كلية الرشيد الجامعة
قسم هندسة تقنيات الحاسوب

المرحلة الثانية

مادة اسس الاتصالات

المحاضرة (10)

Modulation

Modulation

Modulation: is process of imposing an input signal on a carrier wave is known as modulation.

A message carrying signal has to get transmitted over a distance and for it to establish a reliable communication, it needs to take the help of a high frequency signal which should not affect the original characteristics of the message signal.

Message or Modulating Signal

The signal which contains a message to be transmitted, is called as a **message signal**.

It is a baseband signal, which has to undergo the process of modulation, to get transmitted. Hence, it is also called as the **modulating signal**.

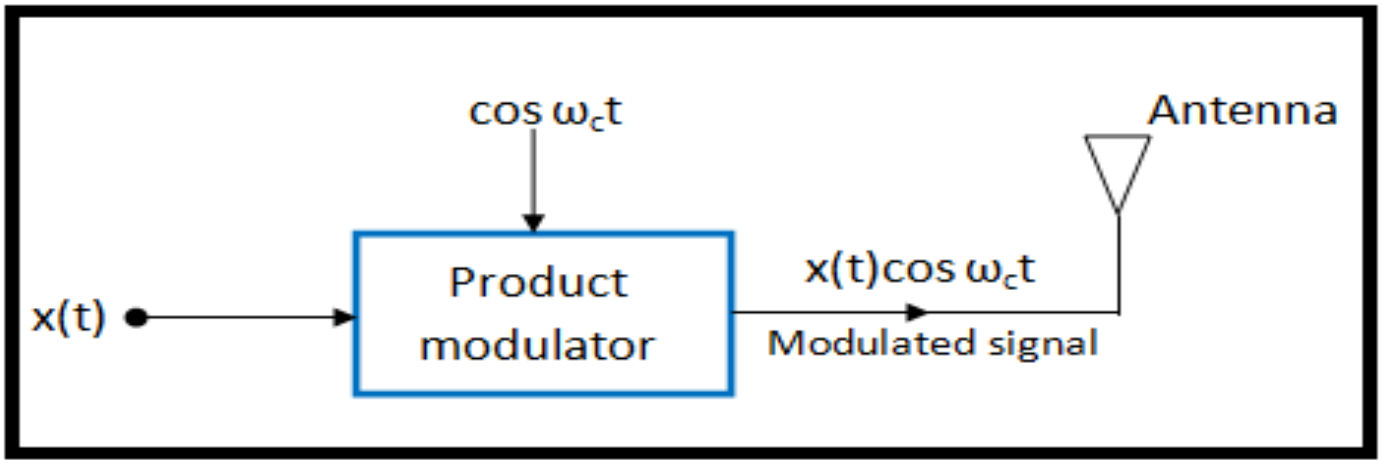
Carrier Signal

The high frequency signal which has a certain phase, frequency, and amplitude but contains no information is called a **carrier signal**.

It is an empty signal. It is just used to carry the signal to the receiver after modulation.

Modulation Process

It's 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.

