SNS COLLEGE OF TECHNOLOGY

An Autonomous Institution
Coimbatore-35

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade(3rd Cycle)
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECB301-ANALOG AND DIGITAL COMMUNICATION

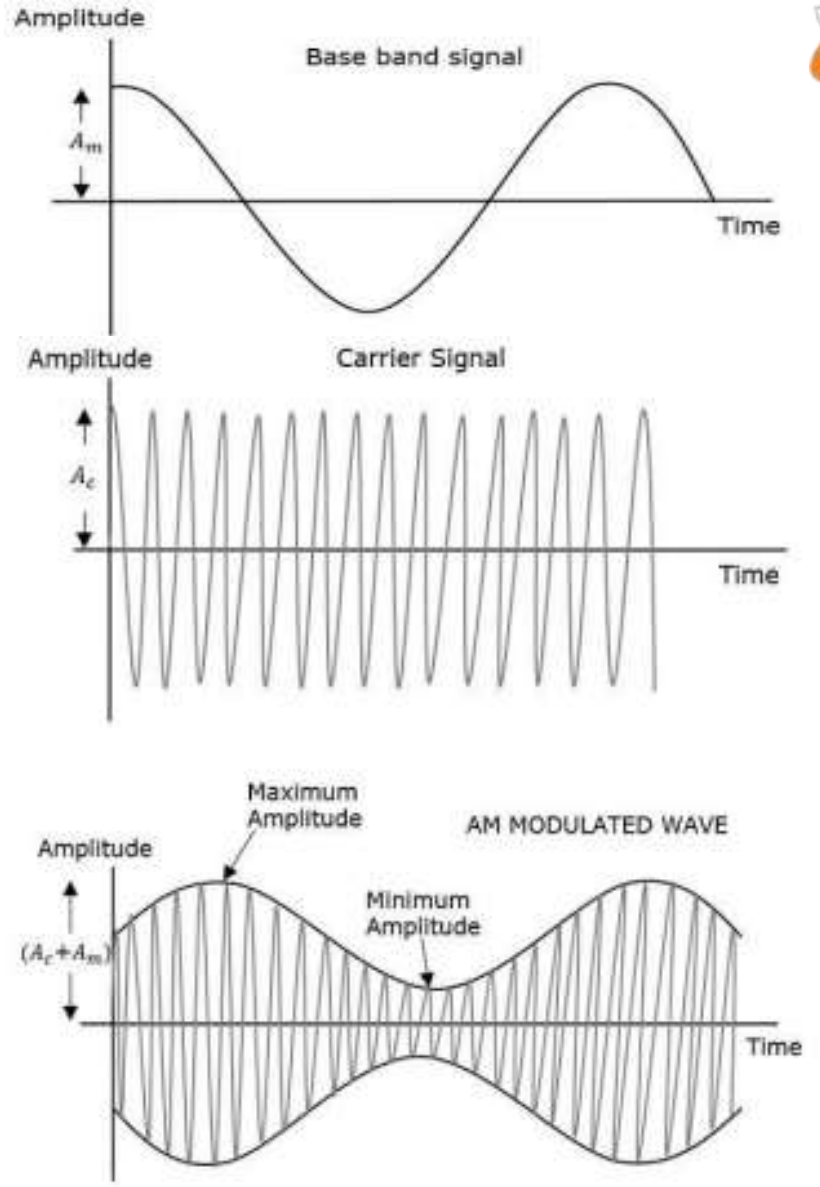
III YEAR/ V SEMESTER

UNIT 1 – ANALOG COMMUNICATION

TOPIC – AMPLITUDE MODULATION

AMPLITUDE MODULATION

The amplitude of the carrier signal varies in accordance with the instantaneous amplitude of the modulating signal.” Which means, the amplitude of the carrier signal containing no information varies as per the amplitude of the signal containing information, at each instant. This can be well explained by the figures.



