplot(6,2,[1,2]);
plot(t,ms);
title('Message Signal');

f2=50;
cs = sin(2*pi*f2*t);
subplot(6,2,[3,4]);
plot(t,cs);
title('Carrier signal');

%Under Modulation
m1=0.5;  %Modulation factor
s1=(1+(m1*ms)).*cs;
subplot(6,2,[5,6]);
plot(t,s1);
title('Under modulation');

%100% Modultaion
m2=1;
s2=(1+(m2*ms)).*cs;
subplot(6,2,[7,8]);
plot(t,s2);
title('100%modulation');

%Over Modultaion
m3=1.5;
s3=(1+(m3*ms)).*cs;
subplot(6,2,[9,10]);
plot(t,s3);
title('Over modulation');
s5=s2.*cs;

[b,a]=butter(5,0.1);
s4=filter(b,a,s5);
subplot(6,2,[11,12]);
plot(t,s4);
title('Demodulated Siganl');
```



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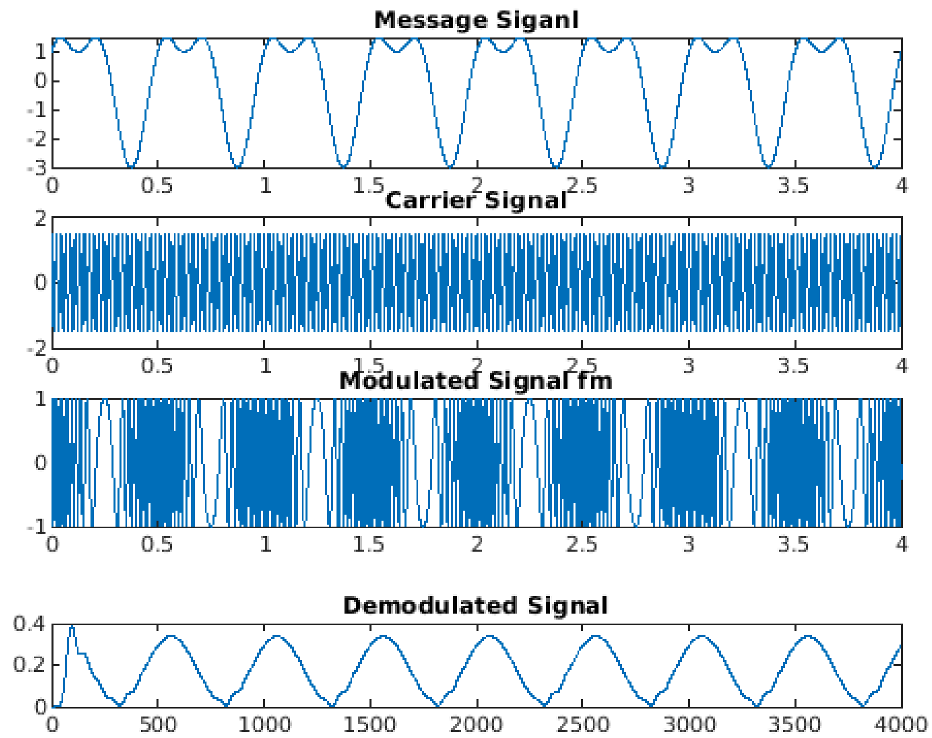
Lab6 Frequency Modulation

```
clc;
clear all;
close all;

t=[0:0.001:4];
f1=2;
m=2*sin(2*pi*f1*t)+cos(2*pi*2*f1*t);

subplot(4,2,[1,2]);
plot(t,m);
title('Message Siganl');

f2=45;
c=1.5*cos(2*pi*f2*t);
subplot(4,2,[3,4]);
plot(t,c);
title('Carrier Signal');

%Frequency Modulation
mf=20;
s=sin((2*pi*f2*t)+(mf*sin(2*pi*f1*t)));

subplot(4,2,[5,6]);
plot(t,s);
title('Modulated Signal fm');

syms t1;
x=diff(s);
y=abs(x);

