ANALOG COMMUNICATION LAB REPORT (EC - 225)

ELECTRONICS AND COMMUNIACTION ENGINEARING

Submitted By

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ECE(A)

Titile : *Amplitude modulation and demodulation.*

Aim : To generate the amplitude modulated signal(AM Wave) by using given carrier signals and message signals in MATLAB and also perform its demodulation.

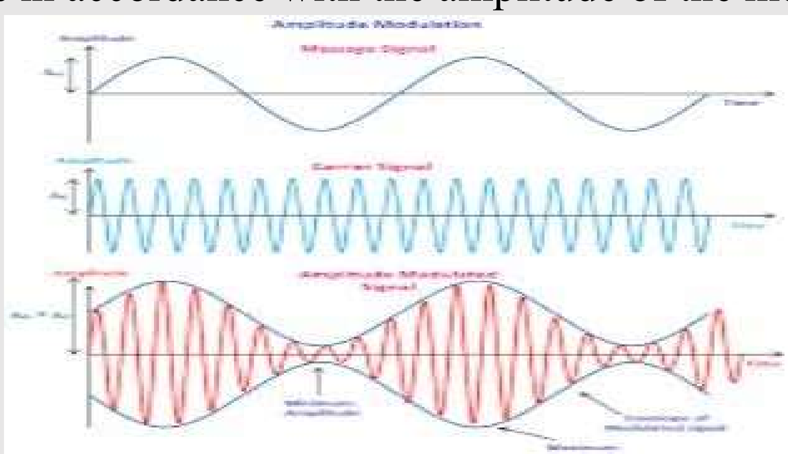
Software Used : **MATLAB** software.

Brief Theory :

In communication systems, a message from a sender is converted into the from of electrical signals by the use of appropriate transducers.

These message signal generated are of low frequency range and are not suitable for transmission across a channel. This leads to the necessity of modulation enabling the message to be transmitted across large distances.

In practice, modulation is carried out by superimposition of the message signal over a high frequency carrier signal, which carries no information in itself. In amplitude modulation, the modulated signal generated is such that it has the frequency of the carrier signal, with its amplitude varies in accordance with the amplitude of the message signal.



Mathematical model :

In amplitude modulation, the amplitude of the carrier voltage varies in accordance with the instantaneous value of modulating voltage.

Let the carrier wave c(t) be

$$c(t)=Ac*\cos(2\pi f_c t+ø)$$

And the modulating wave m(t) be

$$m(t)=Am*\cos(2\pi f_m t)$$

The amplitude modulated wave S_m is as follows

$$Sm(t)=Ac[\ 1+Kam*m(t)]\cos(2\pi fct+ø)$$

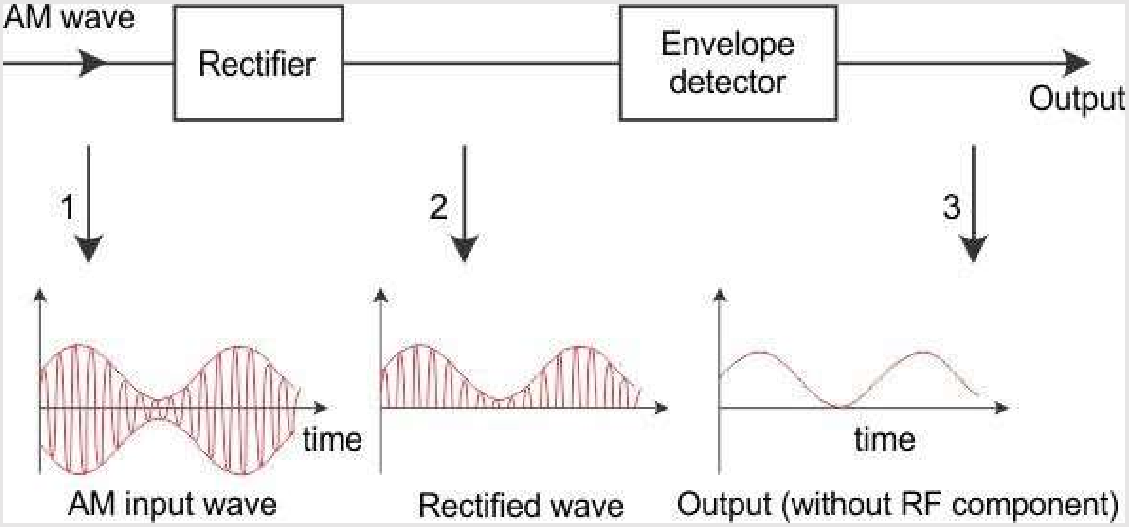
Where Kam is amplitude sensitivity (constant). In AM, the amplitude carrier wave Ac is shifting proportionally to the modulating signal m(t). If the initial phase ø of the carrier wave is 0, and Kam Am is modulating factor m, the resulting wave is as follows :

