BASIC ELECTRONICS

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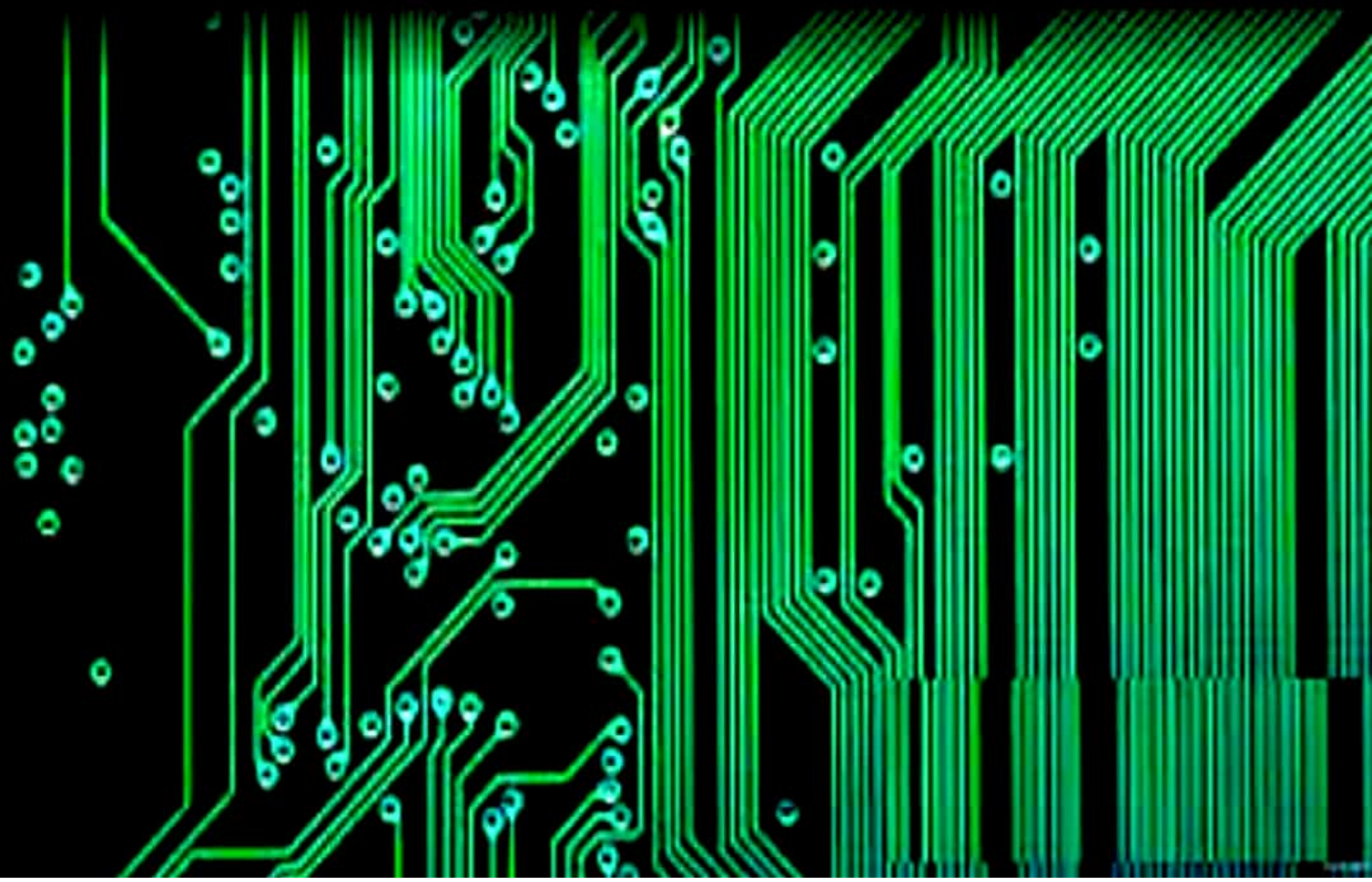