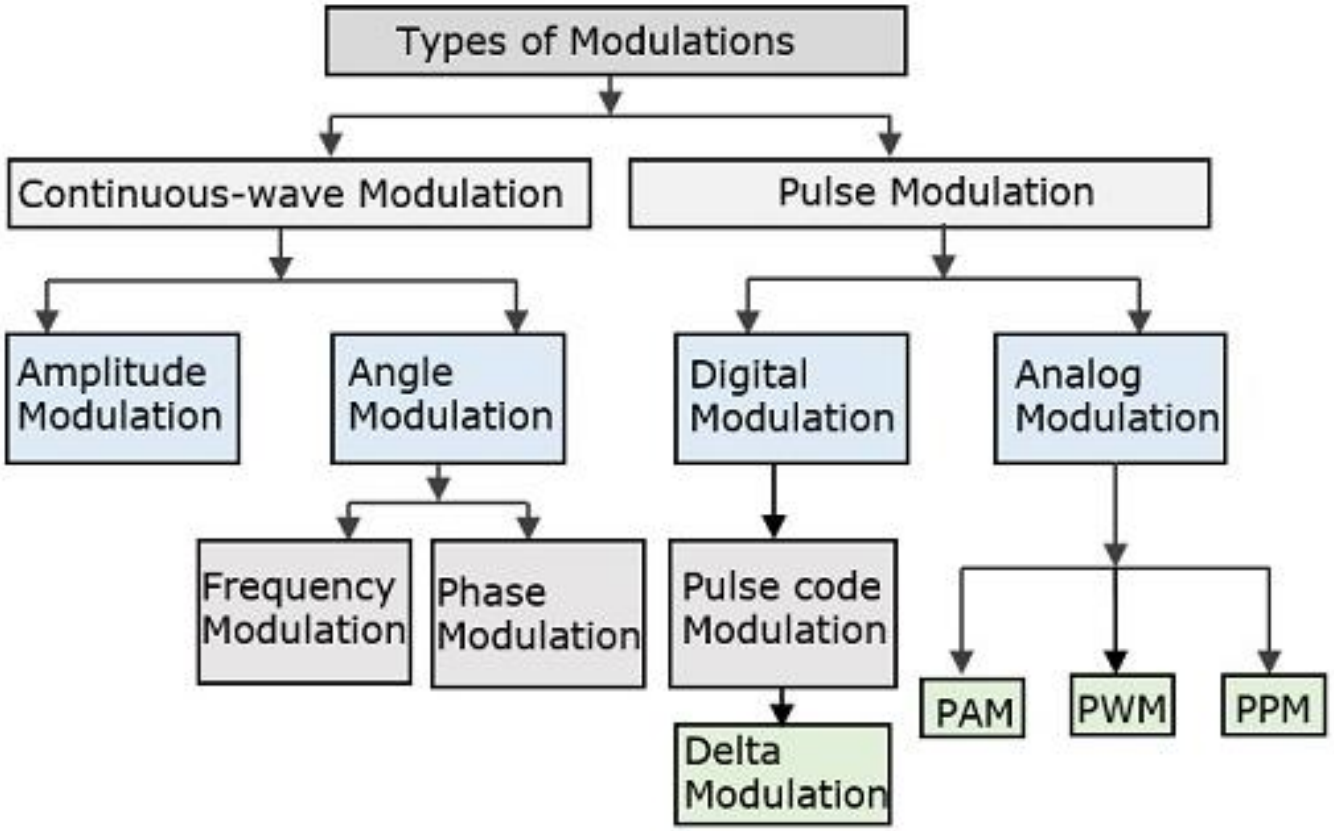


Advantages of Modulation

- Antenna size gets reduced.
- No signal mixing occurs.
- Communication range increases.
- Multiplexing of signals occur.
- An adjustment in the bandwidth is allowed.
- Reception quality improves.

Types of Modulation

There are many types of modulations. Depending upon the modulation techniques used, they are classified as shown in the following figure.



Amplitude Modulation

Amplitude modulation (AM)

- in which the height, the strength or intensity of the signal carrier is varied to represent the data being added to the signal.

