NAME: Siddharth Bose

REGISTRATION NO.: 19BEC1278

EXP. NO: 1

DATE : 11/01/2022

AMPLITUDE MODULATION AND DEMODULATION

AIM: Write a MATLAB program to execute and display the output for Amplitude modulation and demodulation.

SOFTWARE REQUIRED: MATLAB

THEORY:

Amplitude modulation is a process by which the wave signal is transmitted by modulating the amplitude of the signal. The instantaneous value of the carrier amplitude changes in accordance with the amplitude and frequency variations of the modulating signal. The carrier signal frequency is greater than the modulation signal frequency.

If modulation signal $\mathbf{m(t)=A_m cos(2\pi f_m t)}$ and carrier signal $\mathbf{c(t)=A_c cos(2\pi f_c t)}$, then modulated signal $\mathbf{s(t)=[A_c+A_m cos(2\pi f_m t)]\ cos(2\pi f_c t)}$ where,

A_m: Amplitude of modulation signal
f_m: Frequency of modulation signal
A_c: Amplitude of carrier signal
f_c: Frequency of message signal

In amplitude modulation, it is particularly important that the peak value of the modulating signal be less than the peak value of the carrier. The relation between the amplitude of modulation signal and amplitude of carrier signal is given by

$\mathbf{m=A_m/A_c}$

where m is known as the modulation index.

The process of extracting the message signal from the modulated wave is known as demodulation. The circuit, which demodulates the modulated wave is known as the demodulator.

ALGORITHM:

Step 1: Define the values for Am (message signal amplitude), fm (message signal frequency), Ac (carrier signal amplitude), fc (carrier signal frequency) and m (modulation index).

Step 2: Use the equation

- m=Am*sin(2*pi*fm*t) to define the message signal
- C=Ac*sin(2*pi*fc*t) to define the carrier signal
- s=Ac*(1+ma*m).*sin(2*pi*fc*t) to define the modulated signal

Step 3: Use the stem() command to obtain the spectrum of modulated signal and the amdemod() command to obtain the demodulated signal.

Step 4: Plot the message signal, carrier signal, modulated signal, spectrum of modulated signal and the demodulated signal in a single window using the subplot() command.

Step 5: Finally, save and click on Run to obtain the output graphs.

