3. Amplitude modulation.

→ Communication is the process of transmitting information from one place to another place through a channel (or) median

→ Simply the transfer of information from source to desitination.

→ the examples of channel (or) median is co-axal cable, optical fibre, micro wave links.

→ electronics communication is mainly divided into three types.

i) Simple ii) Half-duplex iii) full-duplex.

i) Simple :-

It is a one way communication. In this communication information is transfer from transmitter to reciever only.

Ex :- Radio, TV, PC

ii) Half-Duplex :-

It is a two way communication but not simultaneously. Information is transfer from transmitter to reciever and reciever to transmitter but not at a time.

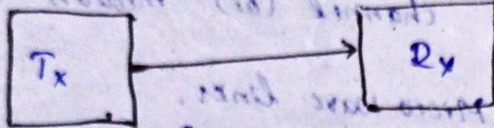
Eg :- Walkie-Takie.

(iii) full Duplex:-

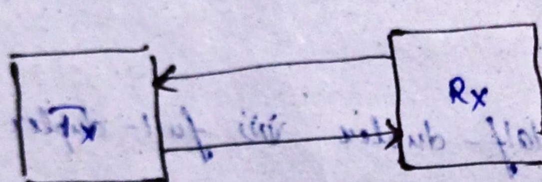
It is a two way communication simultaneously.

In this communication information is transfer from transmitter to reciever and reciever to transmitter at a time.

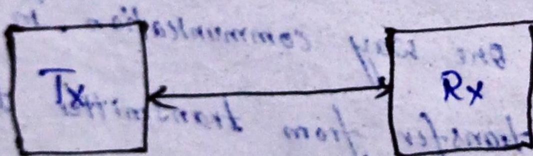
Ex: Mobile phone.



Simplex



Half- Duplex



full- Duplex.

In this transmitting process of information one place to another place some dis-torbance occurs at the channel (or) medium that is called as Noise.

The unwanted form of signals is called as Noise.

Noise are mainly classified into two types

i) external noise ii) Internal noise.

i) External noise:-

Atmospheric noise, Industrial noise, Space noise, (Solar noise, cosmic noise) are the external noise.

ii) Internal noise:-

Thermal noise, shot noise, flicker noise, transit time noise are the internal noise.

Bit rate:-

No. of Bits transmitter per second is called as Bit rate.

Baud-rate:-

No. of symbols (or) Bytes transmitted per second is called as Baund rate.

Band-width:-

the Difference b/w upper cut-off frequency and lower cut-off frequency is called as Band width

S/N ratio (signal to noise ratio):-

It is defined as the ratio signal power to noise power. It is denoted (or) measured is decibals (dc).

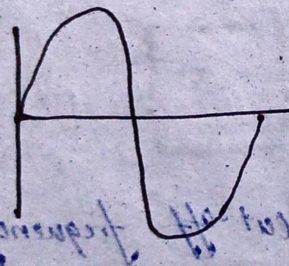
Modulation :-

Modulation is the process of varying characterstics of carrier signal is varied in accordance with the message signal.

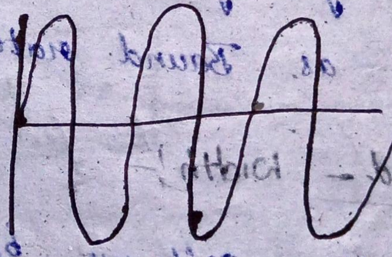
→ It is simplify the process of to convert low frequency signal into high frequency signal.

→ Message signal is a low frequency signal and carrier signal is a high frequency signal.

→ Message signal is also called as modulating signal (or) Base band signal.



a) message signal



b) carrier signal.

