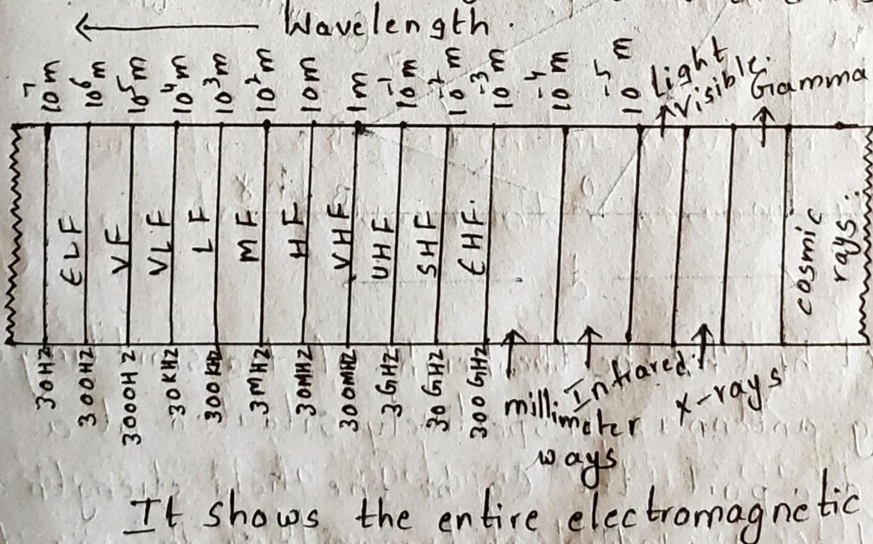
1. Write about Electromagnetic spectrum ?

Electromagnetic waves are signals that oscillate that is, the amplitudes of the electric and magnetic fields vary at a specific rate. The field intensities fluctuate up and down a given number of times per second. The electromagnetic waves vary sinusoidally. Their frequency measured in cycles per second or hertz these oscillations may occur at a very low frequency or at an extremely high frequency. Their entire range of frequency is referred to as the electromagnetic spectrum it includes signals such as the 60-HZ power line frequency and audio signals at the low end in the midrange are the most commonly used radio frequencies for two-way communications, televisions and other applications. At the upper end of the spectrum are infrared and visible light.

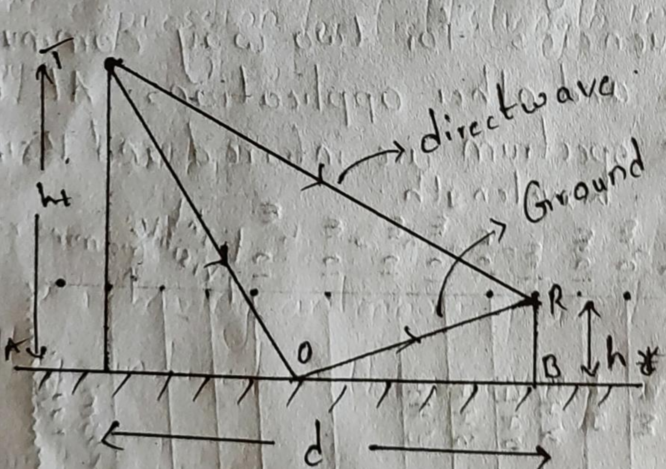


It shows the entire electromagnetic spectrum the relation b/w frequency & wavelength is given by $\lambda = \frac{c}{f}$ where c is the velocity of light which is 3×10^8 m/sec

2. Write about space wave propogation ?

It is also called as direct wave propogation or line of sight propogation. Space waves are direct waves, which travel in straight lines. They depends on line of ~~[stra]~~ sight condition, Space waves are limited in their propogation by curvature of the earth. Thus they propagate similar to the electromagnetic waves in free space. Space wave propogation is useful at higher frequencies and microwave from 30 MHZ onwards. This mode of propagation is through troposphere. Line of sight communication normally abbreviated as LOS is limited to few tens of kilometers.

When the earth curvature can be neglected, space wave propagation will take place.