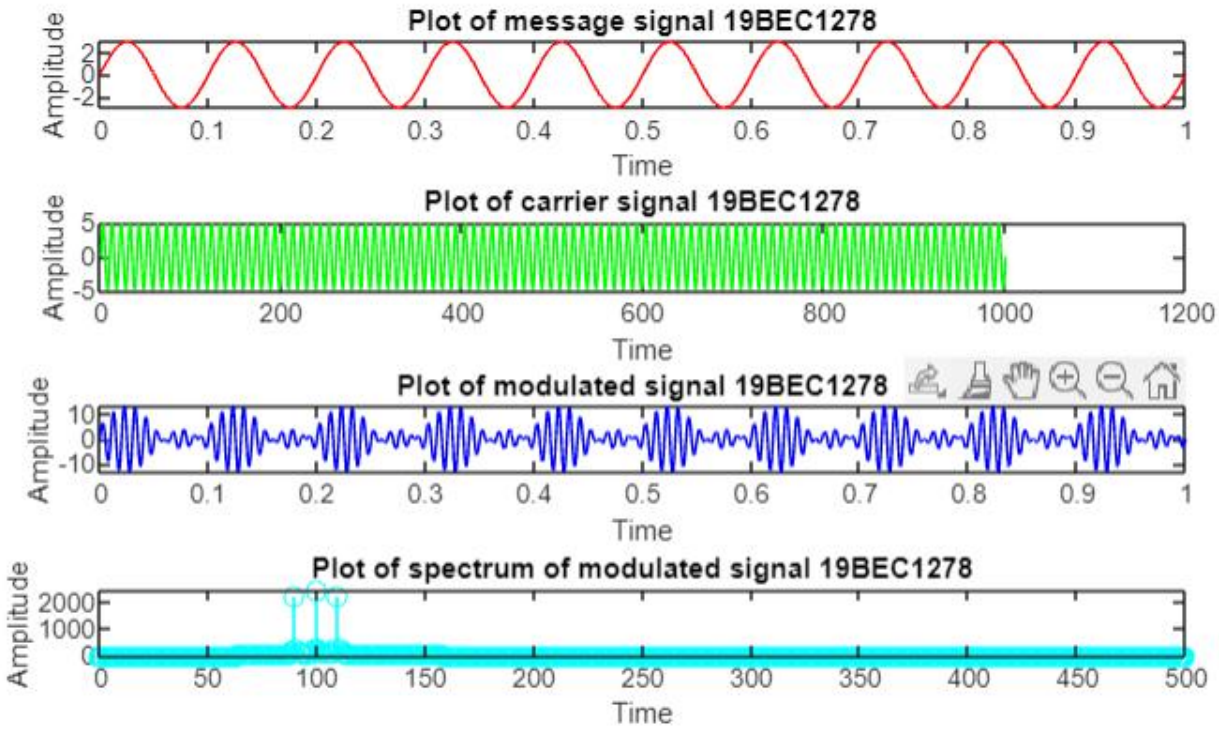
MATLAB CODE:

```
%% AM modulation and frequency spectrum
%message frequency=10Hz
%carrier frequency as 100Hz
clc;
clear;
close all;
Am=3;
Ac=5;
ma=Am/Ac;
fm=10;
fc=100;
Ts=1/1000
```

```
t=0:1/1000:1;
m=Am*sin(2*pi*fm*t);
subplot(5,1,1)
%plot(t,m)
plot(t,m,'r')
xlabel('Time')
ylabel('Amplitude')
title('Plot of message signal 19BEC1278')

%message spectrum
N=length(t);
y=fft(m,N);
z=y(1:floor(N/2)+1);
k=0:floor(N/2);
% figure,stem(k,abs(z))

%carrier signal
C=Ac*sin(2*pi*fc*t)
subplot(5,1,2)
% figure,plot(t,C)
plot(C,'g')
xlabel('Time')
ylabel('Amplitude')
title('Plot of carrier signal 19BEC1278')

%modulated signal
s=Ac*(1+ma*m).*sin(2*pi*fc*t); %s=Ac(1+mam(t)*sin2pifct)
subplot(5,1,3)
plot(t,s,'b')
```

```
%plot(msg)
xlabel('Time')
ylabel('Amplitude')
title('Plot of modulated signal 19BEC1278')
%figure,plot(t,s)

%spectrum of modulated signal
y1=fft(s,N);
z1=y1(1:floor(N/2)+1);
k1=0:floor(N/2);
subplot(5,1,4)
%figure,plot(t,s)
%plot(msg,'b')
stem(k1,abs(z1),'c')
xlabel('Time')
ylabel('Amplitude')
title('Plot of spectrum of modulated signal 19BEC1278')

%%Amplitude demodulation using inbuilt commandFs=1000;
Z=amdemod(s,fc,Fs);
subplot(5,1,5)
plot(t,Z,'k')
xlabel('Time')
ylabel('Amplitude')
title('Plot of demodulated signal using inbuilt matlab command 19BEC1278')
```

OUTPUT:



INFERENCE:

The plot of AM modulated signal was generated and it is observed that the modulated wave has an envelope which is the same as the of message signal. After demodulation, we have obtained the original message signal. Also, the spectrum was plotted where carrier and sidebands are visible.

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REGISTRATION NO.: 19BEC1278

EXP. NO: 2

DATE : 25/01/2022

DSB-SC MODULATION AND DEMODULATION

AIM: Write a MATLAB program to execute and display the output for DSB-SC modulation and demodulation.

SOFTWARE REQUIRED: MATLAB

THEORY:

Double Sideband Suppressed Carrier Modulation or DSB-SC is an amplitude modulated wave transmission scheme in which only sidebands are transmitted and the carrier is not transmitted as it gets suppressed. The carrier does not contain any information and its transmission results in loss of power. Thus, only sidebands are transmitted that contains information. This results in saving of power used in transmission.

If modulation signal $\mathbf{m(t)=A_m cos(2\pi f_m t)}$ and carrier signal $\mathbf{c(t)=A_c cos(2\pi f_c t)}$, then modulated signal $\mathbf{s(t)= m(t).c(t) = A_m A_c\ cos(2\pi f_m t)\ cos(2\pi f_c t))}$ where,

A_m: Amplitude of modulation signal
f_m: Frequency of modulation signal
A_c: Amplitude of carrier signal
f_c: Frequency of message signal

ALGORITHM:

Step 1: Define the values for A (message and carrier signal amplitude), fm (message signal frequency), fc (carrier signal frequency).

Step 2: Use the equation

- msg=A*sin(2*pi*fm*t) to define the message signal
- car=A*sin(2*pi*fc*t) to define the carrier signal
- mod=msg.*car to define the modulated signal

Step 3: Use the stem() command to obtain the spectrum of modulated signal and the amdemod() command to obtain the demodulated signal.