Amplitude signal :-

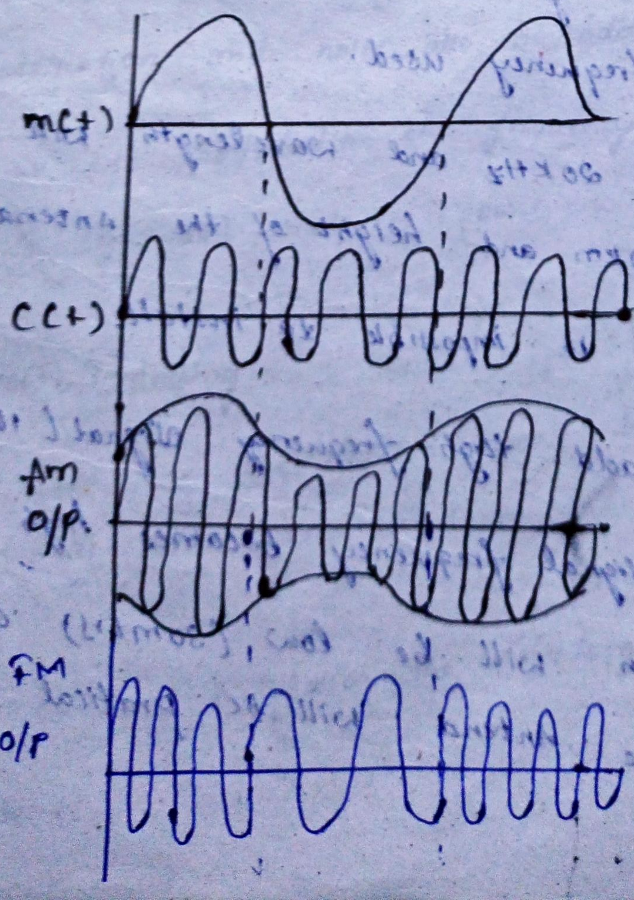
→ In amplitude modulation the amplitude of the carrier signal is varried in occurdants with the message signal (or) modulating signal, frequency and phase are in constant.

frequency modulation:-

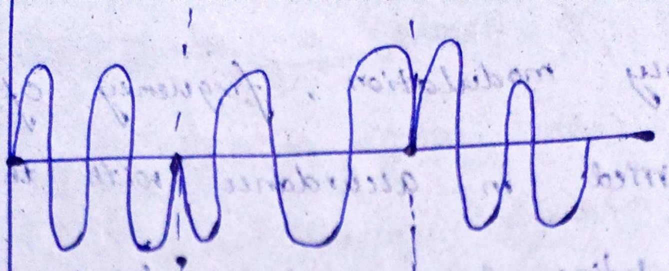
→ In frequency modulation, frequency of carried signal is varried in accurdance with the message signal (or) modulating signal and amplitude and phase are remains constant.

Phase modulation:-

→ In phase modulation, phase of carried signal is varried in accurdence with the message signal (or) modulating signal and frequency and amplitude are remains constant.



PM output.



Need of modulation :-

base band signals are not support the direct transmission such has signal to travel long distance its signal strength has to be increased by modulating with high frequency carrier signal.

1) Reduce the height of Antena :- to recieve the transmission signal the length of Antena should be quater wave-length of the frequency used.

frequency is 20kHz and wavelength will be equal to the 50km and height of the Antena becomes 3.75 km which is impossible to install.

→ when we add High frequency signal (10MHz) with our message signal frequency becomes high.

→ when wavelength will be low (30mtrs) and the height of the Antena will be pratical 7.5mts.

$\lambda = \frac{c}{f}$, $h = \frac{\lambda}{4}$

$\lambda = \frac{3 \times 10^8}{20 \times 10^3}$

$= \frac{3 \times 10^4}{2}$

$= \frac{30,000}{2}$

$= 15,000 mt$

$h = \frac{\lambda}{4}$

$= \frac{15000}{4}$

$= 3750 mt$

$= 3.75 km$

$\lambda = \frac{3 \times 10^8}{10 \times 10^6}$

$\lambda = 3 \times 10 = 30 mt$

$h = \frac{\lambda}{4} = \frac{30}{4} = 7.5 mt.$

2) Power radition:-

Radiated power is directly proportional to the $(\frac{1}{\lambda})^2$.