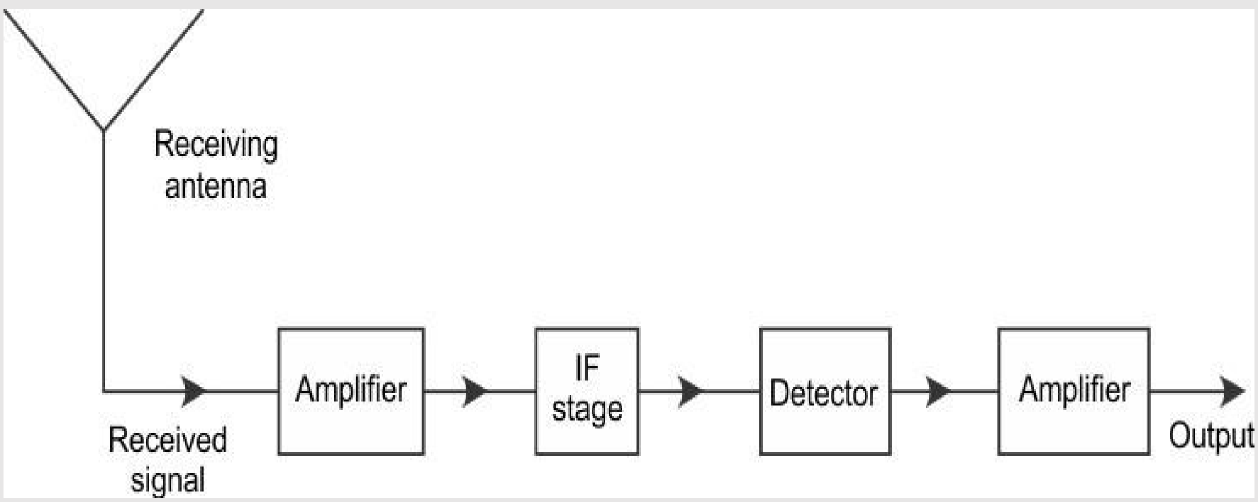
$$Sm(t)=Ac*\cos(2\pi fct) +2[\ \cos (2\pi\ (fc+fm)\ t) +\cos (2\pi(fc-fm)\ t)]$$

The demodulation circuit is used to recover the message signal from the incoming AM wave at the receiver. An envelope detector is a simple and yet highly effective device that is well suited for the demodulation of AM wave, for which the percentage modulation is less than 100%. Ideally, an envelope detector produces an output signal that follows the envelop of the input signal wave form exactly; hence, the name. This circuit is used in almost all commercial AM radio receivers.

Block Diagram :

Following two are block diagram of amplitude modulation signal :





Code and Execution :

The codes attached herewith is for the case of modulation and demodulation . The cases of over modulation and perfect modulation can be obtained with this same code by changing the value of A_m, and/or A_c , to appropriate values, so that the value of μ(modulation index) hence obtained, represents the desired situation.