Step 4: Plot the message signal, carrier signal, modulated signal, spectrum of modulated signal and the demodulated signal in a single window using the subplot() command.

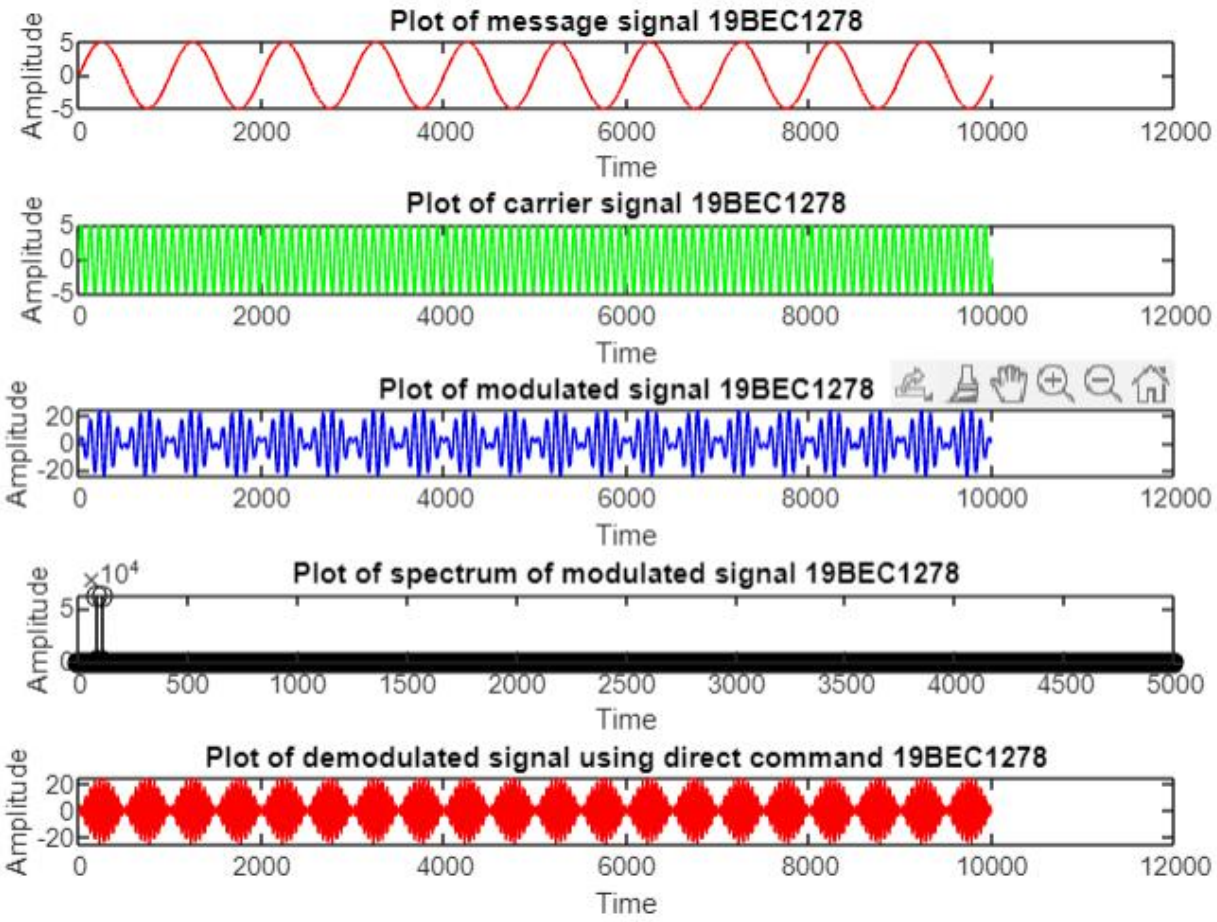
Step 5: Finally, save and click on Run to obtain the output graphs.