CHAPTER – 3

COMMUNICATION SYSTEM

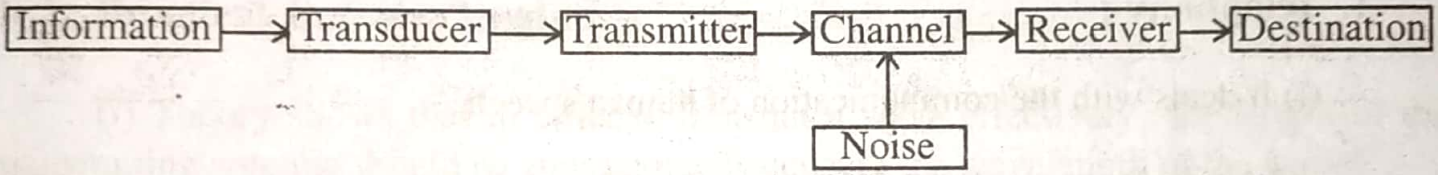
Communication System :

♦ Communication is the process of establishing connection or link between two points for information exchange.

♦ The information may be written message or speech or some picture.

♦ Depending upon the types of information to be sent or received, the communication systems are of different types.

Block diagram of Communication System :



1. Information Source : The information to be transmitted comes from the information source.

2. Transducer : Transducer is a device which converts one form of energy to another form. Here it converts the message signal to electrical signal.

3. Transmitter : The transmitter processes the information and makes it fit for transmission. Here encoding, compressions and error correction operations are performed.

4. Channel : The function of the channel is to provide a physical connection between transmitter and receiver. The channel may be a pair of wires in case of telephone and telegraph system or may be an open space for wireless communiction.

5. Receiver : The main function of the receiver is to produce the message signal i.e. electrical signal from the distorted recieved signal. In receiver part decoding, decompressing, comparing error ditection and correction codes, demodulation of radio signals are done.

6. Noise : The noise is general in communication process. It can not be prevented but can be minimised. Noise is nothing but the unwanted signal which are transmitted

along with original signal when radiated into space that disturbs, interferes and affect the original signal in the communication process.

7. Destination : It is the final stage which is used to convert electrical message signal into its original form.

Types of Communication System :

There are three types of communication system such as :

(1) Telephony

(2) Telegraphy

(3) Wireless Communication System.

1. Telephony :

(i) It deals with the communication of human speech.

(ii) A telephone system mainly consisting of three parts :

(a) Conversion of speech into electrical signal at transmitter end.

(b) The electrical signal are transferred at a distance places through cable.

(c) The conversion of electrical signal into speech again at receiving end.

2. Telegraphy :

(i) It deals with the communication of written message.

(ii) The message in this system contains letters, figures etc. and called as characters.

(iii) The character is represented by a unique combination of basic elements called telegraph code.

3. Wireless communication :

(ii) It is the transmission of information or message from one point to another point without any cable connection.

(ii) This is done by converting the information into electrical signal and then transmitting into the space with the help of antenna.

(iii) It is also called as radio communication.

Modulation :

The process of changing some characteristic (e.g-amplitude, frequency or phase) of a carrier wave in accordance with the intensity of the signal is known as modulation.

Need for modulation :

Modulation is extremely necessary in communication system due to the following reasons :

1. Practical Antenna length :

(i) Theory shows that in order to transmit a wave effectively the length of the transmitting antenna should be approximately equal to the wavelength of the wave.

$$\text{Now wavelength} = \frac{\text{Velocity}}{\text{Frequency}} = \frac{3\times10^8}{\text{Frequency (Hz)}} \text{ metres}$$

(ii) As the audio signal frequencies range from 20Hz to 20KHz, therefore, if they are transmitted directly into space, the length of the transmitting antenna required would be extremely large.