#Code:: Amplitude Modulation:

```
clc;
clear all;
close all;

fc = 5000; %carrier frequency = 1 KHz
fm = 200; %baseband frequency = 100Hz
```

```
Am = 8; %Amplitude of baseband signal
Ac = 10; %Amplitude of carrier signal
m = Am / Ac; %modulating index= 0.5
t = linspace(0,0.01,1000);
%noise = randn(sizeof(t)); %generating noise

ec = Ac * cos(2*pi*fc*t); %definition of carrier signal
em = Am * cos(2*pi*fm*t); %definition of modulating signal
y = [Ac * Am*cos(2*pi*fm*t)].*cos(2*pi*fc*t);
%y = Ac * (1 + (m*sin(2*pi*fm*t).*sin(2*pi*fc*t))); %definition of modulated signal
%y = Ac * (1 + (m*sin(2*pi*fm*t).*sin(2*pi*fc*t)) + noise); %definition of modulated
signal with noise

figure;
subplot(3,1,1);
plot(t,em); %plotting of modulating signal
xlabel('time(sec)');
ylabel('Amplitude(V)');
title('Modulating Signal');
legend('e_m(t)');

subplot(3,1,2);
plot(t,ec); %plotting of carrier signal
xlabel('time(sec)');
ylabel('Amplitude(V)');
title('Carrier Signal');
legend('e_c(t)');

subplot(3,1,3);
plot(t,y); %plotting of modulated signal
xlabel('time(sec)');
ylabel('Amplitude(V)');
title('Modulated Signal');
legend('e(t)');
```