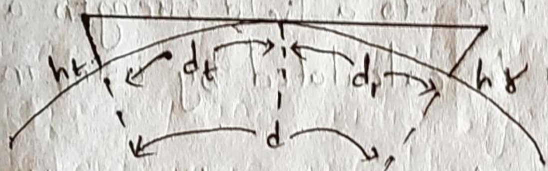
Let h_t & h_r be the height of transmitting and receiving antennas respectively situated at a distance d apart. Let E_0 be the field strength of the direct wave at the receiving point R. The direct wave and the ground reflected wave combine vectorially at receiving antenna. The result field strength E_R at the receiving antenna which is at a distance d from transmitting antenna is

$$E_R = 2E_0 \sin\left[\frac{2\pi h_t h_r}{\lambda d}\right].$$

Radio horizon for space waves is about four-thirds as far as the optical horizon is given by the empirical formula.

$$d_t = 4\sqrt{h_t}$$

Where d_t is the distance from transmitting antenna above ground in 'km' h_t is the height of transmitting antenna above the ground in 'm'.



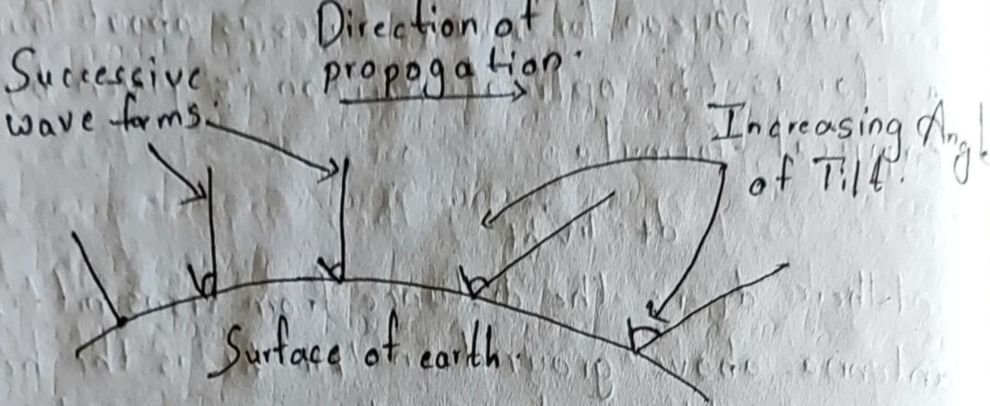
The same formula can be applied to the receiving antenna thus the total distance b/w transmitter and receiver is given by:

$$d = d_t + d_r = 4\sqrt{h_t} + 4\sqrt{h_r}.$$

3. Write about Ground Wave propogation?

It is also called as surface wave propogation. Ground wave is that electromagnetic wave which is guided along the surface of the earth. The ground wave as being produced by vertical antenna's is vertically polarized to prevent short circuiting the electric component. The ground wave propogation along the surface of earth induces charge in earth which travel with the wave and constitute a current

Ground wave propogation is shown in the figure



Radiation from an antenna by means of the ground wave gives rise to a field strength at a distance, which may be calculated by using maxwell's equations

The expression for field strength in volts/meter is given by

$$\epsilon = \frac{120\pi h_t I}{\lambda d}$$

If a receiving antenna is placed at this point The Voltage induced in the receiving antenna is given by

$$V = \frac{120\pi\, h_t h_r}{\lambda d}$$ where

120π = characteristic impedance of free space

h_t = Effective height of transmitting antenna

h_r = Effective height of receiving antenna

I = Antenna Current

d = distance from the transmitting antenna.