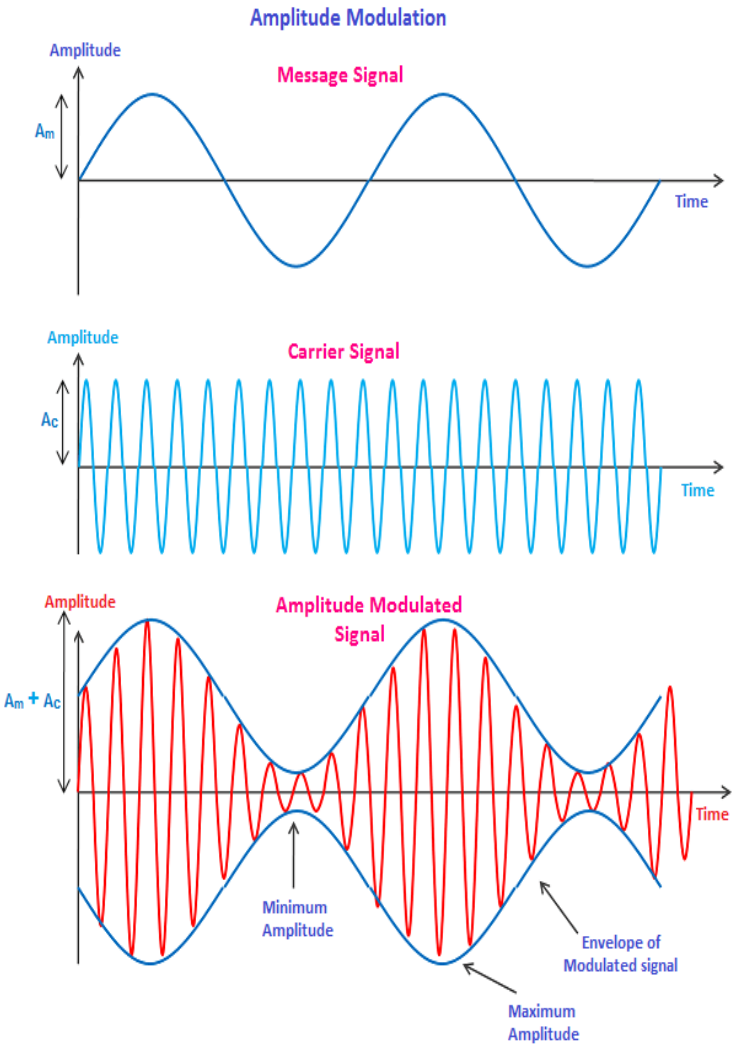
- In amplitude modulation, the carrier wave has constant frequency and the modulating wave information is conveyed by the amplitude of the carrier waves.

Amplitude modulation (AM)

The first figure shows the low frequency modulating signal or message signal which contains useful information,

The second figure shows the high frequency carrier wave which does not contain any information,

The last figure shows the resultant Amplitude modulated signal.



Amplitude modulation (AM)

The advantages of amplitude modulation include the following.

1. Amplitude modulation is economical as well as easily obtainable
2. It is so simple to implement, and by using a circuit with few component it can be demodulated.
3. The receivers of AM are inexpensive because it doesn’t require any specialized components.

Amplitude modulation (AM)

The disadvantages of amplitude modulation include the following.

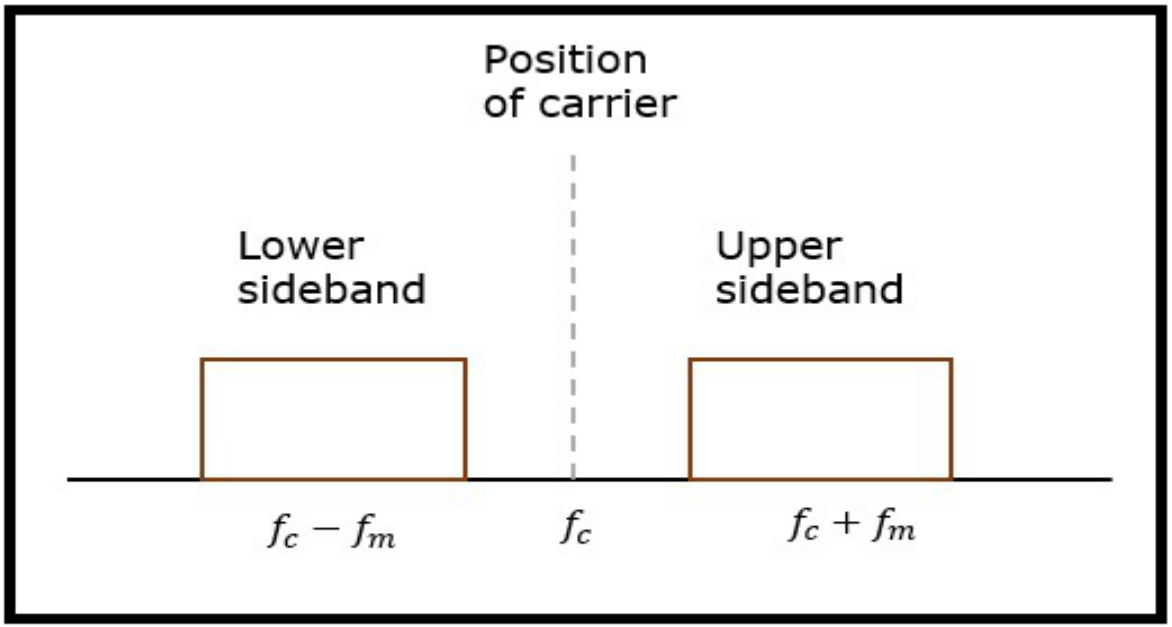
1. The efficiency of this modulation is very low because it uses a lot of power
2. This modulation uses amplitude frequency several times to modulate the signal by a carrier signal.
3. AM systems are susceptible toward the generation of noise generation.