(iii) To radiate a frequency of 20kHz directly into space, we would need a antenna length of 15,000 metres. This is too long antenna to be constructed practically.

2. Operating Range :

(i) The energy of a wave depends upon its frequency. The greater the frequency of the wave the greater the energy possessed by it.

(ii) As the audio, signal frequencies are small therefore these can not be transmitted over large distances if radiated directly into space.

(iii) Therefore, it is necessary to modulate a high frequency carrier wave with audio signal.

3. Wireless Communication :

(i) In radio transmission the transmission should be carried without wires i.e radiated into space.

(ii) At audio frequency, radiation is not possible as the efficiency of radiation is poor.

(iii) Efficient radiation of electrical energy is possible at high frequencies (720 Khz). for this reason modulation is always done in communication system.

Types of Modulation :

There are three types of modulation,

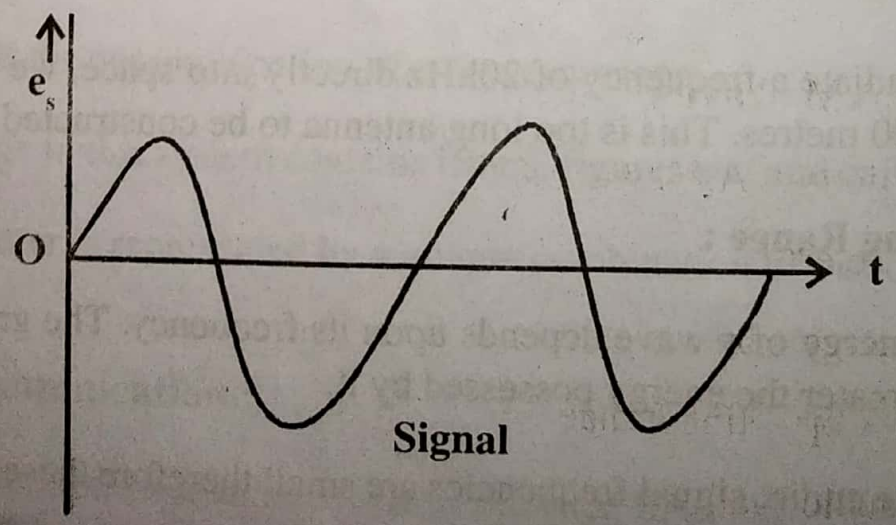
(1) Amplitude Modulation

(2) Frequency Modulation

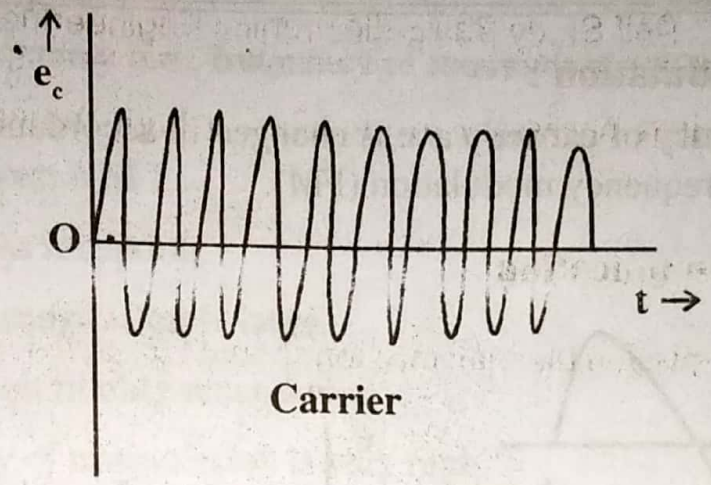
(3) Phase Modulation

1. Amplitude Modulation :

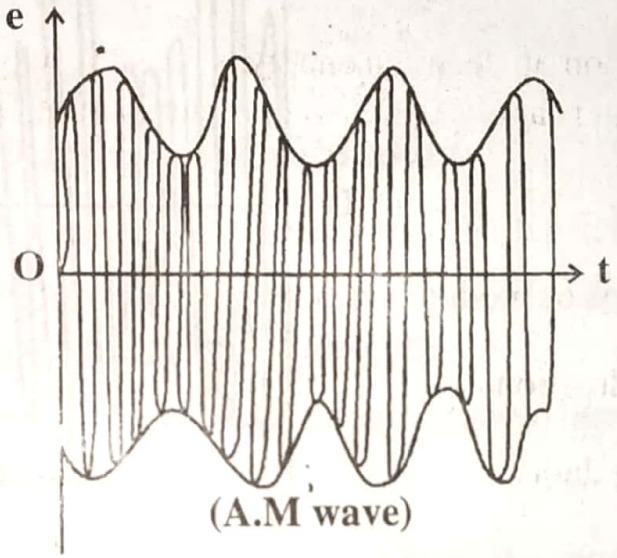
When the amplitude of high frquency of carrier wave is changed in accordance with the intensity of the signal, it is called amplitude modulation.



Signal



Carrier



(A.M wave)

The following points may be noted in amplitude modulation,

(i) The amplitude of the carrier wave changes according to the intensity of the signal.

(i) The amplitude variations of the carrier wave is at the signal frequency f_s.

(ii) The frequency of the amplitude modulated wave remains the same i.e., carrier frequency f_c.

Limitations of AM Wave :

The limitations of A.M. wave are :

