Department of Electrical Engineering

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Course/Section: BEE-6B Semester: 4th semester

EE-232 Signals and Systems

Lab #9: Implementation and Analysis of Amplitude Modulation Transmitter and Receiver System

Name	Reg. no.	Report Marks / 10	Viva Marks / 5	Total/15
Saad Iqbal	32903			

Objectives:

- Understand the operations carried out in the Amplitude modulation and understand their applications

a) Generate a signal defined by the following equation,

$$y[n] = \cos[2\pi n] + 0.5\cos[4\pi n] + 0.5\cos[8\pi n]$$

And let it be your message signal. Plot and analyze both the time domain and frequency domain plots.

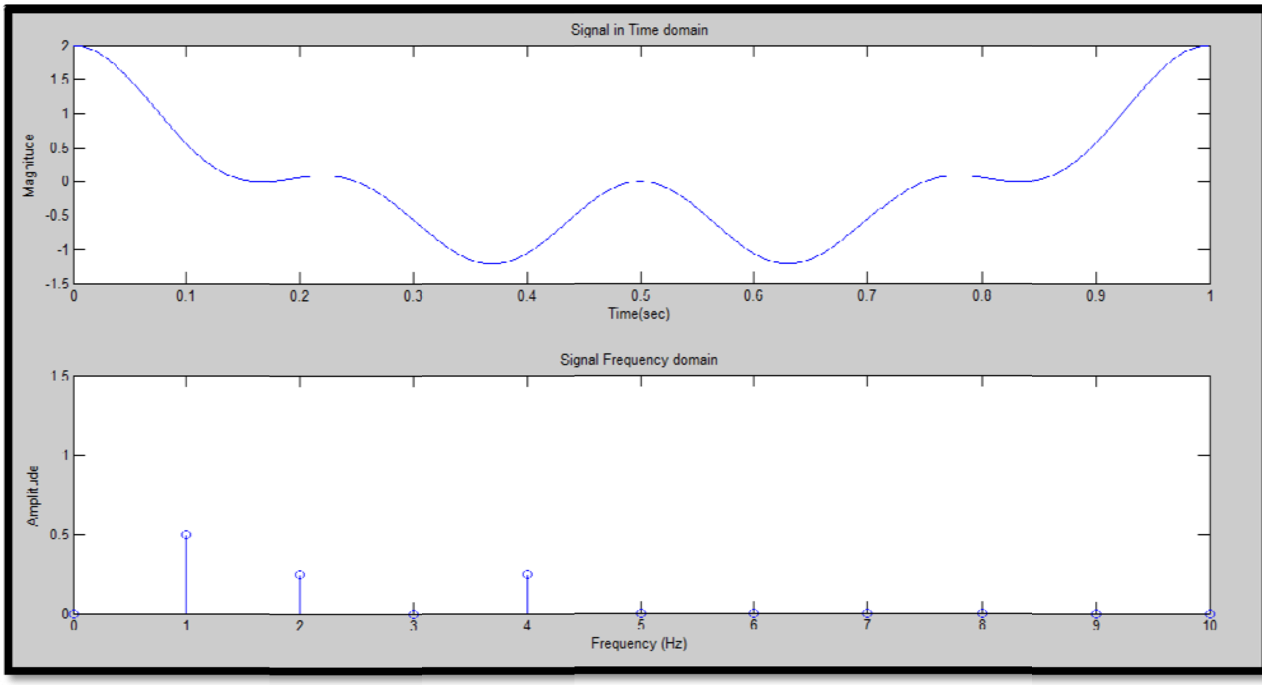
Matlab code:

```
fs=10000;   %Sampling frequency of system
n=[0:1/fs:1-(1/fs)];    %Sample index
y=cos(2*pi*n)+0.5*cos(4*pi*n)+0.5*cos(8*pi*n);  %Signal in time
domain
Y=abs(fft(y))/(fs);   %FFT of signal scaled by fs
N=linspace(0,9999,length(Y));   %Converting Bins in frequency
```

Matlab code for plotting required signal:

```
subplot(2,1,1)
plot(n,y)   %Signal in Time domain
xlabel('Time(sec)')
ylabel('Magnitude')
title('Signal in Time domain')
subplot(2,1,2)
stem(N,Y)   %Signal in frequency domain
xlabel('Frequency (Hz)')
ylabel('Amplitude')
title('Signal Frequency domain')
axis([0 10 0 1.5])
```

Matlab graph:



b) Generate a cosine of 1000Hz and call it you carrier signal. Plot and analyze both the time domain and the frequency domain plots.