MATLAB CODE:

```
clc;
clear all;
close all;

%%Message signal
t=0:0.0001:1;
fm=10;
A=5;
msg=A*sin(2*pi*fm*t);
subplot(5,1,1)
plot(msg,'r')
xlabel('Time')
ylabel('Amplitude')
title('Plot of message signal 19BEC1278')

%%Carrier signal
fc=100;
car=A*sin(2*pi*fc*t)
subplot(5,1,2)
plot(car,'g')
xlabel('Time')
ylabel('Amplitude')
title('Plot of carrier signal 19BEC1278')
```

```
%%Modulated signal
mod=msg.*car
subplot(5,1,3)
plot(mod,'b')
xlabel('Time')
ylabel('Amplitude')
title('Plot of modulated signal 19BEC1278')

%%Spectrum of modulated signal
N=length(t);
w=fft(mod,N);
q=w(1:floor(N/2)+1);
k=0:floor(N/2);
subplot(5,1,4);
stem(k,abs(q),'k')
title('Plot of spectrum of modulated signal 19BEC1278')
xlabel('Time')
ylabel('Amplitude')

%%Demodulation using inbuilt command
Fs=1000;
Z= amdemod(mod,fc,Fs);
subplot(5,1,5);
plot(Z,'r');
xlabel('Time')
ylabel('Amplitude')
title('Plot of demodulated signal using direct command 19BEC1278')
```

OUTPUT:



INFERENCE:

The plot of AM modulated signal was generated and it is observed that the modulated wave has an envelope which is the same as the of message signal. After demodulation, we have obtained the original message signal. Also, the spectrum was plotted where the carrier was suppressed and only the sidebands are visible.

NAME: Siddharth Bose

REGISTRATION NO.: 19BEC1278
DATE : 25/01/2022
EXP. NO: 3
DATE 1 : 01/02/2022

FREQUENCY MODULATION AND DEMODULATION

AIM : Write a MATLAB program to execute and display the output for Frequency modulation and demodulation.

SOFTWARE REQUIRED: MATLAB

THEORY:

Frequency Modulation is a modulation in which the frequency of the carrier wave is altered in accordance with the instantaneous amplitude of the modulating signal, keeping phase and amplitude constant. Modification of carrier wave frequency is performed for the purpose of sending data or information over small distances. In the case of FM, the amplitude of the modulated signal is kept or it remains constant.

If modulation signal $\mathbf{m(t)=A_m cos(2\pi f_m t)}$ and carrier signal $\mathbf{c(t)=A_c cos(2\pi f_c t)}$, then modulated signal $\mathbf{f_m(t) = cos(2*pi*f_c*t+ m(t))}$ where,

A_m: Amplitude of modulation signal
f_m: Frequency of modulation signal
A_c: Amplitude of carrier signal
f_c: Frequency of message signal

ALGORITHM:

Step 1: Define the values for Am (message signal amplitude), fm (message signal frequency), Ac (carrier signal amplitude), fc (carrier signal frequency).
Step 2: Use the equation

- msg=Am*cos(2*pi*fm*t) to define the message signal
- carrier=Ac*cos(2*pi*fc*t); to define the carrier signal
- FM=cos(2*pi*fc*t+ msg) to define the modulated signal

Step 3: Plot the message signal, carrier signal and the modulated signal in a single window using the subplot() command.

Step 4: Use fmmod() and the fmdemod() command to obtain the frequency modulated and demodulated signal respectively.

Step 5: Plot the message signal, modulated signal and the demodulated signal in a single window using the subplot() command.

Step 6: Finally, save and click on Run to obtain the output graphs.

MATLAB CODE:

USING THEORETICAL FORMULA

```
clc
clear all
%Message Signal
Am=5;
t=0:0.001:1;
fm=10;
msg=Am*cos(2*pi*fm*t);
subplot(3,1,1); plot(t,msg)
title('Message signal 19BEC1278');
xlabel('time')
ylabel('amplitude')

%Carrier SignalAc=5;
fc=80;
carrier=Ac*cos(2*pi*fc*t);
subplot(3, 1,2);
plot(t,carrier)
xlabel('Time')
```

```
ylabel('Amplitude')
title('Carrier signal 19BEC1278')

%Modulated Signal
FM=cos(2*pi*fc*t+ msg);
subplot(3,1,3);
plot(t,FM,'r');
title('Modulated Signal 19BEC1278')
xlabel('time')
ylabel('Amplitude')
```