→ without modulation the frequency of the signal is low and radiated power also will be low.

→ If radiated power is very low. It will not reach the destination and noise also be added in the channel.

→ If we use modulation the frequency of the modulating signal is high and radiated power will becomes high.

3) Narrow Banding:-

It doesn't mean the reducing the Band with will remains same and wave length also same.

→ If we use modulation. the wave length of many signals is same.

→ By using modulation antena size requirement will be same.

→ 4) Multiplexing:-

It is the process of sending several signals ~~through~~ (sendi through a common channel.

→ most of the television channel use the same frequency range.

Amplitude modulation:-

In amplitude modulation amplitude of carrieng signal is varied in accordance with the instantaneous value of the modulating signal (or) message signal. the frequency and phase are remains constant.

→ If modulation is done by single frequency that type of frequency is called single tone frequency.

→ If modulation is done by multiple frequency that type of modulation is called as multiple tone modulation.

$x(t) = V_m \cos\omega_m t$

$V_m \Rightarrow$ message signal voltage

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

$V_c \Rightarrow$ carrier signal voltage

$\omega_m = 2\pi f_m$

$\omega_c = 2\pi f_c$

$f_m \Rightarrow$ message signal frequency

$f_c \Rightarrow$ carrier signal frequency

the standard expression of A.M wave is

$s(t) = [V_c + x(t)] \cos\omega_c t$

$s(t) = [V_c + V_m \cdot \cos\omega_m t] \cos\omega_c t$

$s(t) = V_c \cos\omega_c t + V_m \cos\omega_m t \cos\omega_c t$

$s(t) = V_c \cos\omega_c t [1 + \frac{V_m}{V_c} \cdot \cos\omega_m t]$

$m = \frac{V_m}{V_c}$ [m = modulation index of A.M wave]

$s(t) = V_c \cos\omega_c t [1 + m \cos\omega_m t]$

$s(t) = V_c \cos\omega_c t [1 + m \cos\omega_m t]$

$s(t) = V_c \cos\omega_c t + mV_c \cos\omega_c t \cos\omega_m t$

$s(t) = V_c \cos\omega_c t + \frac{mV_c}{2} \cdot 2\cos\omega_c t \cos\omega_m t$

$\boxed{2\cos A \cos B = \cos(A+B) + \cos(A-B)}$

$s(t) = V_c \cos\omega_c t + \frac{mV_c}{2} [\cos(\omega_c + \omega_m)t + \cos(\omega_c - \omega_m)t]$

$s(t) = V_c \cos\omega_c t + \frac{mV_c}{2} \cos(\omega_c + \omega_m)t + \frac{mV_c}{2} \cos(\omega_c - \omega_m)t.$

Carrier frequency component $\longrightarrow V_c \cos w_c t$

USB frequency component $\longrightarrow \frac{mV_c}{2} \cos(w_c + w_m) t$

LSB frequency component $\longrightarrow \frac{mV_c}{2} \cos(w_c - w_m) t$

Modulation Index:-

It is defined as ratio of modulating voltage to carrier voltage.

$$m = \frac{V_m}{V_c}$$

$$m = \frac{V_{max} - V_{min}}{V_{max} + V_{min}}$$

→ If $m = 1$ then it said to be critical modulation.

→ If $m < 1$ then it said to be under modulation.

→ If $m > 1$ then it said to be over modulation.

→ If $m = 0$ then it said to be zen modulation.

$m = 1$; $V_m = V_c$

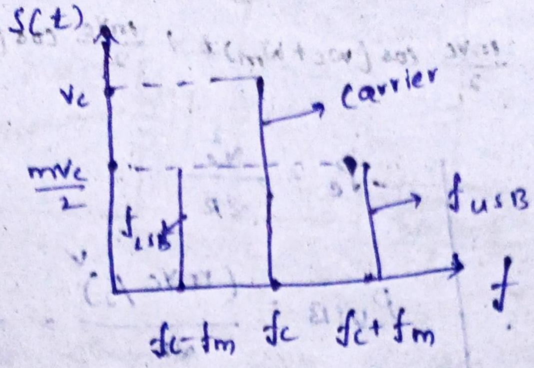
$m < 1$; $V_m < V_c$

$m > 1$; $V_m > V_c$

$m = 0$; $V_m = V_c = 0$.