- The first figure shows the modulating wave, which is the message signal.
- The next one is the carrier wave, which is a high frequency signal and contains no information.
- While, the last one is the resultant modulated wave.
- It can be observed that the positive and negative peaks of the carrier wave, are interconnected with an imaginary line.
- This line helps recreating the exact shape of the modulating signal.

Modulation Index

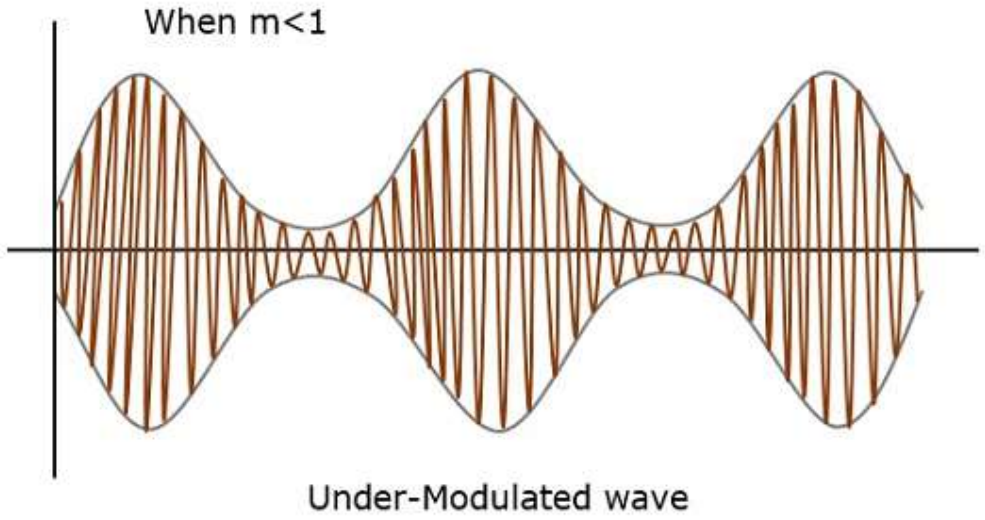
- A carrier wave, after being modulated, if the modulated level is calculated, then such an attempt is called as **Modulation Index** or **Modulation Depth**. It states the level of modulation that a carrier wave undergoes.

$$A_m/A_c = \mu.$$

μ denotes the modulation index or modulation depth. This is often denoted in percentage called as **Percentage Modulation**. It is the extent of modulation denoted in percentage, and is denoted by **m**.

UNDER MODULATION

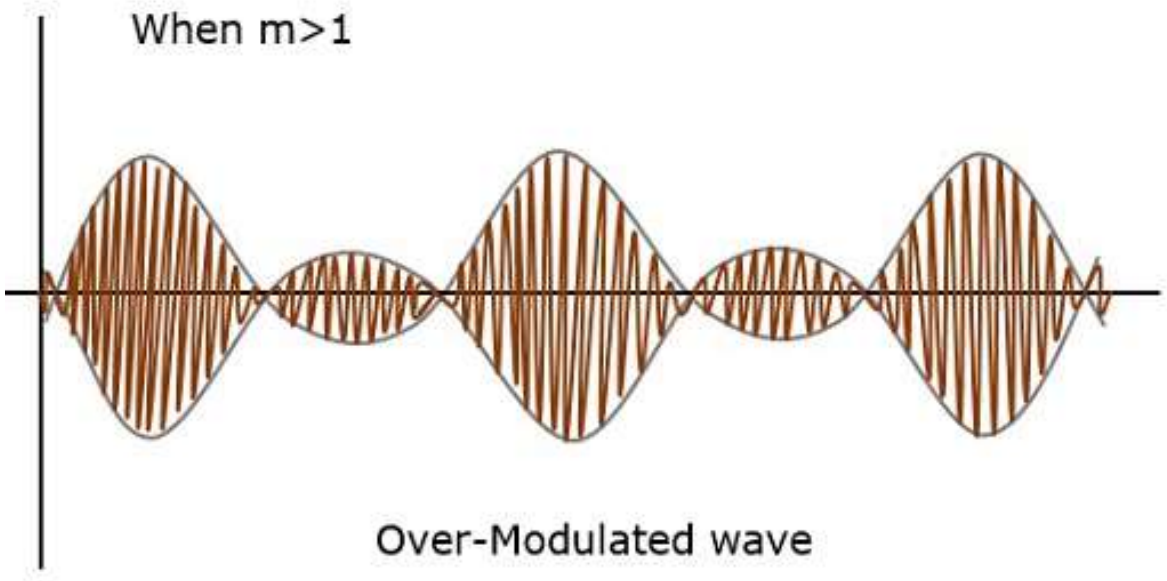
- For a perfect modulation, the value of modulation index should be 1, which means the modulation depth should be 100%.
- For instance, if this value is less than 1, i.e., the modulation index is 0.5, then the modulated output would look like the following figure. It is called as Under-modulation. Such a wave is called as an **under-modulated wave**.