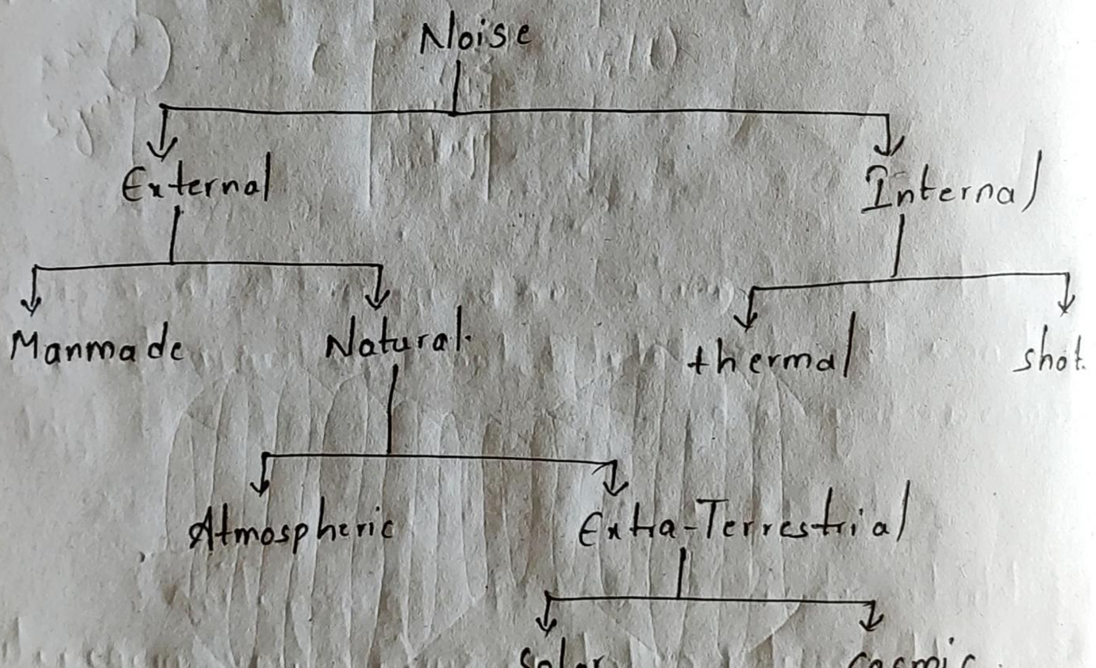
λ = wavelength

1. Explain about Noise in Communication ?

Noise may be defined as any unwanted energy tending to interface with the proper reception and reproduction of transmitted signals.

Noise can be divided in to two types.

* External Noise :- Noise whose sources are external to the receiver.
* Internal Noise :- Noise created with in the receiver itself.



① <u>Man made Noise</u> :- Man made noise results from the radiations produced by electrical machinery, ignition System of automobiles etc, which produce sparks.

② <u>Atmospheric Noise</u> :- It is often referred to as static. static usually comes from lightning b/w the earth and clouds. Atmospheric noise has its great impact on signals at frequencies below 30MHZ.

(3) **Spolar Noise** :- The noise generated by the sun is known as solar noise. The noise intensity produced by the sun varies with time. The sun has a repeatable 11-year noise cycle.

(4) **Cosmic Noise** :- Noise generated by stars outside our solar system is known as cosmic Noise.

(5) **Thermal Agitation Noise** :- This is also known as white noise (or) Johnson noise. The noise generated in the resistive component is referred to as thermal noise.

The noise generated by a resistor is proportional to its absolute temperature and Bandwidth.

$$P_n \propto T\,\delta f$$

$$P_n = KT\,\delta f \quad \text{where}$$

K = Boltzman's constant $= 1.38 \times 10^{-23}$ (J/K)

T = Temperature $K = 273°c$

δf = bandwidth

P_n = max o/p noise power of resistor

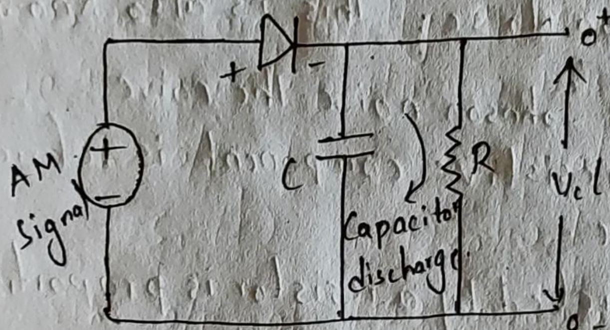
(6) **shot Noise** :- It is present in all amplifying devices and all active devices. shot noise is produced by the random movement of electrons. The amount of shot noise is directly proportional to the amount of dc bias flowing in a device