%Demodulation
[b,a]=butter(10,0.033);
s1=filter(b,a,y);
subplot(6,2,[11,12]);
plot(s1);
title('Demodulated Signal');
```



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Lab6 SSB Modulation

```
clc;
clear all;
close all;

t=[0:0.001:1];
f1=10;
m1=sin(2*pi*f1*t);
m2=hilbert(m1);

subplot(6, 1, 1);
plot(t,m1);
title('Message Siganl');

f2=70;
c1=sin(2*pi*f2*t);
c2=cos(2*pi*f2*t);

subplot(6, 1, 2);
plot(t,c1);
title('Carrier Siganl');

sl = 0.5*(m1.*c1 + m2.*c2);
subplot(6,1,3);
plot(t,sl);
title('SSBSC-Lower Side Band');

su = 0.5*(m1.*c1 - m2.*c2);
subplot(6,1,4);
plot(t,su);
title('SSBSC-Upper Side Band');

%Lower Side band demodulation
sl1=sl.*c1;
[b,a]=butter(5,0.1);
sl2=filter(b,a,sl1);

subplot(6,1,5);
plot(t,sl2);
title('SSB Lower Side Band Demodulated Siganl');

%Upper Side band demodulation
su1=su.*c1;
[b,a]=butter(5,0.1);
su2=filter(b,a,su1);

subplot(6,1,6);
plot(t,su2);
title('SSB Upper Side Band Demodulated Siganl');
```

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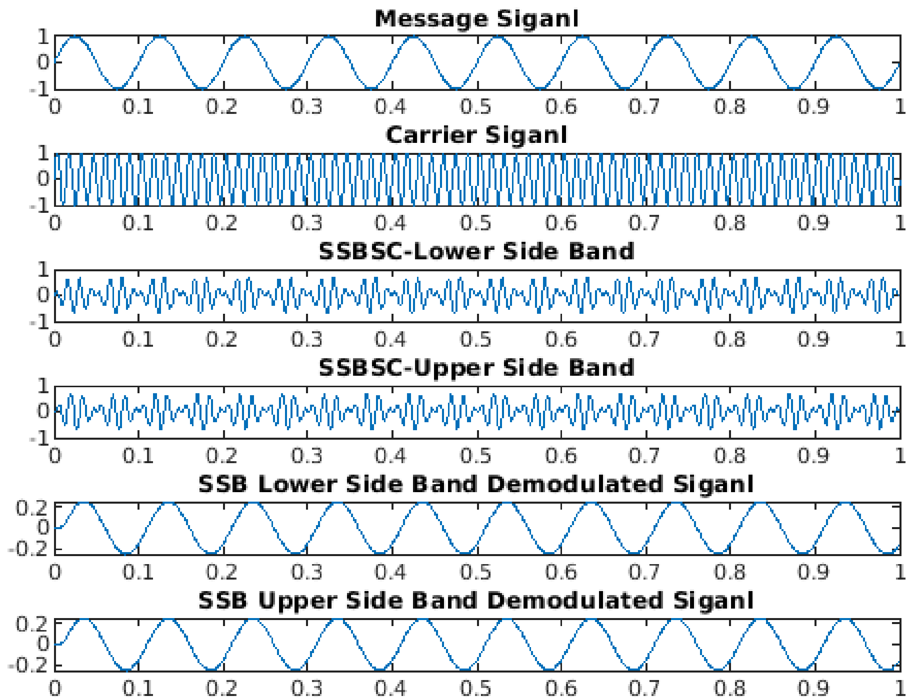

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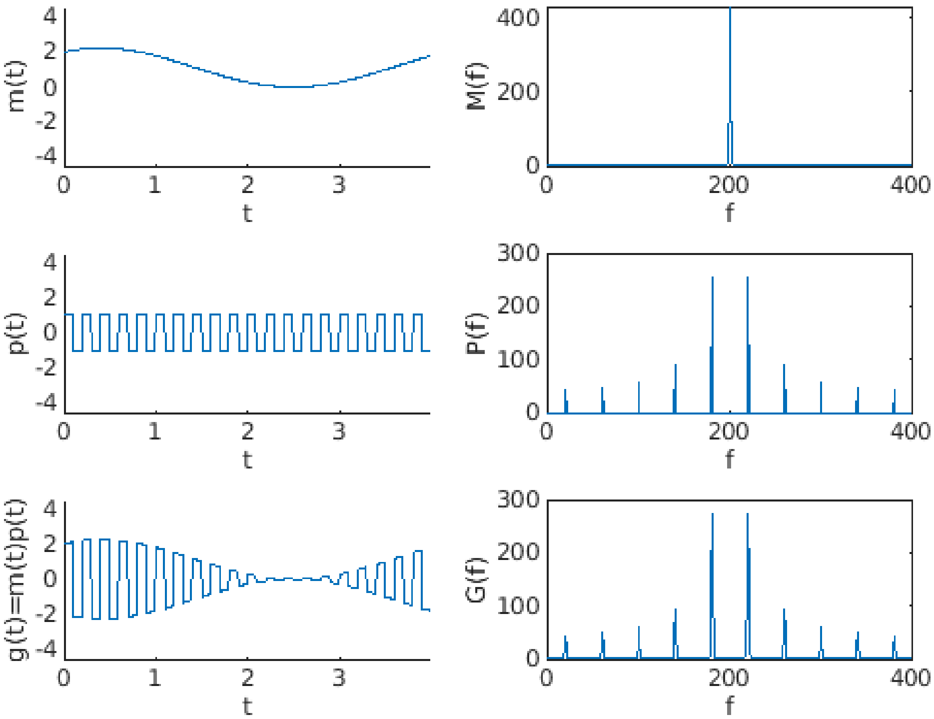
Lab6 Ring Modulation