OVER MODULATION

- If the value of the modulation index is greater than 1, i.e., 1.5 or so, then the wave will be an **over-modulated wave**.

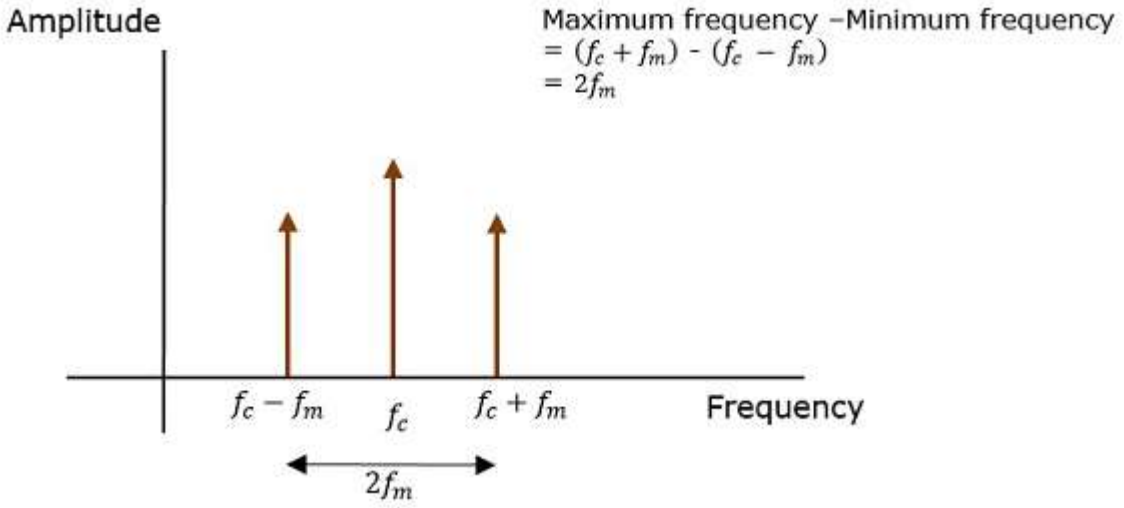
As the value of modulation index increases, the carrier experiences a 180° phase reversal, which causes additional sidebands and hence, the wave gets distorted. Such overmodulated wave causes interference, which cannot be eliminated.