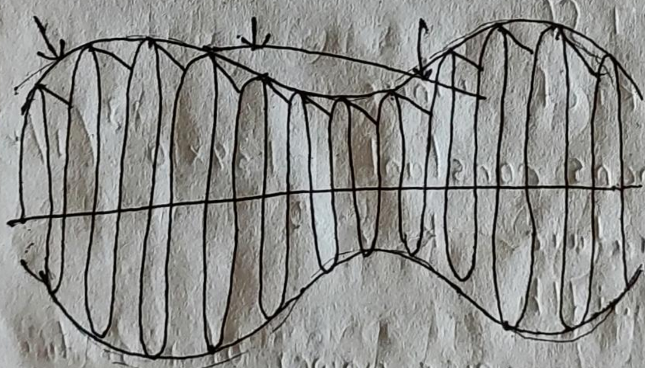
The rms noise current in a device I_n is calculated as

$$I_n = \sqrt{2qIB} \quad \text{where}$$

q = electron charge (1.6×10^{-19} C)
I = direct current (A)
B = bandwidth (Hz)

(2) Explain about Envelope detector.





* Envelope detector is a device used for demodulation of AM wave
* In this output of detector follows th envelope of the modulated signal.
* The Circuit consists of a diode, resistor and capacitor. An AM signal is applied to this as i/p

* On the positive cycle of i/p signal, the diode conductor and the capacitor c charges up to the peak Voltage of the i/p signal.
* On Negative cycle of i/p signal the diode is cutoff and Capacitor c discharges through the resistor with a time constant RC.
* Making RC too large, would make it impossible for the capacitor Voltage to follow the envelope

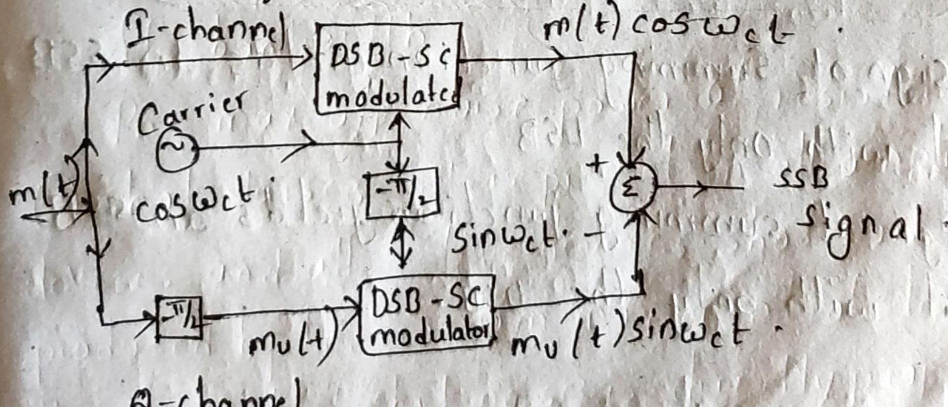
$$\frac{1}{2\pi B} >> RC >> \frac{1}{\omega c}$$

* The envelope detector o/p is $V_c(t) = A + m(t)$ with a ripple of frequency ω_c. The dc term A can be blocked out by a capacitor. The ripple may be reduced by another RC LPF.

③ Explain about phase-shift Method.

WKT $\phi_{SSB}(t) = m(t)\cos\omega_c t \pm m_u(t)\sin\omega_c t \rightarrow ①$

This eq. is basis for this method.



The boxes labled "$-\pi/2$" are the $\pi/2$ phase shifters, which delays the phase of every spectral component by $\pi/2$. Hence it is a Hilbert transformer.

→ SSB modulator uses two DSB modulators, supplied with carrier wave in phase quadrature to each other.

→ The msg signal $m(t)$ and the carrier signal $\cos\omega_c t$ are directly applied to the DSB modulator in I-channel, producing DSB-SC wave.