Amplitude modulation (AM)

Types of Amplitude Modulation

1) Double sideband-suppressed carrier (DSB-SC) modulation

The transmitted wave consists of only the upper and lower sidebands



DSBSC system

Amplitude modulation (AM)

Types of Amplitude Modulation

1) Double sideband-suppressed carrier (DSB-SC) modulation

The transmitted wave consists of only the upper and lower sidebands

The advantage of DSB-SC modulation is

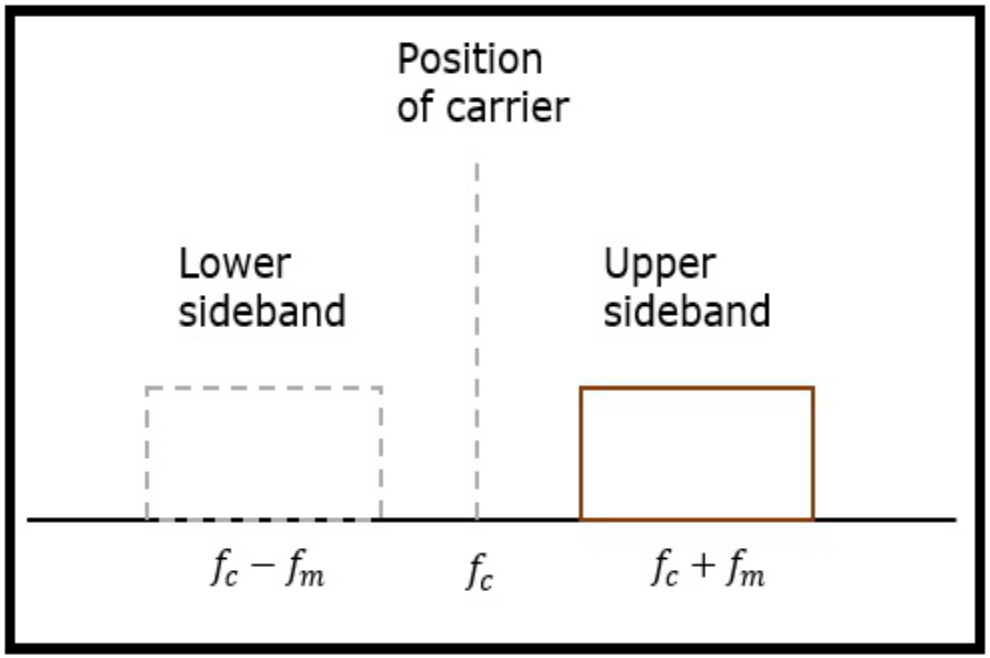
Its consumption of low power as obtained in overcoming the shortcomings faced by other modulation due to suppressed carrier in this modulation

Amplitude modulation (AM)

Types of Amplitude Modulation

2) Single sideband (SSB) modulation

The modulation wave consists only of the upper sideband or the lower sideband.



SSBSC system

Amplitude modulation (AM)

Types of Amplitude Modulation

2) Single sideband (SSB) modulation

The advantages of SSB modulation are –

1. Bandwidth or spectrum space occupied is lesser than AM and DSB signals.
2. transmission of more number of signals is allowed.
3. Power is saved.
4. High power signal can be transmitted.
5. Less amount of noise is present.
6. Signal fading is less likely to occur.