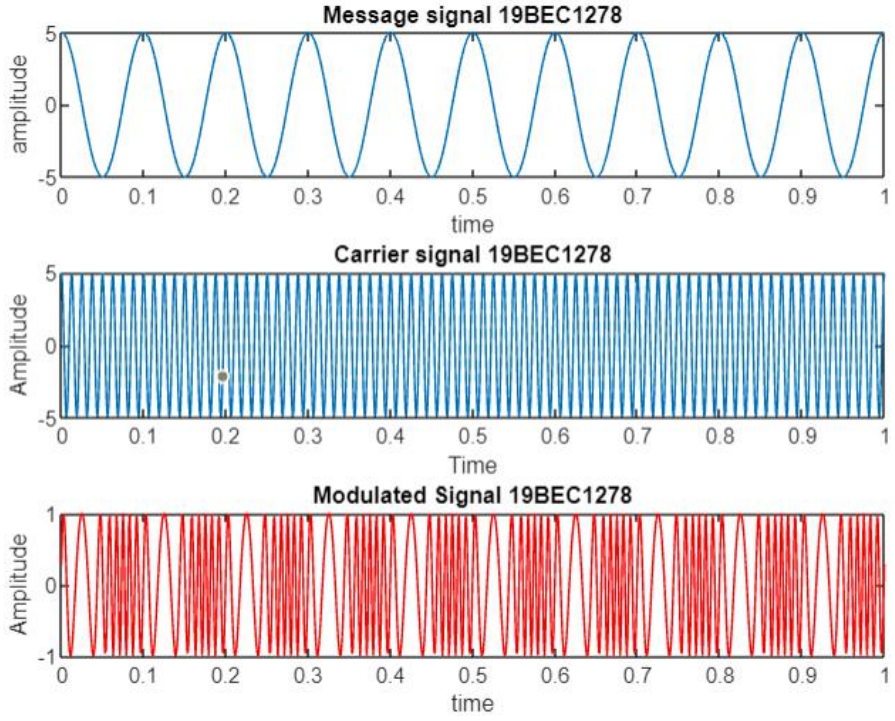
USING IN BUILT COMMAND

```
clc
clear all
t=0:0.0001:0.1;
fm=20;
fc=100;

%Message Signal
x=12;
m=cos(2*pi*fm*t);
subplot(3,1,1), plot(t,m)
xlabel('Time');
ylabel('Amplitude');
title('Message Signal 19BEC1278');

%%Frequency modulation using in built command
y1=fmmod(m,fc,800,50);
subplot(3,1,2), plot(t,y1)
```

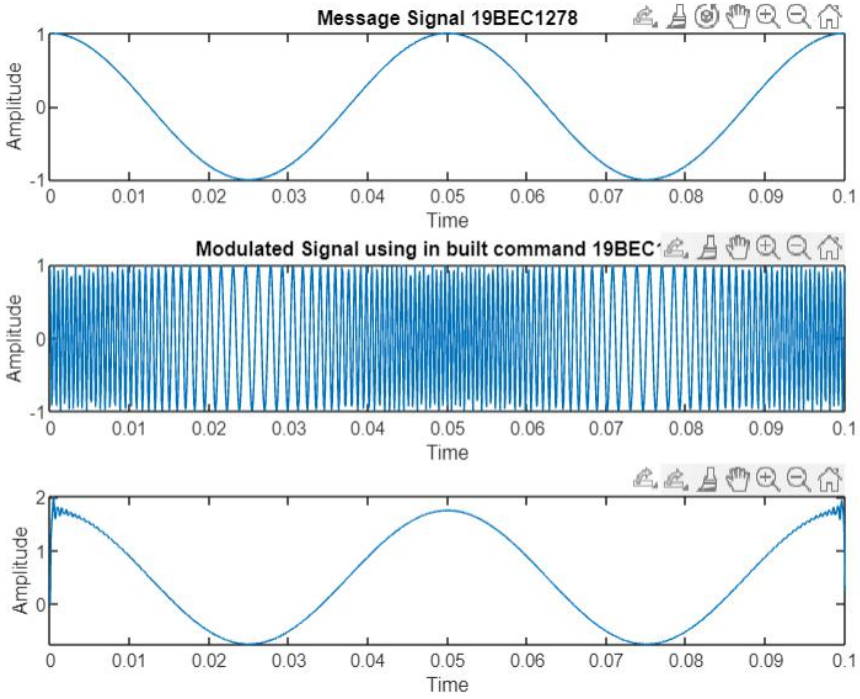
```
xlabel('Time');

ylabel('Amplitude');

title('Modulated Signal using in built command 19BEC1278');


%%Frequency demodulation using in built command

y2=fmdemod(y1,fc,1000,50);

subplot(3,1,3), plot(t,y2)

xlabel('Time');

ylabel('Amplitude');

title('Demodulated Signal using in built command 19BEC1278');
```

OUTPUT:

USING THEORETICAL FORMULA



USING IN BUILT COMMAND



INFERENCE:

The FM modulated and demodulated signal was generated using theoretical formulae and in built commands.