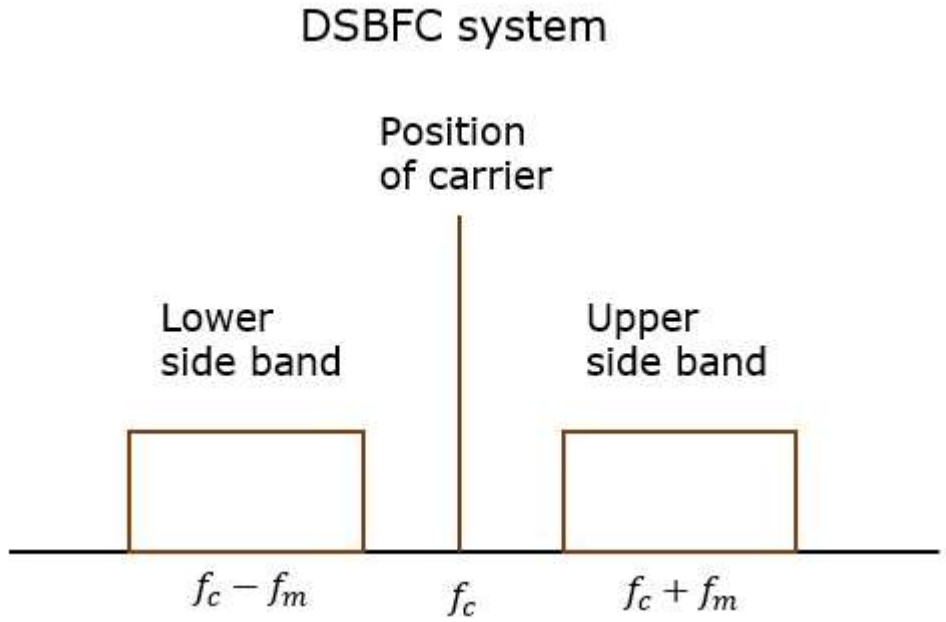


SIDE BAND

- In the process of Amplitude Modulation or Phase Modulation, the modulated wave consists of the carrier wave and two sidebands. The modulated signal has the information in the whole band except at the carrier frequency.
- A **Sideband** is a band of frequencies, containing power, which are the lower and higher frequencies of the carrier frequency. Both the sidebands contain the same information. The representation of amplitude modulated wave in the frequency domain is as shown in the following figure.

DOUBLE SIDEBAND FULL CARRIER

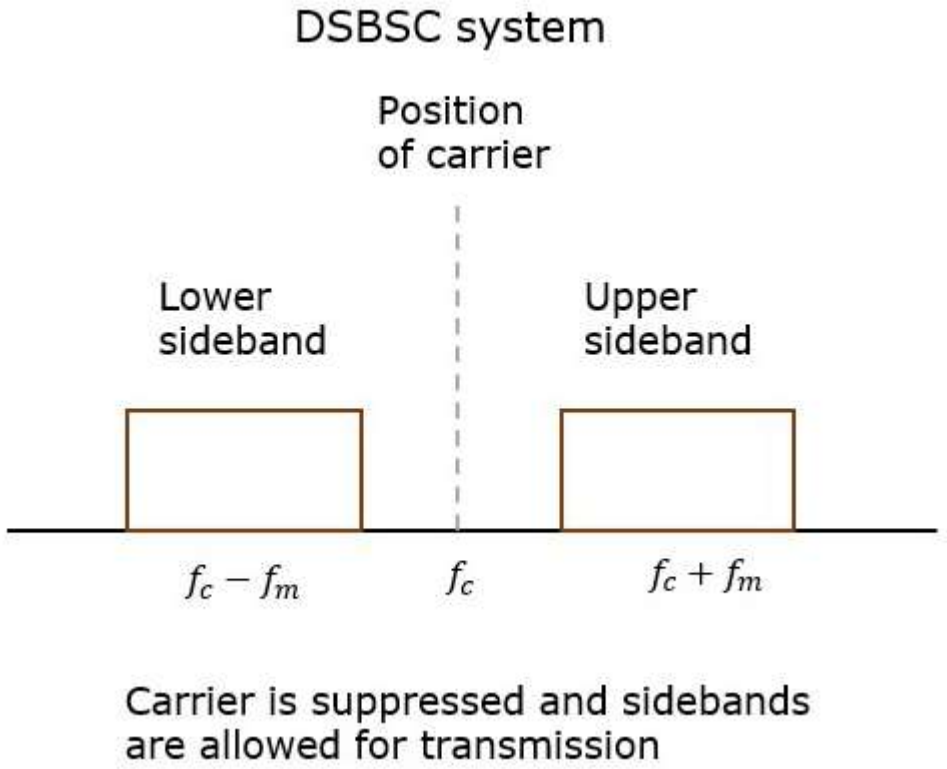




Both the sidebands in the right side of the image contain the same information. The transmission of such a signal which contains a carrier along with two sidebands, can be termed as **Double Sideband Full Carrier** system, or simply **DSB-FC**. It is plotted as shown in the following figure. However, such a transmission is inefficient. Two-thirds of the power is being wasted in the carrier, which carries no information.