(i) Poor efficiency

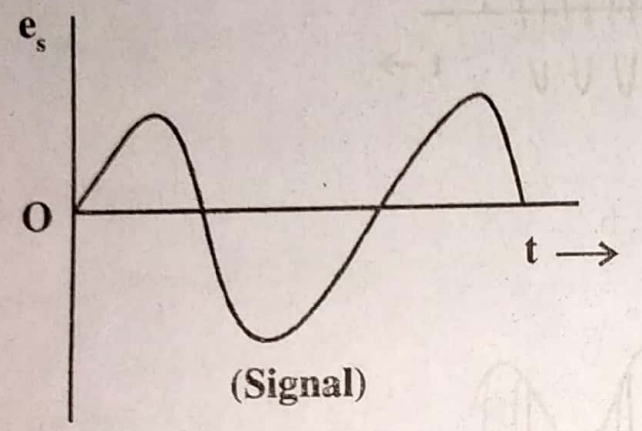
(ii) Noisy Reception

(iii) Smaller operating Range

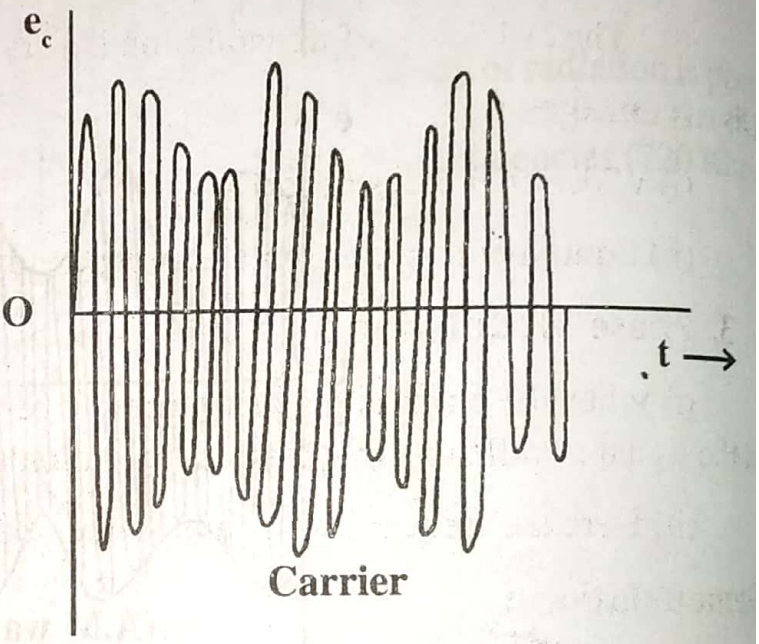
(iv) Poor audio quality

2. Frequency Modulation :

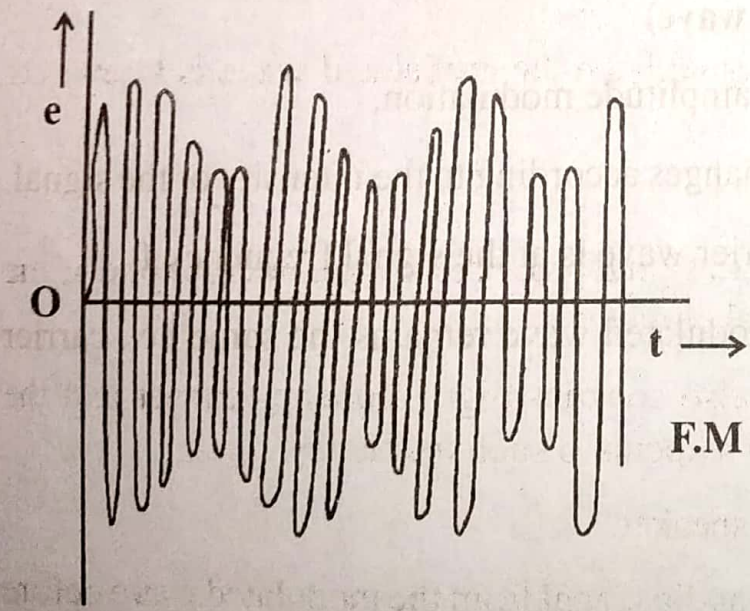
When the frequency of carrier wave is changed in accordance with the intensity of the signal, it is called frequency modulation (FM).



(Signal)



Carrier



F.M wave

The following points may be noted regarding F.M wave.

(i) The frequency deviation of FM signal depends on the amplitude of modulating signal.

(ii) The centre frequency is the frequency without modulation or when the modulating voltage is zero.

(iii) The audio frequency (i.e., frequency of modulating signal) does not determine frequency deviation.

Advantages of FM over AM :

(i) It gives noiseless reception.

(ii) The operating range is quite large.

(iii) It gives the high fidelity reception.

(iv) The efficiency of transmission is very high.

Disadvantages :

(i) Wider channel is needed.

(ii) Equipment used is more complex and costly.

3. Phase Modulation :

(i) When the phase angle of a carrier wave is changed in accordance with the intensity of the signal is called as frequency modulation (FM).

(ii) Here the frequency and amplitude of carrier wave remains constant.

Demodulation :

The process of recovering the audio signal from the modulated wave is known as demodulation or detection.

Necessity of demodulation :

(i) A modulated wave contains the audio signal produced by the microphone at the radio station but it cannot fed to the loudspeaker directly.

(ii) It is because the modulated wave also contains high frequency carrier and the diaphargm of the speaker is not at all able to respond to such frequency.

(iii) So sound is produced by the loud speaker.

(iv) Thus it is necessary to separate the audio signal from the modulated wave before feeding it to the loud speaker.

Radio Transmitter :

Radio communication involves transmission of radio waves, their propagation and their reception by the radio receivers situated at thousands of kilometers away from the broadcasting station.

Classification of Radio Transmitter :

Radio transmitter are classified on the following basis :

1. Types of Modulation used
2. Types of Service involved
3. According to the frequency range involved

Classification based on the type of modulation used :

On the basis of modulation, Radio transmitters are classified as :

1. Amplitude modulated transmitter :

(i) In this class of transmitter, the carrier is amplitude modulated by the modulating signal.

(ii) These transmitters are used for radio broadcast on medium and short waves, radio telephone on short waves, radio telegraphy on short waves and television picture broadcast on very short waves.

2. Frequency Modulated Transmitter :

(i) In F.M transmitter the signal voltage modulates the carrier to vary its frequency.