The value of the modulation index always lies b/w the 0 to 1.

frequency Spectrum of Am Wave :-



→ Band with AM wave can be defined as the difference b/w upper cut-off frequency and lower cut-off frequency.

$$f_{USB} = f_c + f_m, \quad f_{LSB} = f_c - f_m$$

$$BW = (f_{USB}) - (f_{LSB})$$

$$= (f_c + f_m) - (f_c - f_m)$$

$$= \cancel{f_c} + f_m - \cancel{f_c} + f_m$$

$$= 2f_m$$

Band width = $2f_m$

→ Band width of the AM wave is equal to the twice of the message signal frequency.

Power calculation of AM Wave :-

→ the power of the AM wave is equal to the carrier power, upper side band power, lower side band power

$$P_T = P_c + P_{USB} + P_{LSB}.$$

the standard expression of AM wave is

$$S(t) = V_c \cos w t + \frac{m V_c}{2} \cos(w_c + w_m)t + \frac{m V_c}{2} \cos(w_c - w_m)t$$

$$P = \frac{V^2_{Rms}}{R}$$

$$V_{Rms} = \frac{V_m}{\sqrt{2}}$$

$$P = \frac{(V_m/\sqrt{2})^2}{R}$$

$$P = \frac{V^2_m}{2R}$$

$$P_c = \frac{V_c^2}{2R}$$

$$P_{USB} = \frac{(m V_c/2)^2}{2R} = \frac{m^2 V_c^2}{8R}$$

$$P_{LSB} = \frac{(m V_c/2)^2}{2R} = \frac{m^2 V_c^2}{8R}.$$

$$P_T = \frac{V_c^2}{2R} + \frac{m^2 V_c^2}{8R} + \frac{m^2 V_c^2}{8R}$$

$$P_T = P_c\left(1 + \frac{m^2}{4} + \frac{m^2}{4}\right)$$

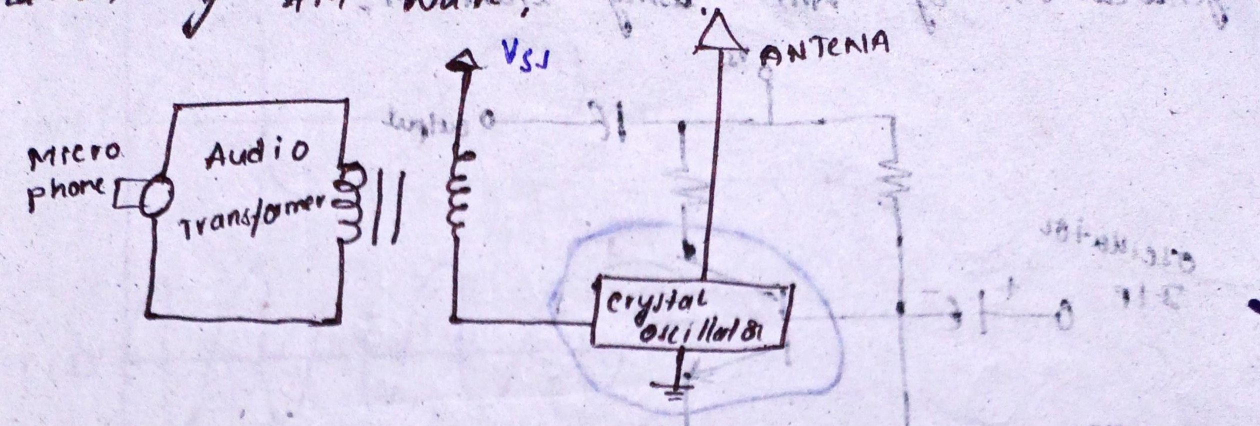
$$= P_c\left(1 + \frac{2m^2}{4}\right)$$

$$P_T = P_c\left(1 + \frac{m^2}{2}\right)$$

→ If modulation Index $m = 1$, then total power of the AM wave is equal to the 1.5 times of the carrier power

→ If $m = 0$ then total power of the AM wave is equal to the carrier power.

generation of AM wave :-



→ It is the simplest form of Am modulator.