→ The o/p of DSB modulator in I-channel

$$s_I(t) = m(t)\cos\omega_c t \rightarrow (2)$$

→ The o/p of DSB modulator in Q-channel

$$s_Q(t) = m_h(t)\sin\omega_c t \rightarrow (3)$$

Adding (2) & (3).

$$s(t) = s_I(t) \pm s_Q(t).$$

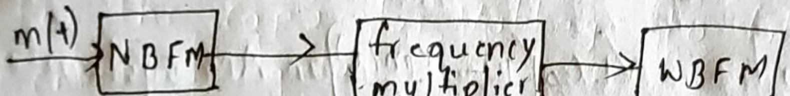
$$\boxed{s(t) = m(t)\cos\omega_c t \pm m_h(t)\sin\omega_c t}$$

'+' sign at summing junction yields an SSB signal with only the LSB.

'−' sign at summing junction yields an SSB signal with only the USB.

① Explain about Armstrong method of FM generation?

Indirect method of Armstrong :- In this method, NBFM is generated by integrating $m(t)$ and using it to phase modulate a carrier. The NBFM is then converted to WBFM by using frequency multiplier.



Block diagram of indirect method of Armstrong generation of FM wave -

→ The o/p is required to have a carrier frequency of 91.2 MHZ & ∇f = 75 KHZ.

→ The deviction Δf is chosen to be 25HZ in order to maintain $B << 1$.

$$\beta = \frac{\Delta f}{f_m} = \frac{50}{25} = 1/2 = 0.5 << 1.$$

Advantage: This scheme has an advantage of frequency stability.

* Direct Method :- It is also called as parameter Variation method & Reactance method of generating WBFm.

* We can generate an FM wave by using the modulating signal $m(t)$ as a control signal this gives $\omega_i(t) = \omega_c + K_f\, m(t)$

for example, in hartley (or) colpitt oscillators, the frequency of oscillation is given by:

$$\omega_0 = \frac{1}{\sqrt{LC}}.$$

If Capacitance C is varied by the modulating signal m(t) i.e, if $C = C_0 - km(t)$.

$$\omega_0 = \frac{1}{\sqrt{LC_0\left[1 - \frac{km(t)}{C_0}\right]}}$$

$$= \frac{1}{\sqrt{LC_0}\left[1 - \frac{km(t)}{C_0}\right]^{1/2}}$$

$$\omega_0 \approx \frac{1}{\sqrt{LC_0}}\left[1 + \frac{km(t)}{2C_0}\right] \quad \frac{km(t)}{C_0} << 1.$$

Here we have used the binomial approximation $(1+x)^n \approx 1+nx$ for $|x| << 1$ thus

$$\omega_0 = \omega_c\left[1 + \frac{km(t)}{2C_0}\right]$$

$$\omega_0 = \omega_c + k_f m(t) \rightarrow (1).$$

Because $C = C_0 - km(t)$ the max Capacitance deviation is $\Delta C = km_p = \frac{2k_f C_0 m_p}{\omega_c}$

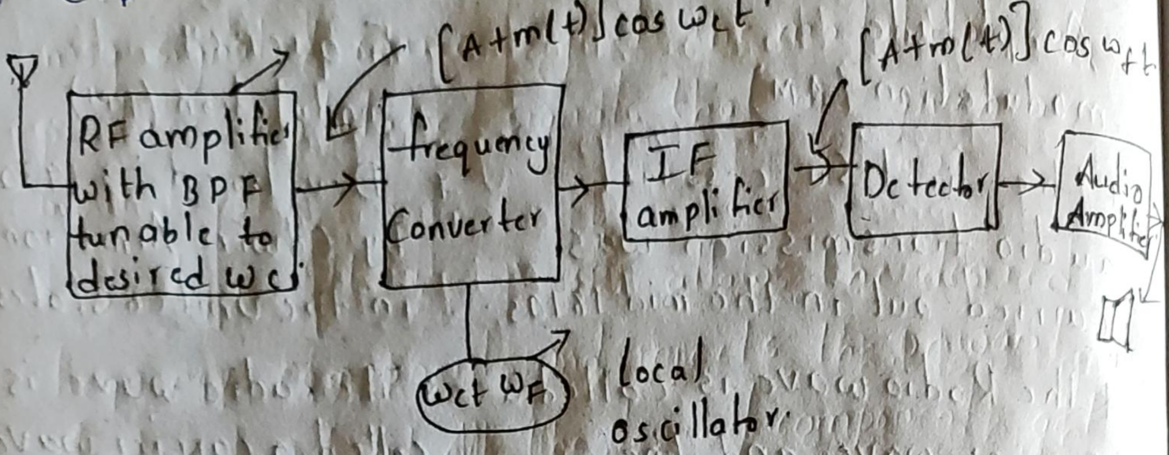
$$\frac{\Delta C}{C_0} = \frac{2k_f m_p}{\omega_c} = 2\frac{\Delta f}{f_c}$$