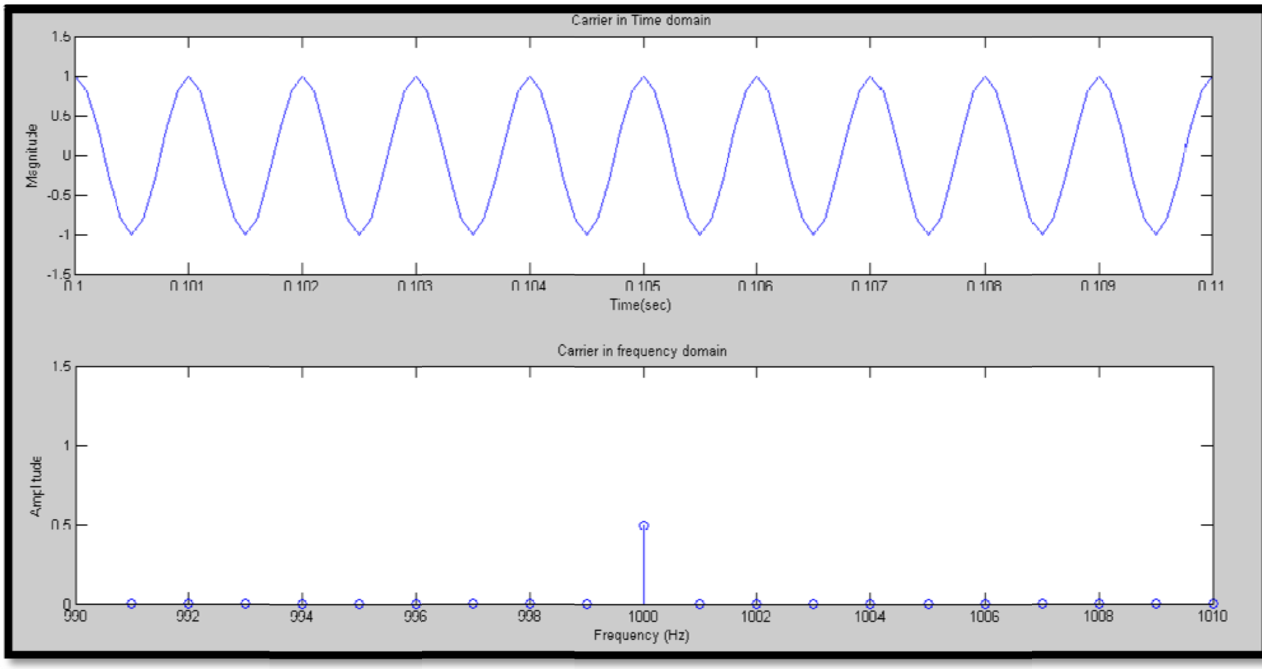
Matlab code:

```
.
.
.
y_carrier=cos(2*pi*1000*n); %Carrier in Time domain
Y_carrier=abs(fft(y_carrier)/(fs));   %carrier in
frequency domain
```

Matlab code for plotting required signal:

```
subplot(2,1,1)  %Signal in Time domain
plot(n,y_carrier)
xlabel('Time(sec)')
ylabel('Magnitude')
title('Carrier in Time domain')
axis([0.1 0.11 -1.5 1.5])
subplot(2,1,2)  %Signal in frequency domain
stem(N,Y_carrier)
xlabel('Frequency (Hz)')
ylabel('Amplitude')
title('Carrier in frequency domain')
axis([990 1010 0 1.5])
```

Matlab graph:



c) Now generate the signal that we will receive at the end of the transmitter system. Plot and analyze both the time and the frequency plots. This signal is the Amplitude modulated signal, carefully examine these plots. Try identifying that how the amplitude of the amplitude modulated signalvaries with time.