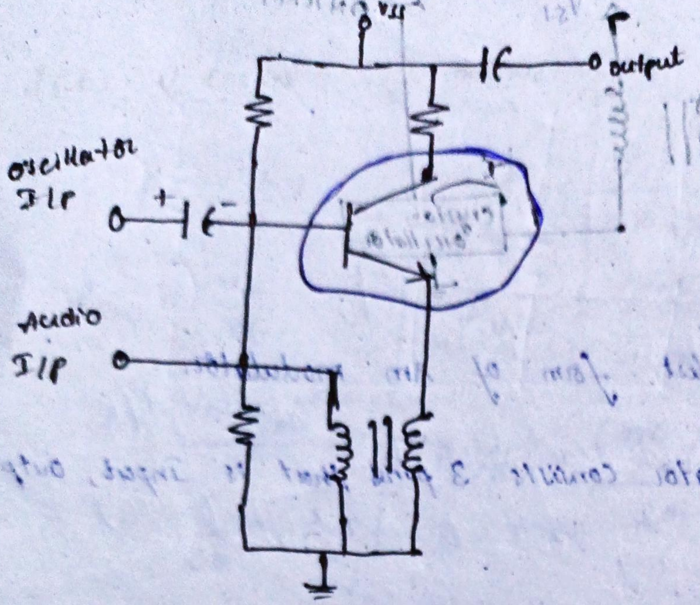
→ the crystal orillator consists 3 pins that is Input, output, ground.

→ By running the Vss supply through the secondary coil of Transformer whose primary coil is connected to Audio input source such as micro phone the actual voltage source supplied to the oscillator will flectuate based on the variation in the input signal.

→ Because crystal oxillators are verystable these voltage variations doesn't effect on the frequency generated by oxillator but they will effect the voltage of oscillator output.

→ the audio input signal will be reflected as voltage changes in the oscillator output signal.

Genaration of Am using transistor!



→ It is the generation of AM wave by using transistor the transistor used to Amplify the strength of the signal

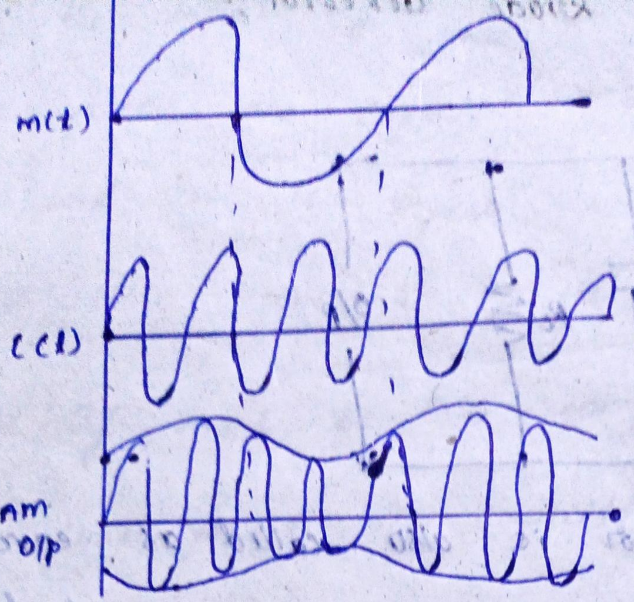
→ Carrier signal is appiled to the base of the signal

→ Message signal is applied to to trasistor emitter through a tranformer

→ the AM signal is taken from the transistor collector

→ the transistor amplifer the input from the oscillator through the emitter collector circuit.

