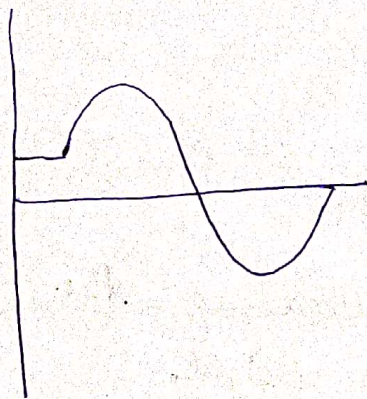
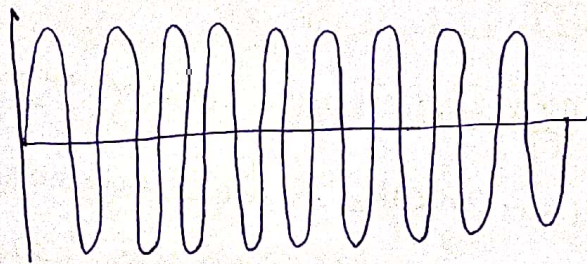


Modulation

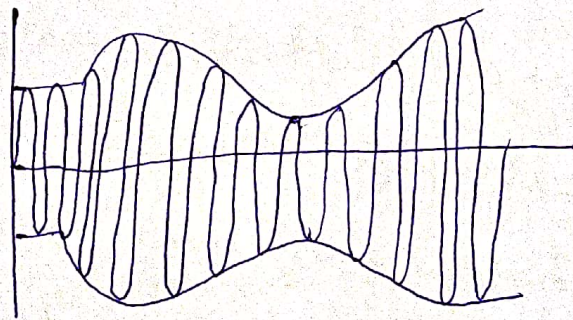
Modulation is process of altering some characteristics (amplitude, frequency or phase angle) of the carrier wave in accordance with instantaneous value of some other wave called the modulation wave.



Modulating Signal



Carrier wave



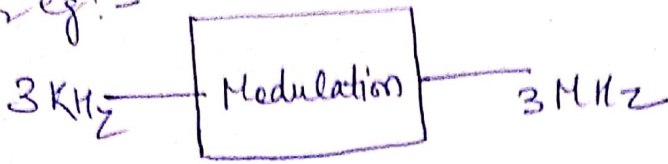
Amplitude modulated wave

Basic Need of Modulation.

- 1) Reducing antenna height :- for proper transmission & reception through an antenna. Minimum height of antenna. $l_{t \text{ min}} = \frac{1}{4} \lambda$ $\lambda = \frac{v}{f} = \frac{c}{f}$.

$$ht = \frac{c}{4f}$$

for eg:-



for $f = 3 \text{ KHz}$

$$ht = \frac{3 \times 10^8}{4 \times 3 \times 10^3} = 25 \text{ km}$$

for $f = 3 \text{ MHz}$

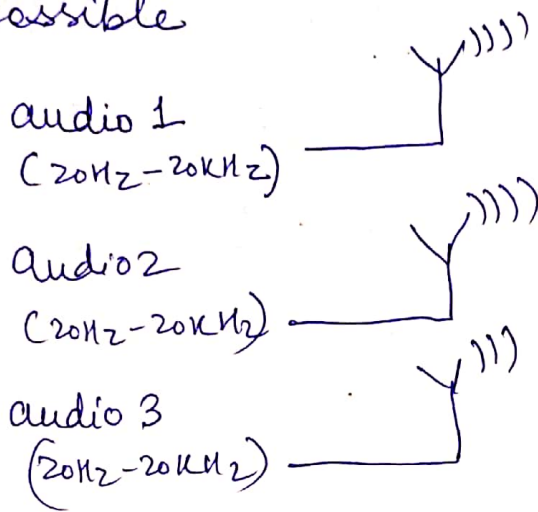
$$ht = \frac{3 \times 10^8}{4 \times 3 \times 10^6} = 25 \text{ m}$$

Modulation is process of increasing the frequency of the signal to reduce antenna height.

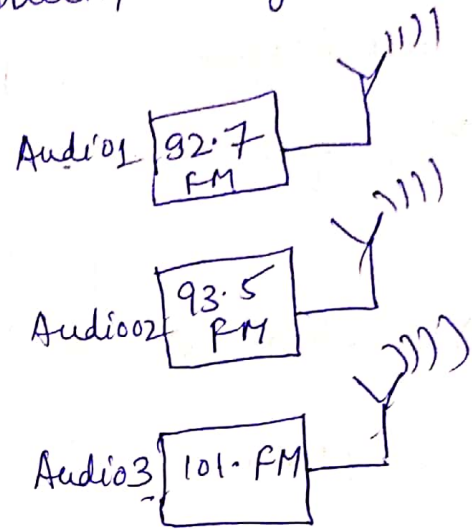
2) Avoid mixing of signals:- all sounds signal are in range from 20Hz - 20KHz. transmission of base-band signal from various sources causes mixing of signal & it is difficult to separate at receiving end. It is necessary to translate them all to different portion of electronic spectrum (channel) individual bandwidth. therefore modulating different signals sources by different carrier frequencies.

3) Multiplexing ^{is possible} :- It is the process of transmission of multiple no. of signal through a single channel at the same time.