```
clc
close all;

t=0:0.01:(4-0.01);
T=10;
f=1/T;
a=2*(sin(2*pi*f*t)+cos(4*pi*f*t));

subplot(3, 2, 1);
axis([0 (4-0.01) -4.5 4.5]);
hold on;
plot(t,a);
xlabel('t');
ylabel('m(t)');

pulses=[ones(1,10) -ones(1,10)];
pul=repmat(pulses,1,20);

subplot(3,2,3);
axis([0 (4-0.01) -4.5 4.5]);
hold on;
plot(t,pul);
xlabel('t');
ylabel('p(t)');
subplot(3, 2, 5);

a1=pul.*a;
axis([0 (4-0.01) -4.5 4.5]);
hold on;
plot(t,a1);
xlabel('t');
ylabel('g(t)=m(t)p(t)');

%FFT
s1=abs(fftshift((fft(a))));
subplot(322);
pt=20;
plot(s1);
xlabel('f');
ylabel('M(f)');

s2=fftshift(abs(fft(pul)));
subplot(324);
plot(s2);
xlabel('f');
ylabel('P(f)');

s3=fftshift(abs(fft(a1)));
subplot(326);
plot(s3);
xlabel('f');
ylabel('G(f)');
```



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Lab5

Pre-Lab Questions

1. Explain multiplexing?

Multiplexing is the process of sending multiple signals over a single shared channel as one complex signal, from which the original signals can be recovered.

2. Explain different types of multiplexing?

Frequency Division Multiplexing – Signals are translated to different frequencies and sent over the channel. Time Division Multiplexing – The time frame in the channel is divided into slots and assigned to each transmitted signal.

3. What are the advantages of multiplexing?

Multiplexing makes it possible to transmit more than one signal over a single channel. And hence, reduces the cost of transmission.

Post Lab Questions

1)Explain Frequency-division multiplexing.