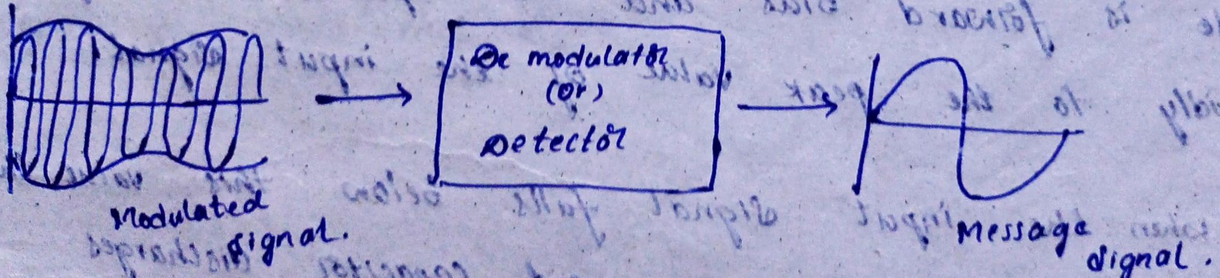
→ the audio input varies it produces a small current in the secondary ~~coil~~ coil of a trans-form this is effects the amount of current that flows through the collector emitter circuit. the intensity of output is varies in the audio input.

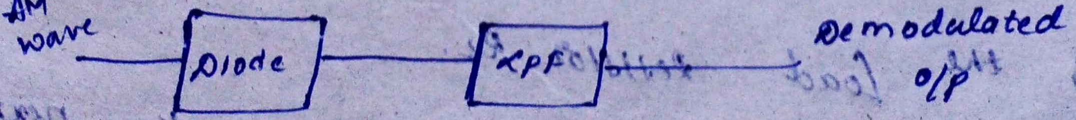


Detection of AM wave :-

The AM wave can be demodulated by using Diode dectector.

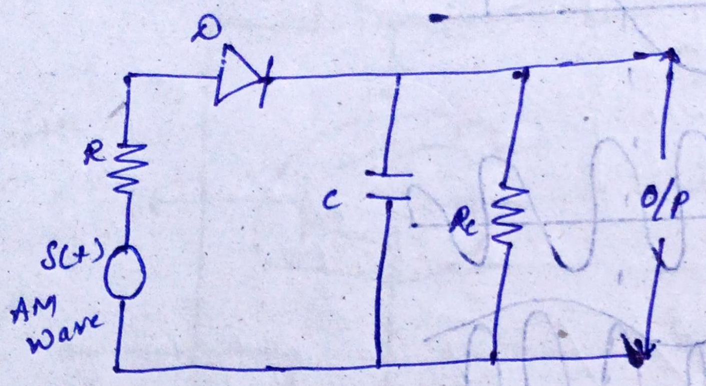
→ the input to the AM demodulator is Amplitude modulated signal and its output is original message signal.





Block diagram of diode Detector.

Circuit Diagram of Diode detector :-



→ the Diode Detector is also called as envelop Detector. It consists of Diode and Diode and low pass filter. the main detecting element is Diode.

→ the lpf contains a parallel combination of the resistor and capacitor.

→ the standard expression of AM wave is

$$S(t) = (V_c + x(t)) \cos w_c t.$$

→ During +ve half cycle of the input signal the diode is forward bias and the capacitor is charges rapidly to the peak value of the input signal.

→ when the input signal falls below this value the diode becomes Reverse bias and capacitor discharges through the Load resistor R_L.

→ the discharge process continues until the next +ve half cycle.

→ When the input signal becomes greater than the voltage across the capacitor the diode conducts again and it is repeat.

→ the time constant of the low pass RC is $T = RC$

→ ~~the~~ If must be low compare with the carrier signal time period the capacitor charges rapidly when applied voltage is upto the diode is conducting

→ the AM signal is rectified by a diode and then filtered by capacitor to recover the envelop which is the original message signal.

→ the o/p of the diode detector is message signal (or) modulating signal.