(ii) Their transmitters are used for radio broadcast in V.H.F or U.H.F. ranges, television sound broadcast in V.H.S or U.H.F. ranges, radio telephone communication in V.H.F. and U.H.F. ranges over small distances.

3. Pulse Modulation Transmitters :

(i) In this transmitter, the signal voltage varies some characteristics of the pulses.

(ii) The characteristic of the pulses varied on modulation may be pulse width, pulse position, pulse amplitude, pulse frequency or pulse code.

(iii) So, the various methods of pulse modulation are : pulse width modulation, pulse position modulation, pulse amplitude modulation, pulse frequency modulation and the pulse code modulation.

2. Classification based on the type of service involved :

(a) Radio Broadcast Transmitters

(b) Radio Telephone Transmitters

(c) Radio Telegraph Transmitters

(d) Television Transmitters

(e) Radar Transmitter

(a) Radio Broadcast Transmitters :

(i) These transmitters are made to transmit speeches, talks music, dramas etc. for information and recreating of the public.

(ii) They have high stability of carrier frequency, low distortion and noise etc.

(iii) The broadcast transmitters are either amplitude modulated or frequency modulated.

(iv) The amplitude modulated broadcast transmitters operate on medium or short waves and radiate carrier powers in the range of 1 kw to 1000 kw or more.

(b) Radio Telephone Transmitter :

(i) These transmitters are provided with certain special devices such as volume compressors, privacy devices, peak limiters etc.

(ii) The antenna is specially designed for directly the electromagnetic energy into a narrow beam towards the distant receiving antenna.

(iii) The radio telephone transmitters may be either amplitude modulated or frequency modulated type.

(iv) The A.M telephone transmitters usually work on short waves and are used for point to point communication over long distances.

(v) The F.M radio Transmitters usually work on u.h.f and carry power less than 1kw even.

(c) Radio Telegraph Transmitters :

(i) The radio telegraph transmitter transmits signals from one radio station to another.

(ii) It may use either amplitude modulation or frequency modulation.

(iii) The transmitting antennas are highly directive to beam the electro-magnetic energy towards the receiving antenna at the receiving radio station.

(iv) The tansmitter is also used for point to point communication.

(d) Television Transmitters :

(i) Two transmitters are used for television broadcast one for transmitting picture and the other for transmiting sound.

(ii) Both operate in v.h.f or u.h.f. range.

(iii) The picture transmitter is amplitude modulated by the picture signal occupying a band of about 5.5 MHz.

(iv) The sound transmitter is usually frequency modulated.

(e) Radar Transmitter :

(i) These are of two types (a) Pulse radar (b) C.w radar.

(ii) It uses frequency modulation of the carrier voltage.

3. Classification on Frequency Range involved :

1. Medium wave Transmitters.

2. Short wave Transmitters.

3. V.H.F and U.H.F Transmitters.

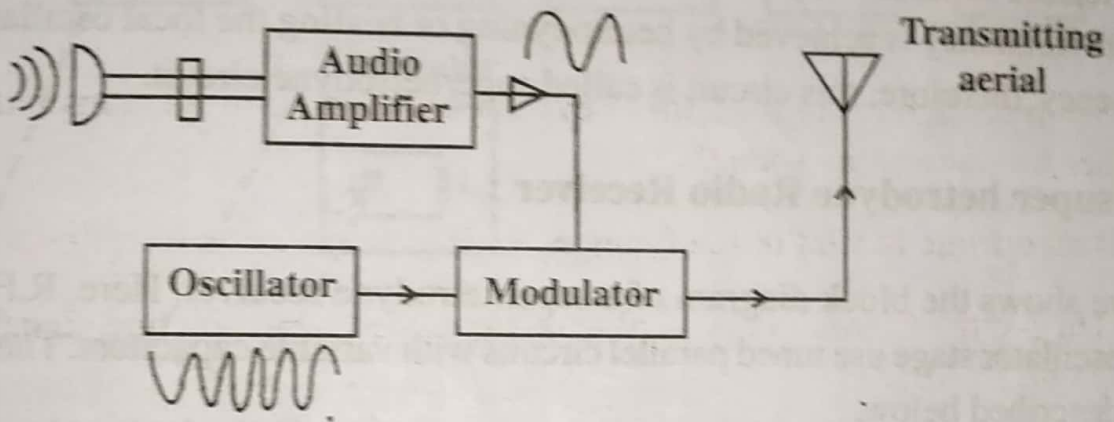
4. Microwave Transmitters.