Angle Modulation

1. Frequency modulation (FM)

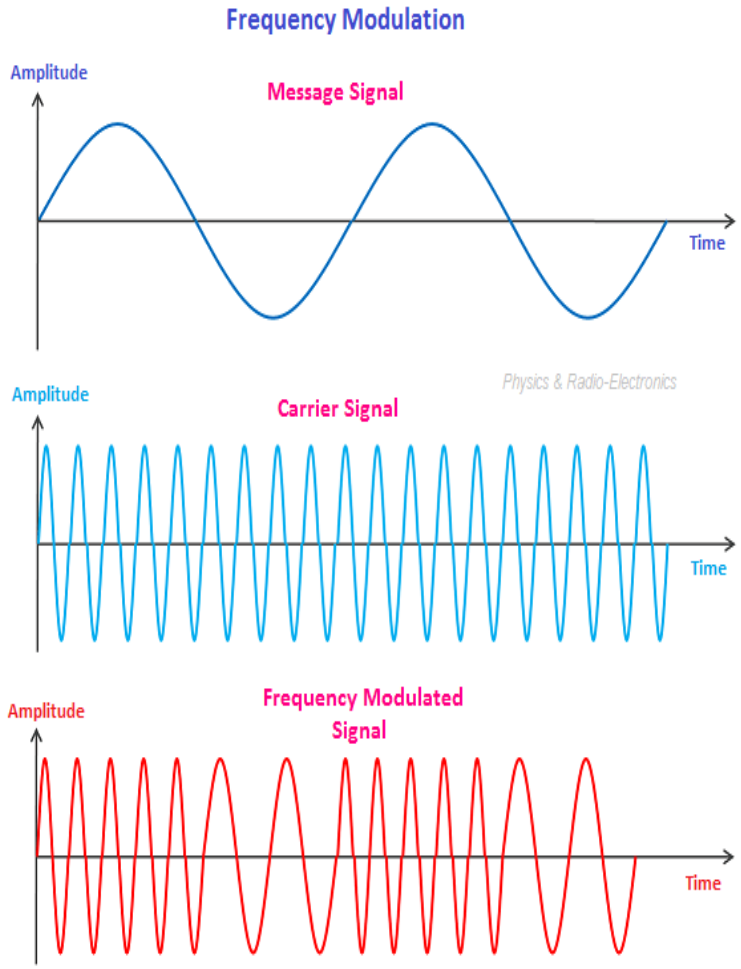
- in which the frequency of the carrier waveform is varied to reflect the frequency of the data.
- Frequency modulation is a type of modulation where the information (message signal) is transmitted over a carrier wave by varying its frequency in accordance with the amplitude of the message signal.

Frequency modulation (FM)

The first figure shows the low frequency modulating signal or message signal which contains useful information,

The second figure shows the high frequency carrier wave which does not contain any information,

The last figure shows the resultant Frequency modulated signal.



Frequency modulation (FM)

Advantages of Frequency modulation

1. All the power transmitted in frequency modulation is useful whereas in amplitude modulation, most of the power is in carrier (which is useless).
2. Adjacent channel interference does not takes place in frequency modulation.
3. High signal to noise ratio (S/N). In simple words, it has less noise

Frequency modulation (FM)

Drawbacks of Frequency modulation

It requires wider bandwidth than amplitude modulation.

Applications of frequency modulation

1. FM broadcasting
2. Radar
3. Magnetic tape recording systems
4. Telemetry
5. Two-way radio systems
6. Music synthesis
7. Seismic prospecting
8. Video transmission systems

2. Phase modulation (PM)

in which the phase of the carrier waveform is varied to reflect changes in the frequency of the data. In PM, the frequency is unchanged while the phase is changed relative to the base carrier frequency. It is similar to FM.

- **Phase modulation** is the process of transmitting information over a carrier wave by varying its phase in accordance with the amplitude of the message
- **Polarization modulation**, in which the angle of rotation of an optical carrier signal is varied to reflect transmitted data.

Phase modulation (PM)

The first figure shows the lov frequency modulating signa or message signal whicl contains useful information,

The second figure shows th high frequency carrier wav which does not contain an information,

The last figure shows th resultant Phase modulate signal.