Heaven's Light is Our Guide

Rajshahi University of Engineering & Technology

(RUET)

Department of ECE

Course Title: Communication Engineering Sessional

Course No: ECE 3208

Experiment No: 1

Experiment Name: Study of Amplitude Modulation

Submitted by:

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Date: 14-05-2022

Submitted to:

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Experiment No.: 01

Name of Experiment: Study of Amplitude Modulation.

Theory:

Modulation is the process of converting data into radio waves by adding information to an electronic or optical carrier signal. A carrier signal is one with a steady waveform, constant height, or amplitude, and frequency.

Amplitude modulation is a process by which the wave signal is transmitted by modulating the amplitude of the signal. In amplitude modulation, there is a variation in the amplitude of the carrier. The voltage or the power level of the information signal changes the amplitude of the carrier. The carrier does not vary in amplitude. The modulating data is in the form of signal components consisting of frequencies either higher or lower than that of the carrier.

Let the modulating signal be,

$$\boldsymbol{m(t) = V_m \, sin(\omega_m t)}$$

And the carrier signal be,

$$\boldsymbol{c(t) = V_c \, sin(\omega_c t)}$$

So, the modulator signal be,

$$\begin{aligned}
\boldsymbol{M} &= \boldsymbol{[V_c + V_m \, sin(\omega_m t)] \, sin(\omega_c t)} \\
&= \boldsymbol{V_c \left[1 + \frac{V_m}{V_c} sin\omega_m t\right] sin\omega_c t} \quad \boldsymbol{[\,Modulation\ index, \mu = \frac{V_m}{V_c}]} \\
&= \boldsymbol{[1 + \mu sin\omega_m t] sin\omega_c t} \\
&= \boldsymbol{V_c sin\omega_c t + \ \mu sin\omega_m t] sin\omega_c t} \\
&= \boldsymbol{V_c sin\omega_c t + \tfrac{\mu V_c}{2} cos(\omega_c - \omega_m)\, t - \tfrac{\mu V_c}{2} cos(\omega_c + \omega_m)\, t}
\end{aligned}$$

Here, $\boldsymbol{\frac{\mu V_c}{2} cos(\omega_c - \omega_m)\, t}$ is lower side band

$\boldsymbol{\frac{\mu V_c}{2} cos(\omega_c + \omega_m)\, t}$ is higher side band

The bandwidth required for amplitude modulated wave is twice the frequency of the modulating signal.

Code:

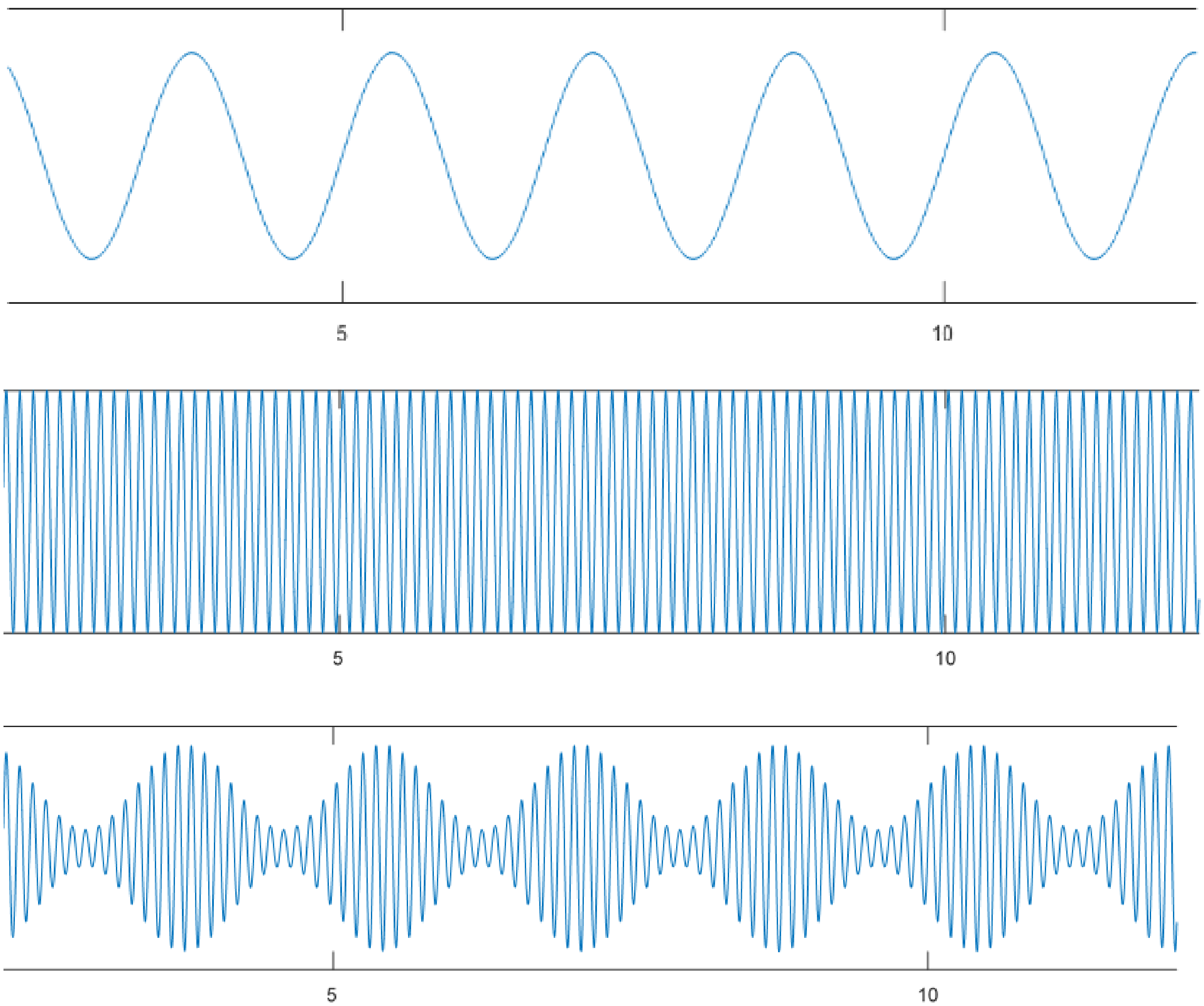
```
clc;
clear all;

Vm = 0.7;
pi = 3.1416;
fm = 0.6;
Vc = 1.7;
fc = 10;

t = 0: 0.0001:15;
m = Vm* sin(2*pi*fm*t);
subplot(3,1,1);
plot(t,m);

t = 0: 0.0001:15;
c = Vc * sin(2*pi*fc*t);
subplot(3,1,2);
plot(t,c);
t = 0: 0.0001:15;
M = (Vc+m).* sin(2*pi*fc*t);
subplot(3,1,3);
plot(t,M);
```

Output Graph:



Conclusion:

Amplitude Modulation is the simplest and earliest form of transmitters. AM applications include broad-casting in medium and high frequency applications, CB radio and aircraft communications. AM is a non-linear process. Sum and difference frequencies are created that carry the information.

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Experiment No: 2

Experiment Name: Study of Frequency Modulation

Submitted by:

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Roll: 1710039

Date: 14-05-2022

Submitted to:

Milton Kumer Kundu

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<u>Experiment No.</u>: 02

<u>Name of Experiment:</u>

Study of Frequency Modulation.

<u>Theory:</u>

Modulation is the process of converting data into radio waves by adding information to an electronic or optical carrier signal. A carrier signal is one with a steady waveform, constant height, or amplitude, and frequency.

Frequency modulation is the process by which frequency of the carrier signal changes with respect to the modulating signal. When the audio signal is modulated onto the radio frequency carrier, the new radio frequency signal moves up and down in frequency. The amount by which the signal moves up and down is known as the deviation and is normally quoted as the number of kilohertz deviation. If the signal have a deviation of ***±d*** kHz. In this case the carrier is made to move up and down by ***d*** kHz.

Let the message signal be,

$$m(t) = V_m \sin(\omega_m t)$$

And the carrier signal be,

$$c(t) = V_c \sin(\omega_c t)$$

For frequency modulation we know that the modulated signal will be, ***ω_c (1+K*message signal)***

