Answer on Question #53682-Physics-Optics

Explain the concept of modulation and its need in long distance communication. What is difference between amplitude modulation and frequency modulation?

Answer

When audio signals are transmitted over thousands of kilometers through radio transmission, the audio frequencies that lie within the frequency range of 15 Hertz to 20 Kilohertz have very small signal power and thus cannot be transmitted via antenna for communication purposes. The radiation of electrical energy is only possible at frequencies above 20 Kilohertz. The main advantage of high frequency signals is that they can be transmitted over very long distances by dissipating very small power. Thus, the audio signals must be sent along with the high frequency signals for communication. This can be done by superimposing electrical audio signals on a high frequency wave called the carrier wave. The carrier wave is generated from radio-frequency oscillators and is undamped in nature. Thus, when the audio-frequency signal is superimposed on a carrier wave, the resulting wave gets all the characteristics of the audio signal. The method of superimposing an audio signal over the carrier wave is called **modulation**.

After modulation is done, the resulting wave can be given to the antenna and the signal can be transmitted over a long distance.

Comparison chart (difference between amplitude modulation and frequency modulation)

	AM	**FM**
Stands for	AM stands for Amplitude Modulation	FM stands for Frequency Modulation
Origin	AM method of audio transmission was first successfully carried out in the mid 1870s.	FM radio was developed in the United states in the 1930s, mainly by Edwin Armstrong.
Modulating differences	In AM, a radio wave known as the "carrier" or "carrier wave" is modulated in amplitude by the signal that is to be transmitted. The frequency and phase remain the same.	In FM, a radio wave known as the "carrier" or "carrier wave" is modulated in frequency by the signal that is to be transmitted. The amplitude and phase remain the same.
Pros and cons	AM has poorer sound quality compared with FM, but is cheaper and can be transmitted over long distances. It has a lower bandwidth so it can have more stations available in any frequency range.	FM is less prone to interference than AM. However, FM signals are impacted by physical barriers. FM has better sound quality due to higher bandwidth.
Frequency Range	AM radio ranges from 535 to 1705 KHz (OR) Up to 1200 bits per second.	FM radio ranges in a higher spectrum from 88 to 108 MHz. (OR) 1200 to 2400 bits per second.
Bandwidth Requirements	Twice the highest modulating frequency. In AM radio broadcasting, the modulating signal has bandwidth of 15kHz, and hence the bandwidth of an amplitude-modulated signal is 30kHz.	Twice the sum of the modulating signal frequency and the frequency deviation. If the frequency deviation is 75kHz and the modulating signal frequency is 15kHz, the bandwidth required is 180kHz.
Zero crossing in modulated signal	Equidistant	Not equidistant
Complexity	Transmitter and receiver are simple but synchronization is needed in case of SSBSC AM carrier.	Transmitter and receiver are more complex as variation of modulating signal has to be converted and detected from corresponding variation in frequencies.(i.e. voltage to frequency and frequency to voltage conversion has

		to be done).
Noise	AM is more susceptible to noise because noise affects amplitude, which is where information is "stored" in an AM signal.	FM is less susceptible to noise because information in an FM signal is transmitted through varying the frequency, and not the amplitude.