Radio Transmitter :

Radio Communication means the radiation of radio waves by the transmitting station, the propagation of these waves through space and their reception by radio receiver.

Transmitter : Transmitter is an extremely important equipment and is housed in the broadcasting station. Its purpose is to produce radio waves for transmission into space. The important components of transmitter are microphone, audio amplifier, oscillator and modulator.

(i) Microphone : A microphone is a device which converts sound wave in to electrical wave. When the speaker speaks or a musical instrument is played, the varying air pressure on the microphone generates an audio electrical signal which corresponds in frequency to the original signal. The output of microphone is fed to the modulator for rendering the process of modulation.



(Block diagram of Radio Transmitter)

(ii) Audio amplifier : The audio signal from the microphone is quite weak and requires, amplification. This job is accomplished by cascaded audio amplifier. The amplifier output from the last audio amplifier is fed to the modulator for rendering the process of modulation.

(iii) Oscillator : The function of oscillator is to produce a high frequency signal, called carrier wave. Usually, a crystal oscillator is used for the purpose. The power level of the carrier wave is raised to a sufficient level by radio frequency amplifier stage. Most of the broadcasting stations have carrier wave power of several kilowatts. Such high power is neccessary for transmitting the signal to the required distance.

(iv) Modulator : The amplified audio signal and carrier wave are fed to the modulator. Here, the audio signal is superimposed on the carrier wave in a suitable manner. The resultant waves are called modulated waves or radio waves and the process is called modulation. The process of modulation permits the transmission of audio signal at the carrier frequency. As the carrier frequency is very high, therefore, the audio signal can be transmitted to large distances. The radio waves from the transmitter are fed to the transmitting antenna or aerial from where these are radiated in to space.

(v) Transmitting antenna : The transmitting antenna transmit to the modulated waves into the receiving antenna.

Super-hetrodyne Receiver :

The shortcoming of straight radio receiver w... ...ercome by the superhetrodyne by major Edwirn H. At present, all modern receivers utilise the superhetrodyne circuit. The production of fixed intermediate frequency (IF) 455 KHz is the salient feature superhetrodyne ckt. As the conversion of incoming radio frequency to intermediate frequency is achieved by heterodyning or beating the local oscillator against radio frequency, therefore, this circuit is called superhetrodyne circuit.

Stages of super hetrodyne Radio Receiver :