The signals to be transmitted are modulated to different frequencies such that there is no cross talk between them and sent over a single channel.

2. Differentiate FDM & TDM

In FDM, the transmitted signals are assigned different frequency slots whereas in TDM, they are assigned different time slots.

3. What is the BW of FDM

The bandwidth of the channel must be sum of all bandwidths of component signals and guard bands.

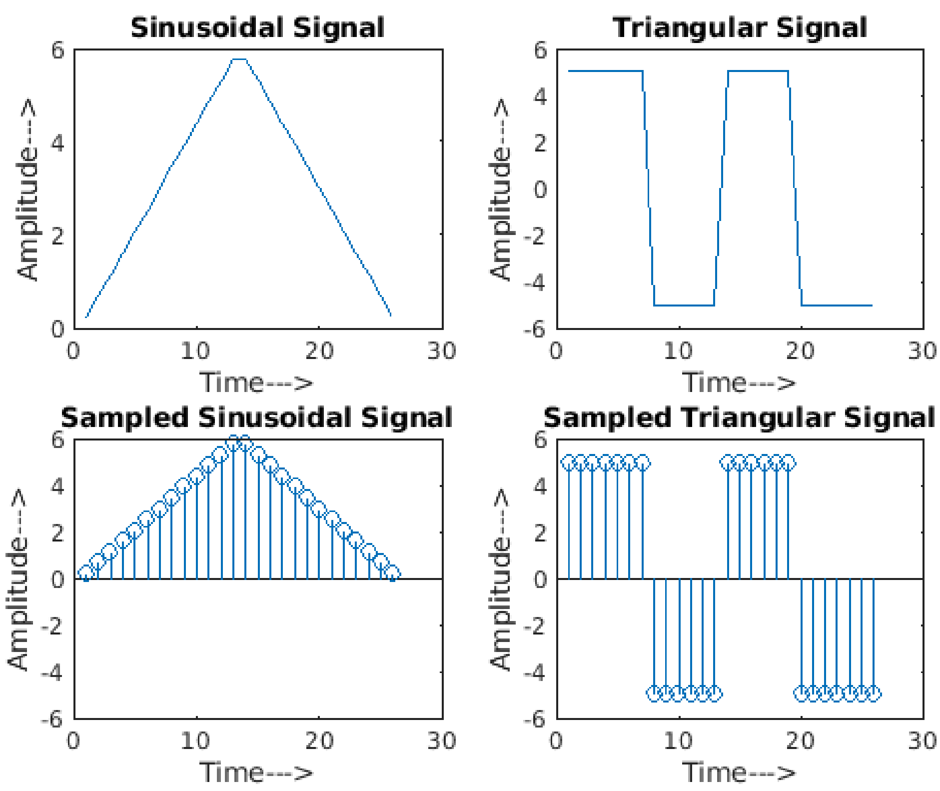
4. Explain FDM Generation

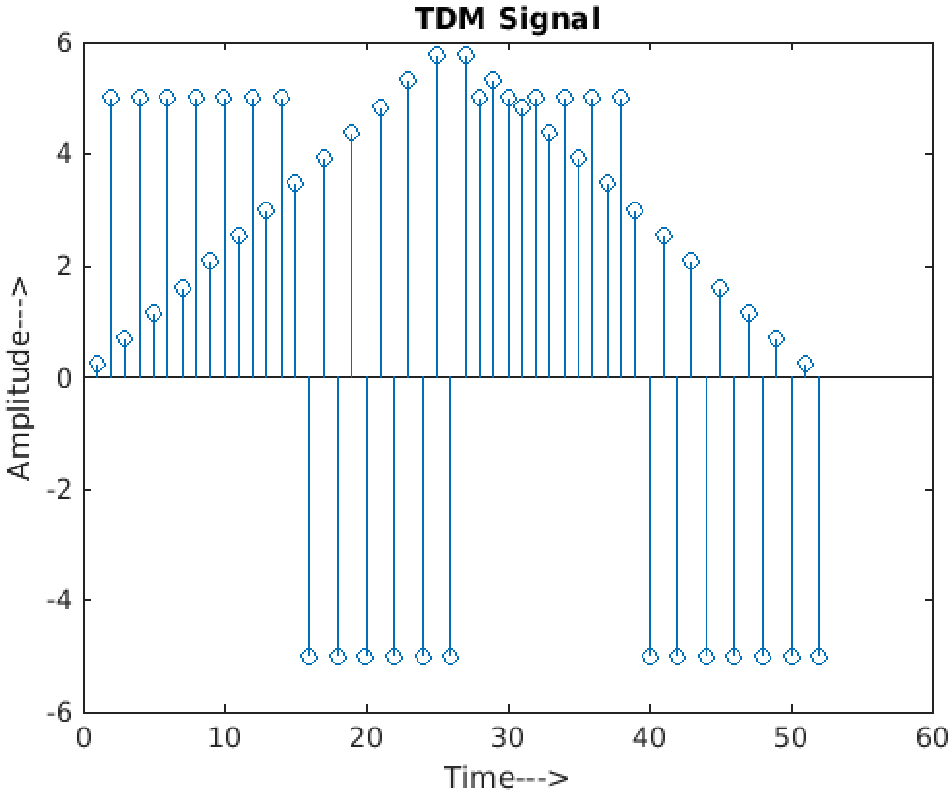
The signals to be transmitted are modulated to different carrier frequencies and added together to be sent over the channel.

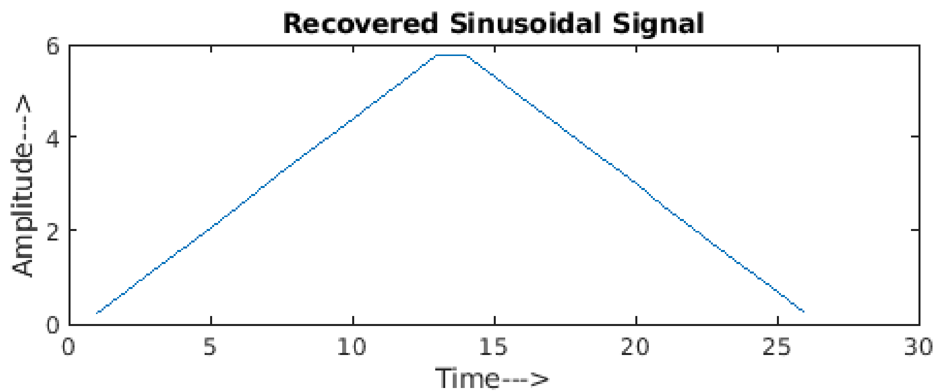
Lab5(b)

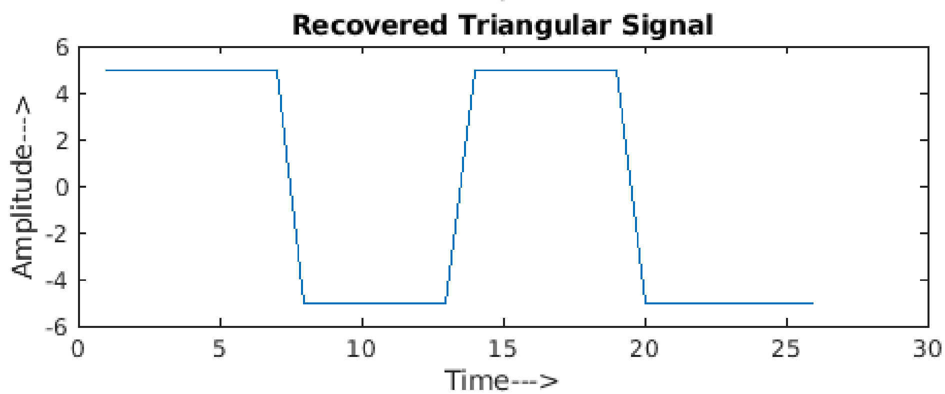
```
clc;
close all;