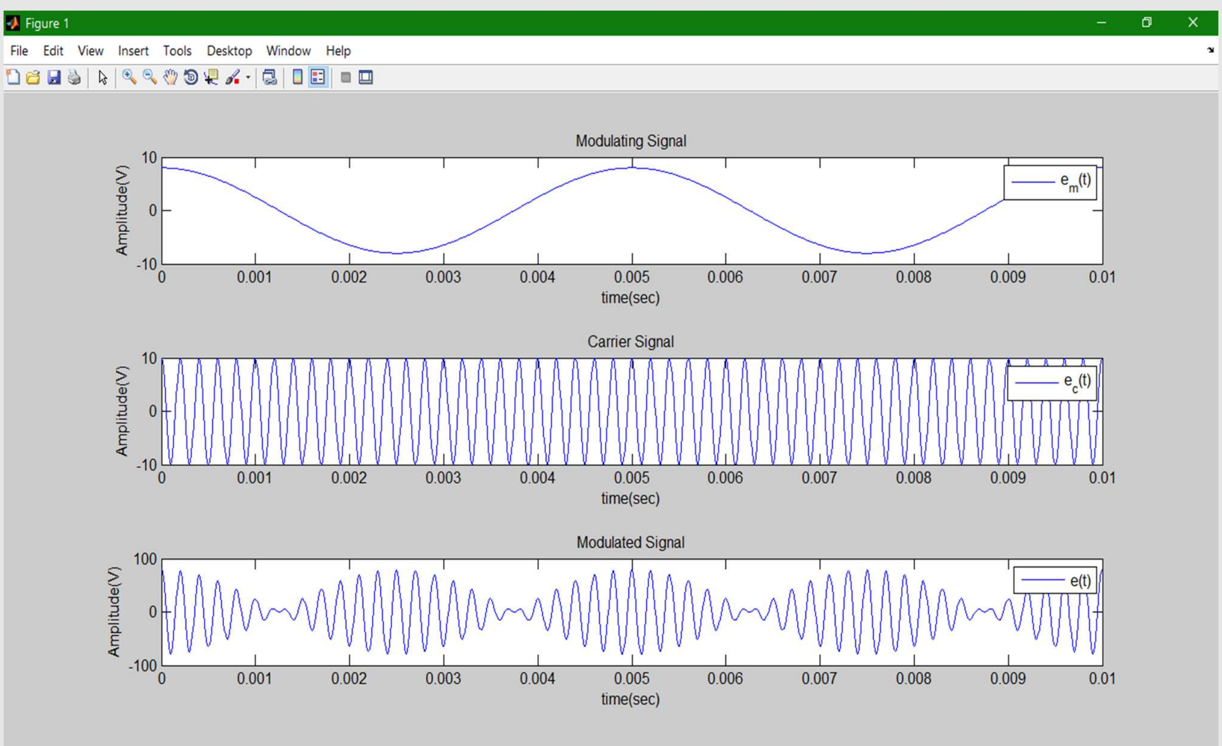


Fig1: Amplitude Modulation

#Code:: Amplitude Demodulation:

```
clc;
clear all;
close all;
fs = 80000;
fc = 5000;   %carrier frequency = 1kHz
fm = 200;    %modulating frequecy = 100Hz
Ac = 10;     %amplitude of carrier signal
Am = 8;      %amplitude of modulating signal
m = Am / Ac; %modulation index = 0.5
t = linspace(0,0.02,1000);


ec = Ac * cos(2*pi*fc*t); %definition of carrier signal
em = Am * cos(2*pi*fm*t); %definition of modulating signal
y = Ac*(m + em).*ec;
% y = Ac * (1 + (m*sin(2*pi*fm*t).*sin(2*pi*fc*t))); %definition of modulated signal

r= abs(y); %Rectified Output

% filter
f_high = 2*fm;
f_low = 0.5*fm;
[num,den] = butter(2,[f_low f_high]*2/fs); % Lowpass filter
% s1 = amdemod(am,fc,fm,0,0,num,den); % Demodulate
s1 = filter(num,den,r);

figure;

subplot(3,1,1);
plot(t, r);
title('Rectified Signal');
xlabel('Time');
ylabel('Amplitude');
legend('r(t)');

subplot(3,1,2);
plot(t, s1);
title('Demodulated Signal');
xlabel('Time');
ylabel('Amplitude');
legend('s1(t)');
```

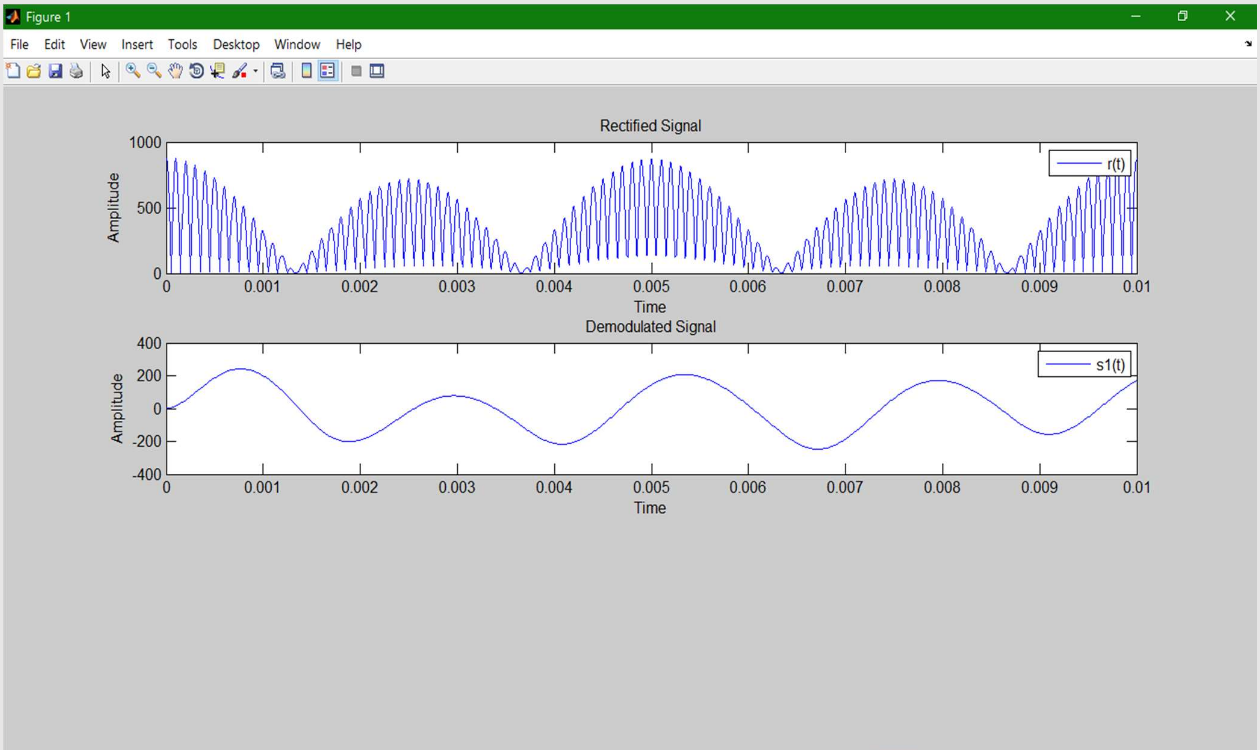


Fig2: Amplitude Demodulation

Conclusion :

Amplitude modulation and subsequently demodulation of a low frequency message signal with the help of a high frequency carrier signal has been carried out and all the three cases of under modulation, over modulation, and perfect modulation have been observed.