direct FM generation produces sufficient freq. deviation & but this method has poor frequency stability.

(2) Difference b/w FM and AM generation.

Amplitude modulation (AM)	Frequency modulation (FM)
* The first successful audio transmission was carried out in the mid 1870s.	* Developed in 1930 by Edwin Armstrong, in the United states.
* The Radio wave is called a Carrier wave and the frequency and phase remain the same	* The radio wave is called a carrier wave, but the amplitude and phase remain the same.
* Has poor sound quality, but can transmit longer distance.	* Has higher bandwidth with better sound quality.
* The frequency range of AM radio waves Varies from 535 to 1705HZ.	* The frequency range of FM is 88 to 108MHz in the higher spectrum.
* More susceptible to noise	* less susceptible to noise.

1) Explain about Superheterodyne of AM receiver.



The radio receiver used in an AM system is called the superheterodyne AM receiver.

* Receiving antenna :- It receives radio signals from Various broadcasting stations is used to receive the electromagnetic wave and convert it into RF signal.

* RF Section :- It is basically a tunable filter and an amplifier that picksup the desired station by tuning the filter to the right frequency band.

* Frequency Mixer :- It translates the carrier from ω_c to a fixed IF frequency of 455 KHZ. for this purpose it uses a local oscillator of frequency 455 KHZ above the incoming carrier frequency.

$$f_{LO} = f_c + f_{IF}$$

* **IF amplier:-** The intermediate frequency obtained from the mixer is fed to an IF amplifier which provides good amplification and selectivity to the signal.
* **Detector:-** The IF amplifier o/p is fed to detector for demodulating ~~sia~~ the modulated signal.
* **Audio amplifier:-** The audio o/p obtained from detector is fed to audio freq. amplifier to get a specified power level suitable for activate the loud speaker.
* **Loud speaker:-** Loud speaker converts audio signal into original sound signals as received from the broadcasting station

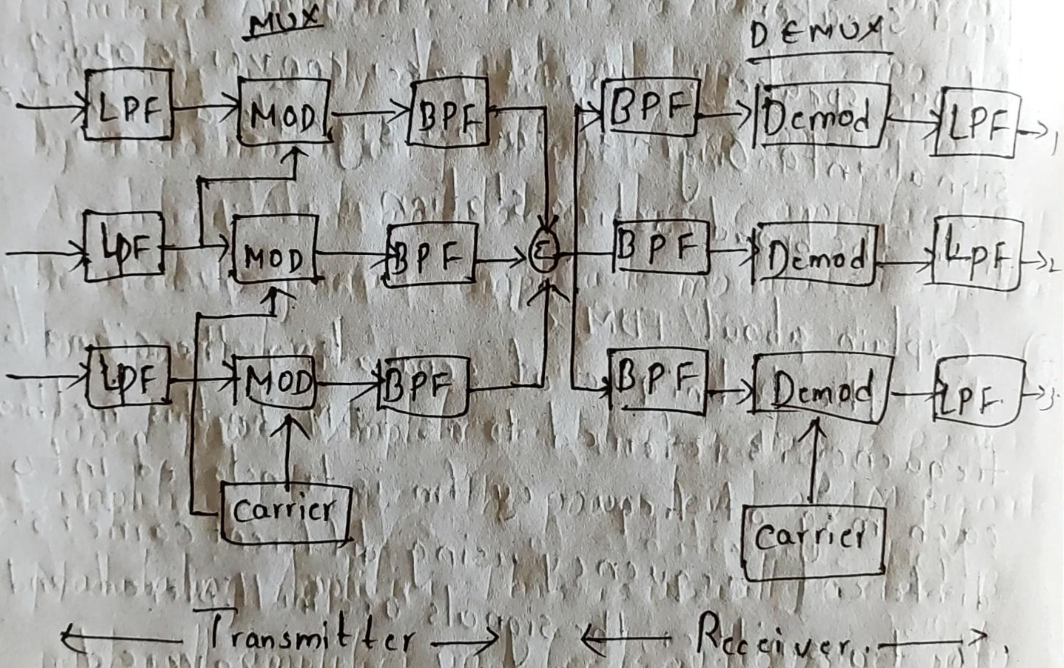
(2) Explain about FDM ?