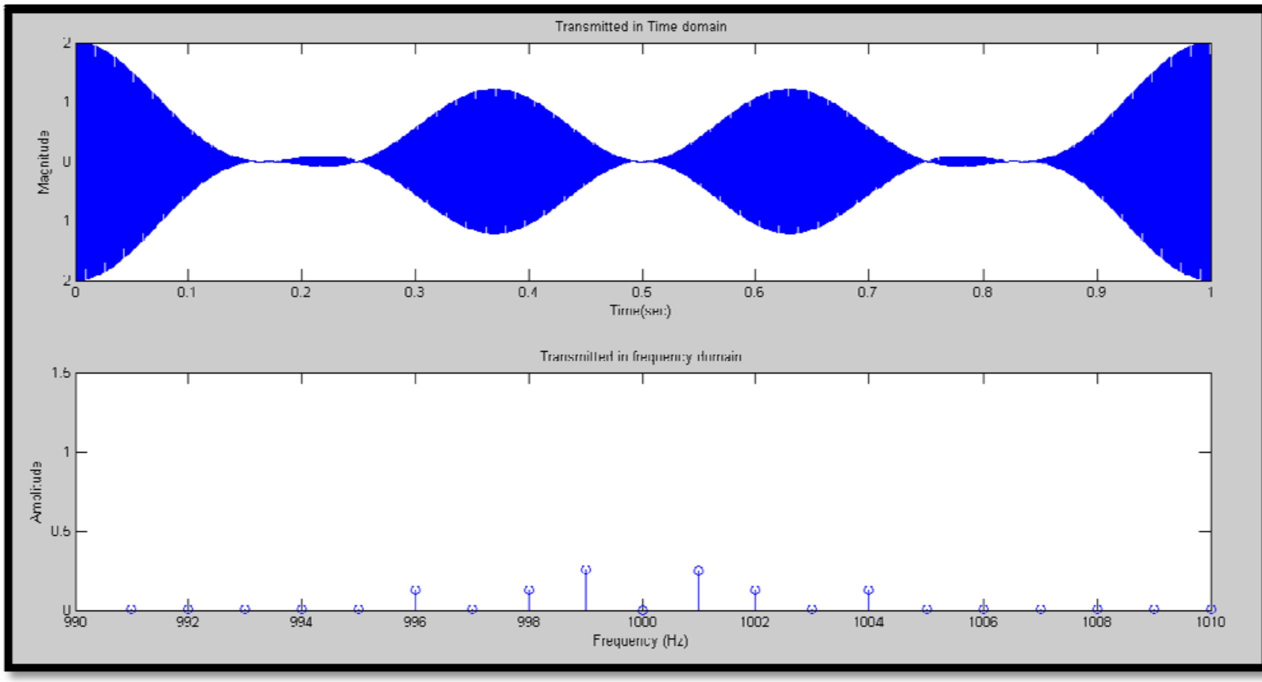
Matlab code:

```
.
.
.
transmitted=y.*y_carrier;    %Signal in time domain
Y_transmitted=abs(fft(transmitted)/(fs)); %Signal in 
frequency domain
```

Matlab code for plotting required signal:

```
subplot(2,1,1)
plot(n,transmitted) %Signal in time domain
xlabel('Time(sec)')
ylabel('Magnitude')
title('Transmitted in Time domain')
subplot(2,1,2)
stem(N,Y_transmitted)   %Signal in frequency domain
xlabel('Frequency (Hz)')
ylabel('Amplitude')
title('Transmitted in frequency domain')
axis([990 1010 0 1.5])
```

Matlab graph:



Answer:

When we multiply orignal signal with carrier signal in time domain, then this is convolution of signals in frequency domain. So, frequency signature of original signal shifted at carrier frequency as even function around carrier frequency as shown in graph.

d) Assuming we have a noise less channel we receive the signal generated in the previous part as the input to the receiver circuit. Generate the output signal by implementing the system given in the block diagram. Plot and analyze the output signal. A detailed answer is required focusing on what has actually happened here.