* generally without modulation multiplexing is not possible



free space



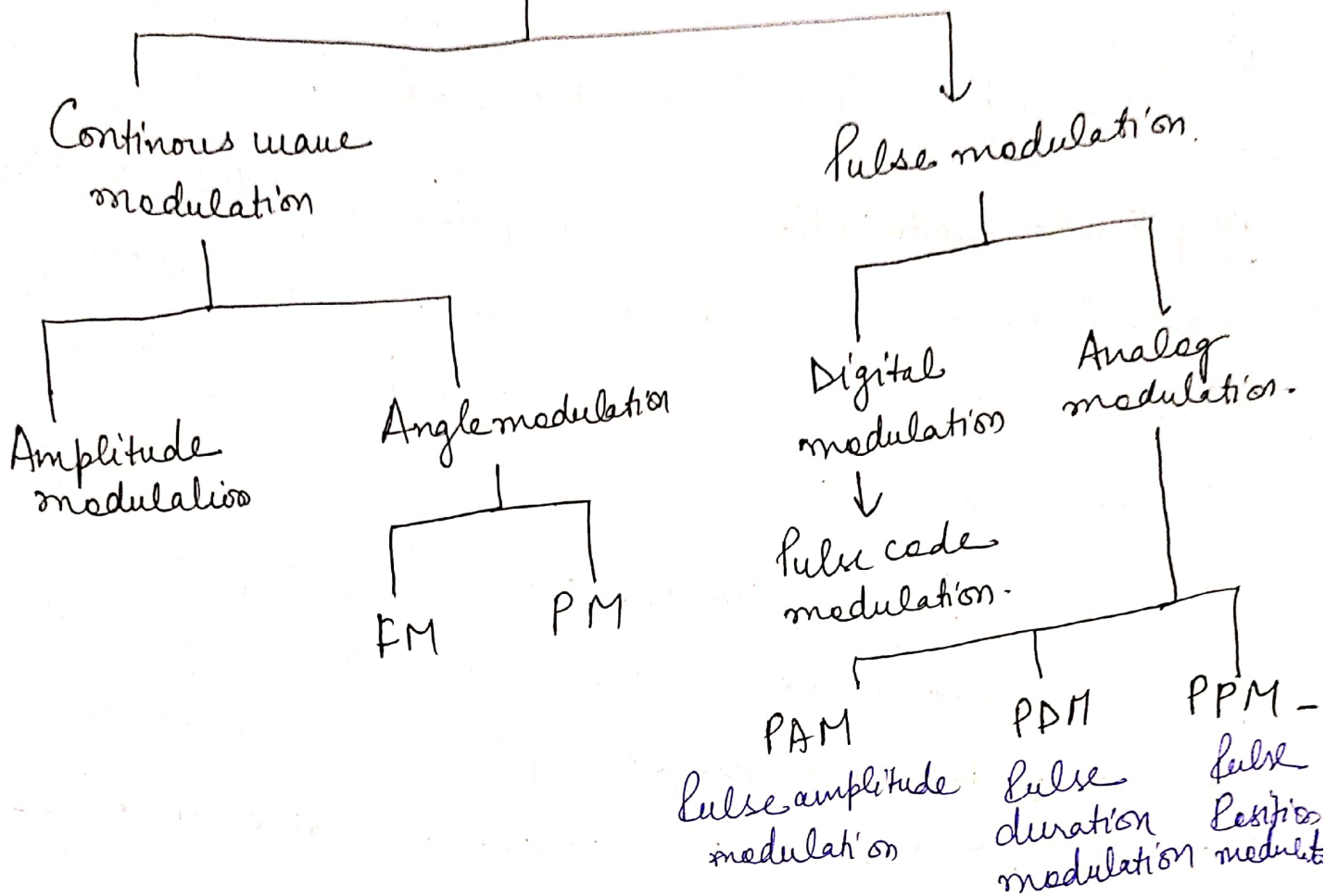
4) Increases range of communication. at low frequencies radiation is poor & signals get highly attenuated therefore baseband signal cannot be transmitted towards long distance. Modulation increases the frequency of signal to be radiated. this increases distance over which signal can be transmitted.

5) Allows adjustment in the bandwidth. Bandwidth of modulated signal may be made smaller or larger than original signal. S/N ratio in receiving which is function of signal BW can thus be improved by proper

Control of B.W. of modulating range

5) Improves quality of reception :- the signal communication using modulation techniques such as frequency modulation, pulse code modulation, reduce the effect of noise to great extent. Reduction of noise improves the quality of reception.

Types of Modulation



Basics of Signal Representation

B.W. requirement for transmission of signal. It is different for each signal. It basically depends on B.W. occupied by modulating signal.

1) Telegraphy Signal — the shortest time element of typical of duration 20ms.

$$B.W. = \text{frequency} = \frac{1}{20 \times 10^{-3}}$$

2) Voice & speech signal $\Rightarrow 300\text{Hz}$ to 3000Hz

$$B.W. \rightarrow 2700\text{Hz}$$

3) Music Signal — 30 Hz - 15 kHz
B.W. \rightarrow 14970 Hz

4) Television Signal \rightarrow GHz \rightarrow B.W.

Amplitude modulation:— The amplitude of the carrier wave is varied in accordance with the modulating signal keeping the frequency & phase of the carrier wave unchanged.

Instead of amplitude, either frequency or phase of sinusoidal carrier wave can be changed according to the message. Keeping the amplitude constant. This is another method of modulation called Angle modulation.

The angle modulation, ~~the~~ is further subdivided into frequency modulation & phase modulation.

In frequency modulation, the frequency of the carrier wave is varied in accordance with modulating signal, keeping amplitude & phase of the carrier wave unchanged.

In Phase modulation, the phase of carrier wave is varied in accordance with the modulating signal, keeping the amplitude & frequency of the carrier wave unchanged.

However, the modulation may also be classified, according to the nature of carrier wave.

1) Continuous wave modulation - when the carrier wave is continuous in nature, the modulation is continuous ^{wave} modulation or analog modulation. (Amplitude modulation & angle modulation).

2) Pulse modulation - when the carrier wave is pulse type waveform, the modulation process is referred to as pulse modulation. Pulse modulation may be of analog or digital type.