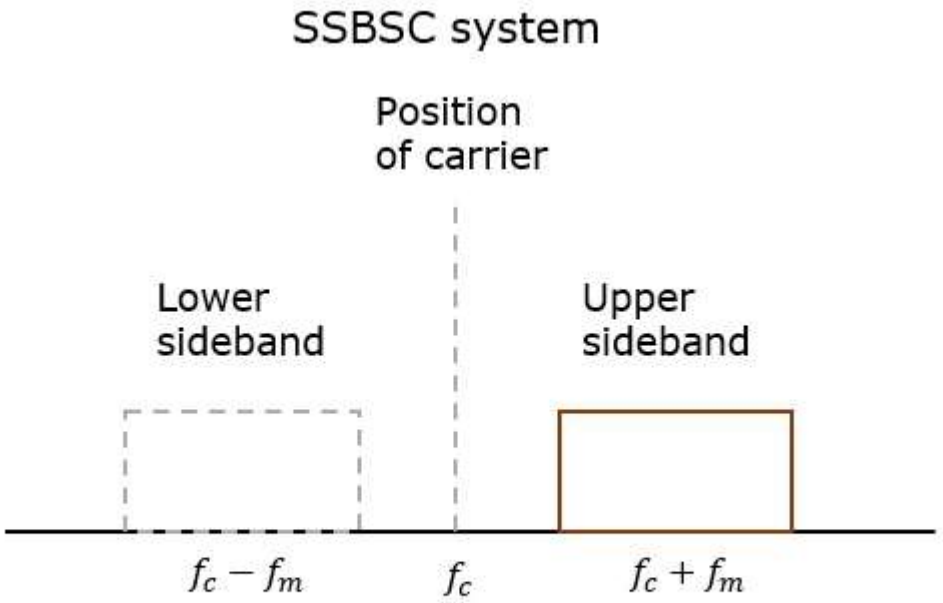
DOUBLE SIDEBAND SUPPRESSED CARRIER

- If this carrier is suppressed and the power saved is distributed to the two sidebands, such a process is called as **Double Sideband Suppressed Carrier** system, or simply **DSBSC**. It is plotted as shown in the following figure.



SINGLE SIDEBAND SUPPRESSED CARRIER

- The process of suppressing one of the sidebands, along with the carrier and transmitting a single sideband is called as **Single Sideband Suppressed Carrier** system, or simply **SSB-SC** or **SSB**. It is plotted as shown in the following figure.



Carrier and a sideband are suppressed and a single sideband is allowed for transmission

Sideband Modulation – Advantages

- Bandwidth or spectrum space occupied is lesser than AM and DSB signals.
- Transmission of more number of signals is allowed.
- Power is saved.
- High power signal can be transmitted.
- Less amount of noise is present.
- Signal fading is less likely to occur.

Sideband Modulation – Disadvantages

- The generation and detection of SSB signal is a complex process.
- Quality of the signal gets affected unless the SSB transmitter and receiver have an excellent frequency stability.

Sideband Modulation – Applications

- For power saving requirements and low bandwidth requirements.
- In land, air, and maritime mobile communications.
- In point-to-point communications.
- In radio communications.
- In television, telemetry, and radar communications.
- In military communications, such as amateur radio, etc.

ASSESSMENT

1.What is meant Amplitude Modulation

2.Differentiate between DSB-SC and SSB-SC

3.Define Over Modulation

4.Applications of Sidebands

THANK YOU