% Signal generation
t=0:.5:4*pi;
l = length(t);
sig1 = 6*triang(l);
sig2=5*square(t);

% Display of Both Signal
subplot(2,2,1);
plot(sig1);
axis([0 30 0 6]);
title('Sinusoidal Signal');
ylabel('Amplitude--->');
xlabel('Time--->');

subplot(2,2,2);
plot(sig2);
axis([0 30 -6 6]);
title('Triangular Signal');
ylabel('Amplitude--->');
xlabel('Time--->');

%Sampled Signal
subplot(2,2,3);
stem(sig1);
axis([0 30 -6 6]);
title('Sampled Sinusoidal Signal');
ylabel('Amplitude--->');
xlabel('Time--->');

subplot(2,2,4);
stem(sig2);
axis([0 30 -6 6]);
title('Sampled Triangular Signal');
ylabel('Amplitude--->');
xlabel('Time--->');

l1=length(sig1);
l2=length(sig2);
for i=1:l1
    sig(1,i)=sig1(i);
    sig(2,i)=sig2(i);
end
% TDM of both quantize signal

tdmsig=reshape(sig, 1, 2*l1);
%Display of TDM Signal
figure;
stem(tdmsig);
axis([0 60 -6 6]);
```

```
title('TDM Signal');
ylabel('Amplitude--->');
xlabel('Time--->');

% Demultiplexing of TDM Signal
demux=reshape(tdmsig,2,l1);
for i=1:l1
    sig3(i)=demux(1,i);
    sig4(i)=demux(2,i);
end

% Display of demultiplexed signal
figure;
subplot(2,1,1);
plot(sig3);
axis([0 30 0 6]);
title('Recovered Sinusoidal Signal');
ylabel('Amplitude--->');
xlabel('Time--->');

subplot(2,1,2);
plot(sig4);
axis([0 30 -6 6]);
title('Recovered Triangular Signal');
ylabel('Amplitude--->');
xlabel('Time--->');
```




TDM Signal
Amplitude--->
Time--->
6
4
2
0
-2
-4
-6
0
10
20
30
40
50
60


Recovered Sinusoidal Signal
Amplitude--->
Time--->
6
4
2
0
0
5
10
15
20
25
30


Recovered Triangular Signal
Amplitude--->
Time--->
6
4
2
0
-2
-4
-6
0
5
10
15
20
25
30

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Lab5

```
clc;
close all;

Fs = 200;
t = [0:Fs-1]'/Fs;

%Signal 1
x1 = sin(2*pi*15*t);
z1 = fft(x1, Fs);
z1=abs(z1);

%Siganl 2
x2 = 2*cos(2*pi*35*t);
z2 = fft(x2, Fs);
z2=abs(z2);

subplot(4,1,1);
plot(x1);
title('Signal 1');
xlabel('Time');
ylabel('Amplitude');

subplot(4,1,2);
plot(x2);
title('Signal 2');
xlabel('Time');
ylabel('Amplitude');

subplot(4,1,3);
plot(z1);
title('Spectrum of signal 1');
xlabel('Frequency');
ylabel('Magnitude');

subplot(4,1,4);
plot(z2);
title('Spectrum of signal 2');
xlabel('frequency')
ylabel('magnitude');

% Frequency division multiplexing
z=z1+z2;
figure;
plot(z);
title('Frequency multiplexed signals');

% frequency demultiplexing
%Filtering Signal 1
f1=[ones(20,1); zeros(160,1); ones(20,1)];
figure;
dz1=z.*f1;
```