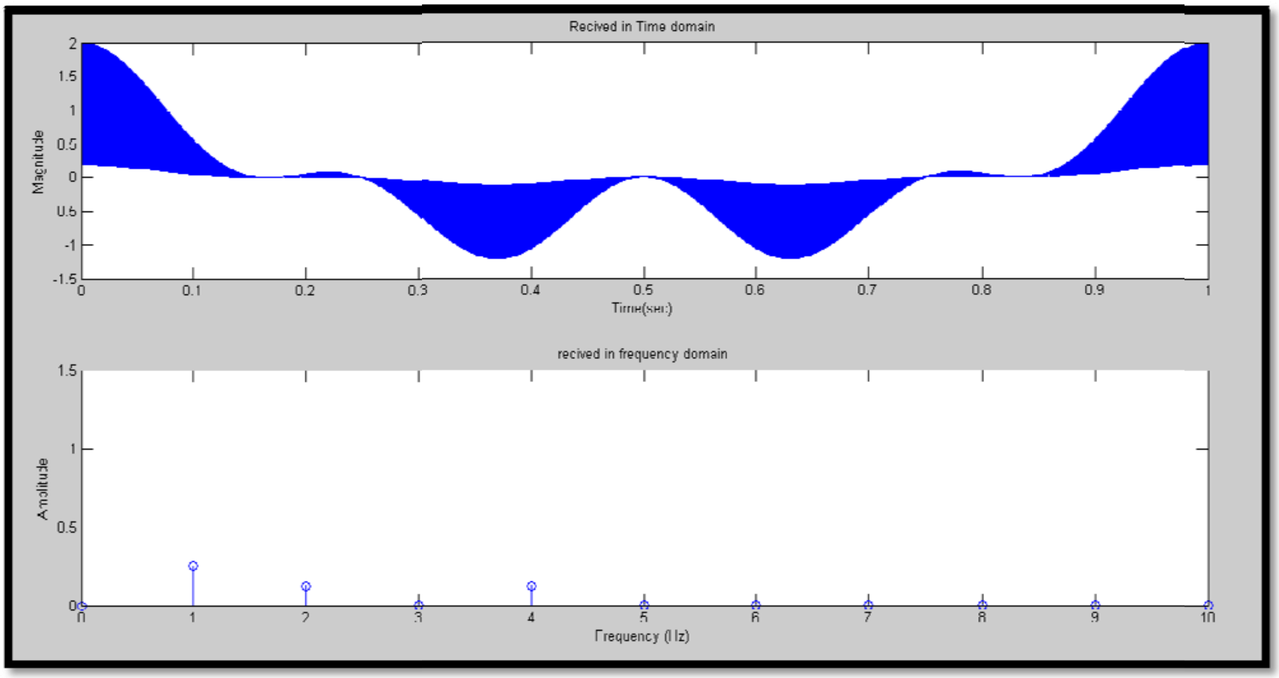
Matlab code:

```
.
.
.
Reciver=transmitted.*y_carrier;  %Signal in time domain
Y_Reciver=abs(fft(Reciver)/(fs));  %Signal in frequency
domain
```

Matlab code for plotting required signal:

```
subplot(2,1,1)
plot(n,Reciver)  %Signal in Time domain
xlabel('Time(sec)')
ylabel('Magnitude')
title('Recived in Time domain')
subplot(2,1,2)
stem(N,Y_Reciver)    %Signal in frequency domain
xlabel('Frequency (Hz)')
ylabel('Amplitude')
title('recived in frequency domain')
axis([0 10 0 1.5])
```

Matlab graph:



Answer:

When we multiply transmitted signal with carrier signal in time domain, then this is convolution of signals in frequency domain. So, convolution of carrier and transmitted signals restore original signal, which is superimposed with transmitted signal in time domain as shown in graph.

e) If you would have noticed that the output signal in the previous part was supposed to be the message signal, but it is quite different. Can you identify what operation (in terms of filtering) we need to perform to retrieve our original message signal? Explain how you arrived at your answer.