$$M = V_c(sin \int_0^t w\, dt)$$

$$= \int_0^t \omega_c(1 + K * V_m\, sin(\omega_m t)\, dt$$

$$= V_c\, sin[\omega_c t - \frac{KV_m\omega_c}{\omega_m} cos(\omega_m t)]$$

Here,

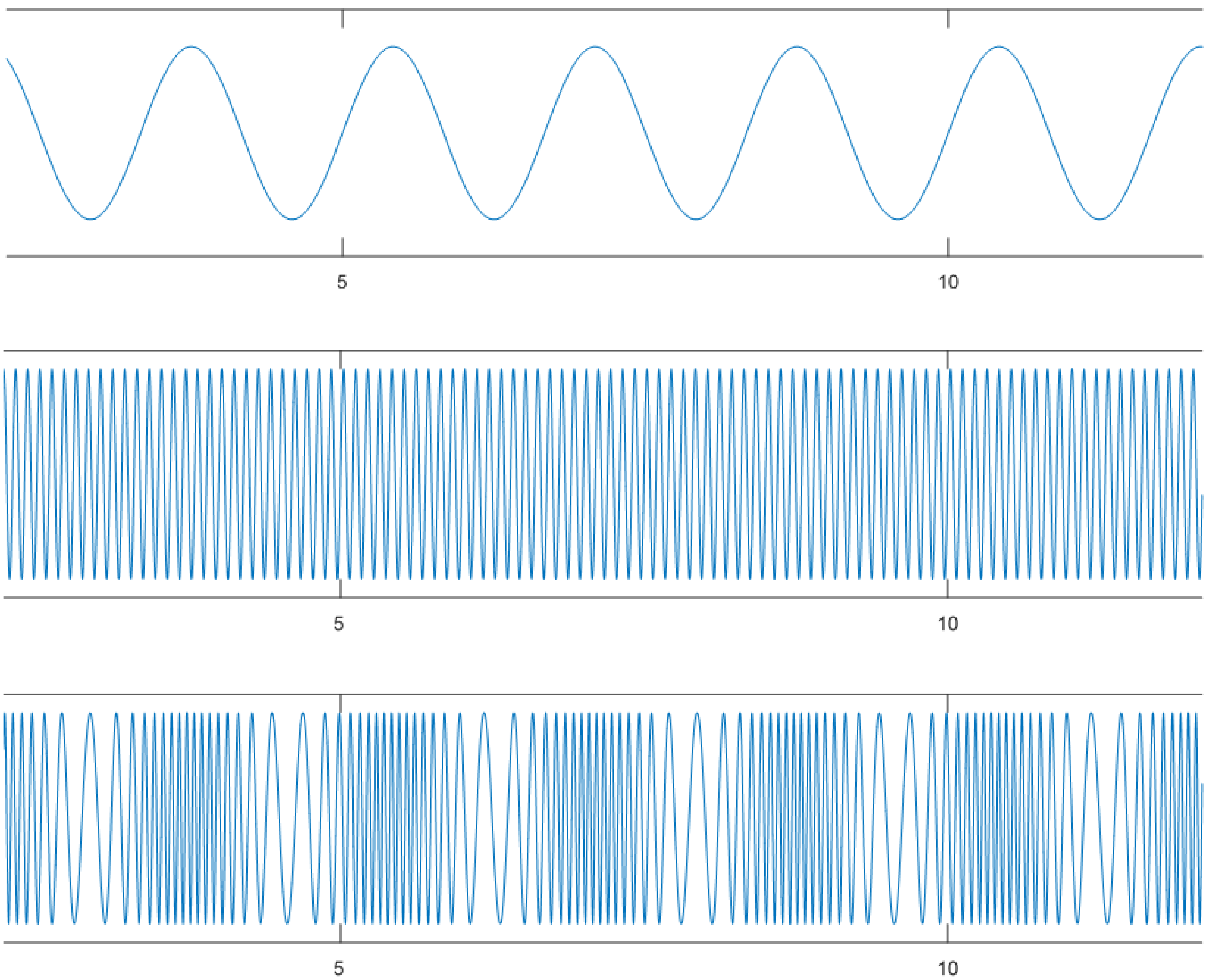
Frequency deviation is, $KV_m\omega_c \rightarrow \delta$

Modulation index for frequency modulation is, $\mu_m = \frac{\delta}{\omega_m}$

Code:

```
clc;
clear all;

Vm = 0.7;
pi = 3.1416;
fm = 0.6;
k = 0.9;
Vc = 1.7;
fc = 10;

t = 0: 0.0001:15;
m = Vm* sin(2*pi*fm*t);
subplot(3,1,1);
plot(t,m);

t = 0: 0.0001:15;
c = Vc * sin(2*pi*fc*t);
subplot(3,1,2);
plot(t,c);

t = 0: 0.0001:15;
M = Vc.* sin(2*pi*fc*t-((k*Vm*2*pi*fc) * cos(2*pi*fm*t))/(2*pi*fm));
subplot(3,1,3);
plot(t,M);
```

Output Graph:



Conclusion:

Frequency Modulation (FM) is an important modulation scheme both because of its widespread commercial use, and because of its simplicity. The frequency of a radio wave is less vulnerable to noise than the amplitude, FM was originally introduced to reduce noise and improve the quality of radio reception. In order to accomplish this, FM radio signals have bandwidth several times that of AM signals.