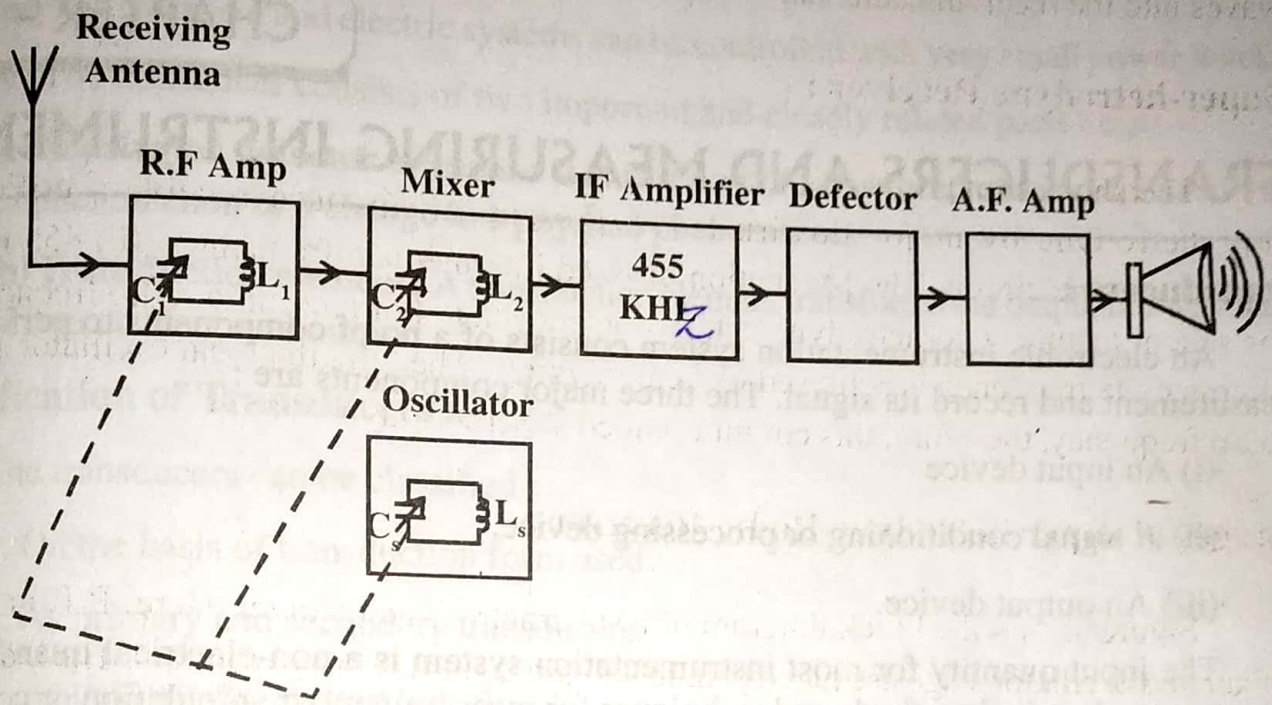
Figure shows the block diagram of a superhetrodyne receiver. Here, R.F. amplifier mixer and oscillator stage use tuned parallel circuits with variable capacitors. The individual stages are described below.

(i) R.F.amplifier stage : The R.F. amplifier stage uses a tuned parallel circuit L_1C_1 with a variable capacitor C_1. The radiowaves from various broadcasting stations are intercepted by the receiving aerial and are coupled to this stage.

(ii) Mixer stage : The amplified output of R.F. amplifier is fed to the mixer stage where it is combined with output of local oscillator. The two frequencies beat together and produce an intermediate frequency (IF). IF is the difference between oscillator frequency and radio frequency.

I.F = Oscillator frequency – Radio frequency.

Mixer will always produce 455 kHz frequency above the radio frequency is that oscillator always produces a frequency 455 KHz above selected radio frequency. This is achieved by making C_3 smaller than C_1 and C_2. By making C_3 smaller, oscillator will tune to a higher frequency C_3 is designed to tune the oscillator to a frequency higher than radio wave frequency by 455. In mixer stage, the carrier frequency is reduced and IF still contains the audio signal.



(Block diagram of superhetrodgte Receiver)

(iii) I.F. Amplifier stage : The output of mixer is always 455 KHz and is fed to fixed tuned IF amplifiers. These amplifiers are tuned to one frequency (i.e. 455 KHz)

(iv) Detector stage : The output from last IF amplifier stage is coupled to the input of detector stage. Here audio signal is extracted from IF output. Here, diode detector is used because of its lowdistortion.

(v) A.F. amplifier stage : The audio signal output of detector stage is fed to a multistage audio amplifier. Here, the audio signal is amplified until it is sufficiently strong to drive the speaker.

Loud speaker : The speaker converts audio signal into sound waves corresponding to original sound at the broadcasting station.