Matlab code:

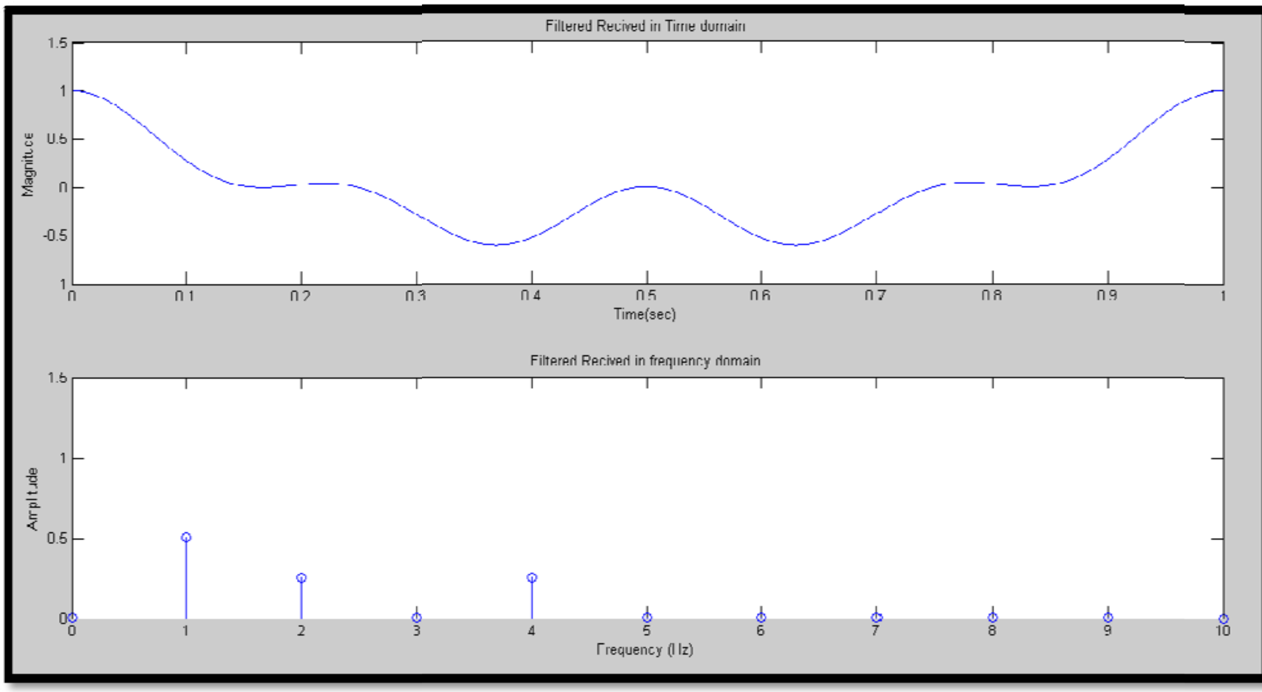
```
.
.
.
%After Amplifying and filtering
Filter=[2*ones(1,10),zeros(1,length(Y_Reciver)-10)];
%Filter

Y_Reciver_f=Y_Reciver.*Filter;  %after filteration
Reciver_f=ifft(Y_Reciver_f)*10000;  %Signal in time
domain
```

Matlab code for plotting required signal:

```
subplot(2,1,1)
plot(n,Reciver_f)   %Signal in time domain
xlabel('Time(sec)')
ylabel('Magnitude')
title('Filtered Recived in Time domain')
subplot(2,1,2)
stem(N,Y_Reciver_f) %Signal in frequency domain
xlabel('Frequency (Hz)')
ylabel('Amplitude')
title('Filtered Recived in frequency domain')
axis([0 10 0 1.5])
```

Matlab graph:



Answer:

Now obtain pure original signal, we use low pass filter to remove higher frequency from recived signal and gain provide gain of 2 to restore its strength.

Conclusion:

In this lab, we learn about amplitude modulation of signal and practically did on sample signal using matlab.