```
subplot(4, 1, 1);
plot(dz1);
title("Filtered signal 1");
xlabel('Frequency(Hz)');
ylabel('Amplitude');

d1 = ifft(dz1);
subplot(4,1,2);
plot(t,d1);
title('Recovered signal 1');
xlabel('Time');
ylabel('Amplitude');

%Filtering Siganl 2
f2=[zeros(30,1); ones(140,1); zeros(30,1)];
dz2=z.*f2;
d2 = ifft(dz2);

subplot(4, 1, 3);
plot(dz2);
title("Filtered signal 2");
xlabel('Frequency(Hz)');
ylabel('Amplitude');

subplot(4, 1, 4);
plot(t,d2);
title('Recovered signal 2');
xlabel('Time');
ylabel('Amplitude');
```

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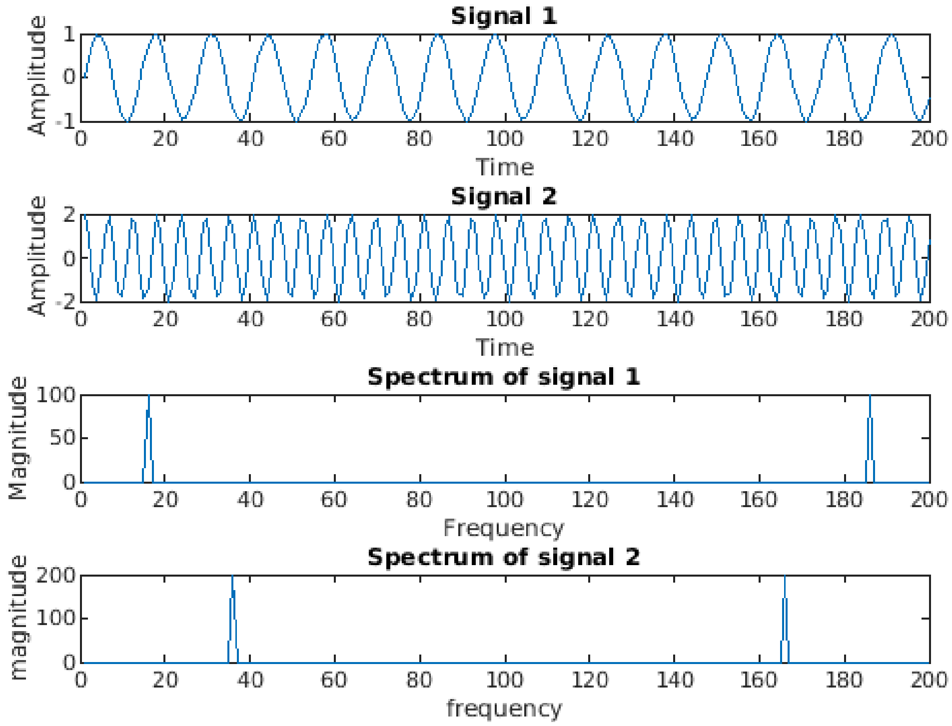
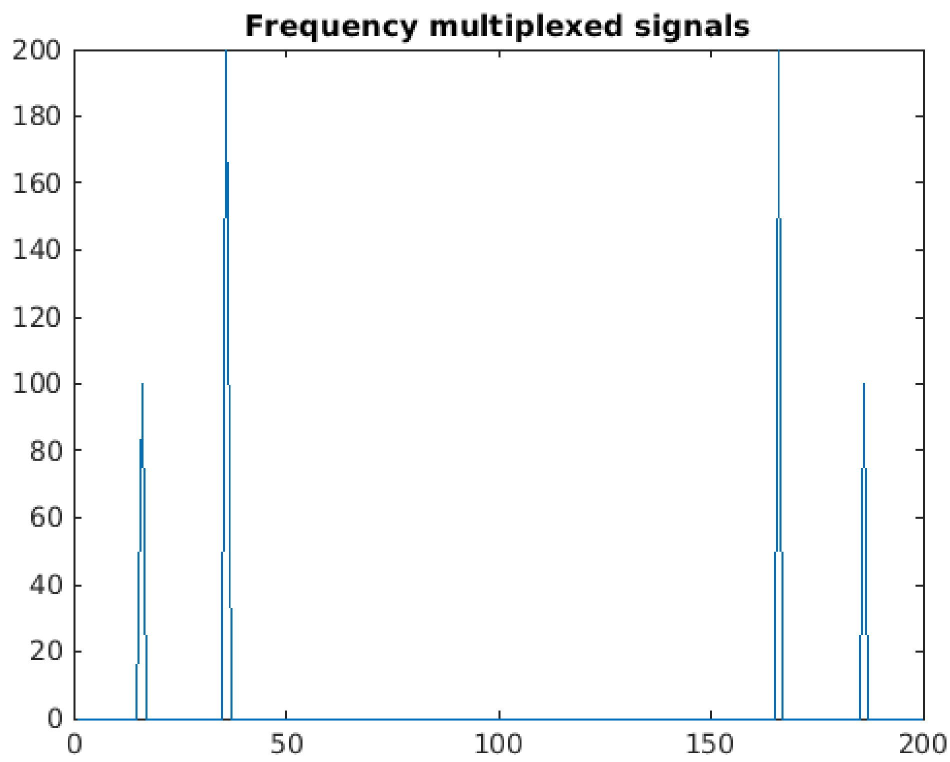
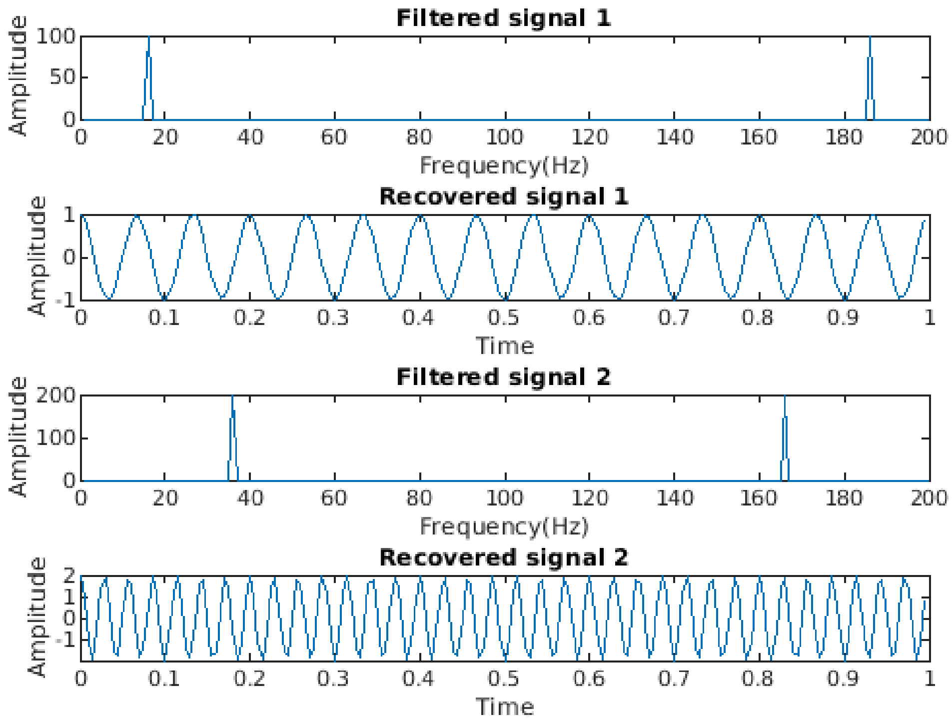

Signal 1
Amplitude
Time
Signal 2
Amplitude
Time
Spectrum of signal 1
Magnitude
Frequency
Spectrum of signal 2
magnitude
frequency


Frequency multiplexed signals



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