The technique of separating the signals in frequency is referred to as FDM. In this method, each msg of frequency fm is translated into different frequency using different carriers. At different frequency, the signals are multiplexed and at the transmitter, the signals are multiplexed and at receiver, original signals are recovered.

* Low pass filter:- Msg signals from different sources are given as i/p to LF. This filter allows only low freq components & attenuates the high frequency components. Thus low frequency msg signals are obtained at the o/p of ~~LF~~.

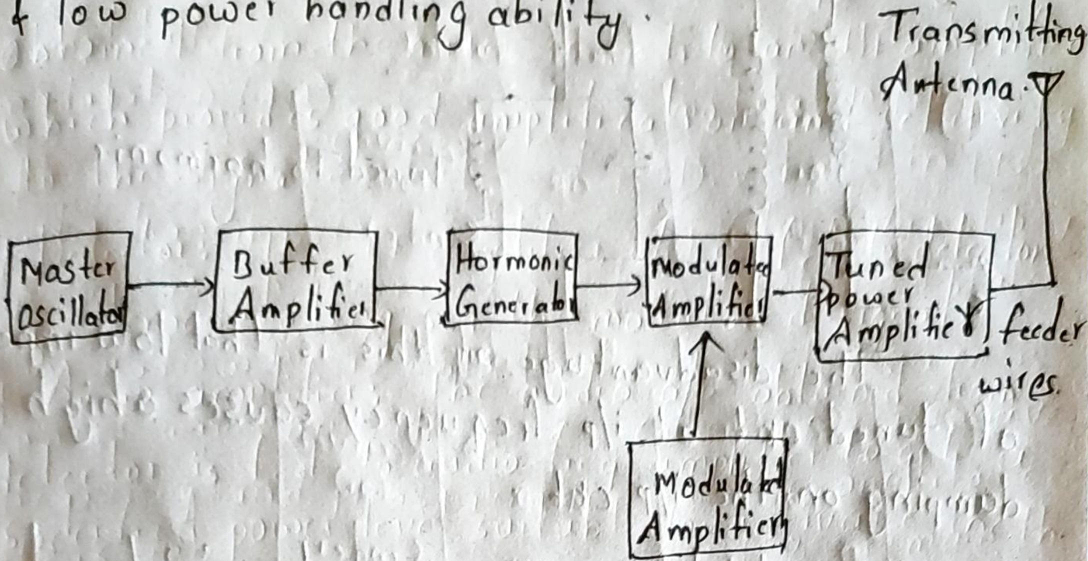
* Modulator:- The i/p's to the modulator are msg signal & carrier signal. The modulator o/p produces modulated signals that are given as input to BPF.

* Band pass filter:- A BPF allows the desired frequency components and rejects the unwanted freq components. All the desired components get combined and enter in to a sigle communication channel.



③ Explain about Low level AM Transmitters.

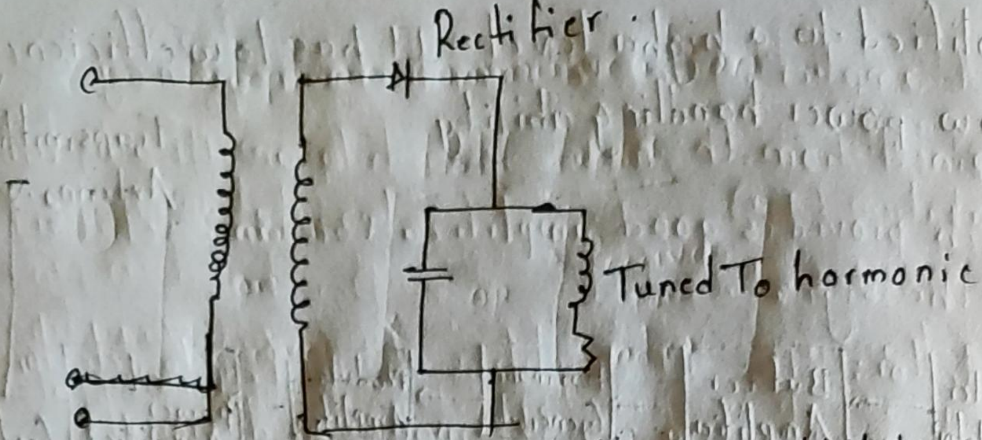
In this system the modulation process occurs at low power level. The lowlevel modulation has limited applications & is employed in certain applications and the advantage of lowlevel modulation is that the audio signal need not be amplified to a higher level. It has low efficiency & low power handling ability.



Master Oscillator:- It generates oscillations of desired frequency with higher and constant Values. The generated frequency is required to remain constant with in closed units inspite of Variations in the supply voltage, ambient temperature & temperature of components of load

Buffer Amplifier:- Buffer Amplifier is connected in b/w master oscillator & harmonic generator which doesn't draw any i/p current and hence causes no loading " changes in carrier frequency and hence Variations in loading are thus avoided.

Hormonic generators:- Hormonic generators differ in the means adopted to disort the pure sine Voltage. pure sine wave may be rectified by feeding it to a half wave rectifier.



The disadvantage of this is that low impedance of tuned ckt at i/p frequency causes a high damping on the i/p ckt.

Modulated Amplifier :- This is a class 'c' tuned amplifier usually of push pull type & is modulated by audio modulating Voltage from modulating Amplifier. Grid modulated class c amplifier may be used to generate amplitude modulated signal at low power level.

Tuned power Amplifier :- It is a class B power amplifier. It raises the power level of AM signal.

Modulating Amplifier : This is usually a class B push pull amplifier and feeds audio power into modulated amplifier in the plate ckt. class 'B' operation is generally used because of high plate ckt frequency.

Transmitting antenna :- The low level modulated Signal is fed to a transmitting antenna for effective radiation.

(4) Explain the types of Electronic communication System.

Electronic communications are classified into two types. They are :-

* Simplex communication
* Duplex communication.

Simplex communication :- In this communication, information can be transmitted in one direction. A device using the simplex mode of transmission can either send (or) Receive the msg, but can't perform both. These are rarely used to send acknowledgment because return path is needed

Ex:- Radio & TV broadcasting

$$\boxed{\text{Sender}} \xrightarrow{\text{Simplex}} \boxed{\text{Receiver}}$$

Duplex communication :- It is of two types.

* Half duplex :- The form of two-way communication in which only one station transmitts at a time is Known as half duplex communication

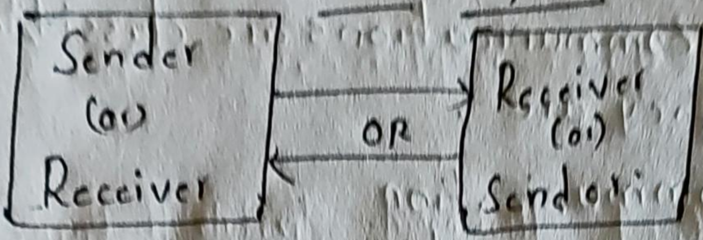
Ex: Citizen band

* full Duplex :- The full duplex communication allows the device to send and receive data simultaneously. A full duplex communication is faster as it avoids the delay that occurs in a half-duplex communication, each time the direction of transmission is changed.

Ex:- Telephone communication

Half duplex

1



Full duplex

2