➢ **Receiver**

☞ Receiver converts the received signal from the transmitter via channel into useful form. Signal is received at the receiver with the help of a transducer. Received electrical signal is amplified (given extra energy) and then processed to retrieve the message signal in the desired form. Note that all the steps done in the receiver (other than amplification) are inverse of the steps taken at the transmitter so that the final form of received message signal is same as the transmitted signal. They are used in mobile phones, TV, Radios, etc.

➢ **Attenuation**

☞ The loss of strength of a signal during its propagation through the communication channel is known as attenuation. The effect of attenuation increases with distance in the medium. Medium is chosen very carefully for a given communication model to ensure that attenuation is reduced.

➢ **Video Frequency**

☞ The image of an object is made to fall on a plate using T.V. camera.This plate is called signal plate. The plate consists of many photocells. The light from the object is converted into video signals or video frequency waves or VF.

➢ **Amplification**

Amplification is the process of energizing the signal. It is defined as the ratio of the output amplitude to the input amplitude of the signal.

A= Vout/Vin

It is an important process in the communication system and makes it more efficient. It is done with the help of an external energy source.

➢ **Range**

☞ Range is defined as the maximum distance over which a signal can be transmitted in a communication system. It depends on the strength of the transmitted signal, attenuation of the medium and sensitivity of the receiver.

➢ **Repeaters**

☞ Repeaters are devices used to increase the range of a communication system. It usually consists of an amplifier and adds energy to the transmitted signal. Some special repeaters reconstruct the transmitted signal and hence also help reduce the effect of noise.

➢ Advantages of Television

☞ Television is one of the greatest source of information via news channels.
☞ It makes us aware of many socio-economic issues of the world.
☞ It is a great source of entertainment like music,movies,live ,matches etc
☞ It is a good source of education through many education based channels.

➢ Working of Television

☞ The image of an object is made to fall on a plate using T.V. camera.This plate is called signal plate. The plate consists of many photocells. The light from the object is converted into video signals or video frequency waves. Before this process, the image is scanned as dots and lines by the scanner. Normally cathode ray tube is called scanner. The VF signals are amplified and modulated on RF waves.The modulated waves are amplified and transmitted through the antenna . The sound is transmitted as in a radio.
☞ Antenna receives the modulated waves. Channel selection is nothing but the selection of the frequency of a T.V. station. After demodulation, VFsignals are fed to the picture tube called cathode ray tube. The cathode ray tube produces an original picture. The sound is reproduced as in radio receiver

➢ Working of Fax Machine

☞ A fax machine scans the document by light and the image is changed into electrical signals by photo cells. The message travels through the telephone lines and received by the fax machine at the other end. After decoding, machine produces the copy of the original document. Every fax machine has a number like a telephone. This has to be dialed before sending a message.

➢ Advantage of FAX Machine

☞ The long form of fax is facsimile transmission. All types of documents, either printed or hand written, line diagrams and photographs can be sent or received using the fax machine. It is different from electronic mail. Information is sent through telephone line.

➢ Communication using telephone

➢ Communication through telephone:

☞ The telephone is a two-way cable communication device. The telephone gives a trin-trin sound. The sound waves are converted into electric signals by the mouth-piece. The signals reach the earpiece at the other end by cables. Cellular telephone exchange system uses computerized techniques. Each transmitting unit has its own code. For example, Bangalore code is 080. This number has to be dialed first and then the telephone number for calling on the persons of different exchange areas.

➢ Generalized communication system

☞ The attached figure shows a generalized communication system block diagram. It is used to transmit a message signal through a system. The message signal is converted into electrical signal which is transmitted with the help of transmitter. It is sent over some communication medium like air or wires. It is received at the receiver where the electrical signal is reconverted back to a meaningful form.

➢ **Difference between analog and digital signal**

Basis	Analog signal	Digital signal
Signal	Analog signal is a continuous signal which represents physical measurements	Digital signals are discrete time signals generated by digital modulation
Waves	Denoted by sine waves	Denoted by square waves
Representation	Uses continuous range of values to represent information	Uses discrete or discontinuous values to represent information
Example	e Human voice in air, analog electronic devices.	Computers, CDs, DVDs, and other digital electronic devices

➢ **Transducer**

☞ Transducer is a device which is used to convert one form of energy into another form. In communication system, it is used for conversion of a form of signal into electrical signal or vice-versa. Example: Microphone converts speech signals into electrical signals.

➢ **Signal**

Information converted in electrical form is known as a signal. It is of two forms:
☞ Analog Signal: It varies continuously with time. Example: Sound signals in landline telephone cables.
☞ Digital Signal: It can take only a finite set of values. Binary signals are the most famous digital signals and the two voltage levels are denoted by a 0 (Low) and a 1 (High). Example: Signals used in computer circuits.

➢ **Components and features involved in radio communication**

☞ **Microphones**: In microphones, a thin film called diaphragm vibrates by sound waves which are transferred to a crystal which is generally made from quartz.

☞ **Quartz**: It is a crystalline form of commonly occurring silicon dioxide.Crystals of such types produce electrical signals when they are subjected to stress. The variations in AF are according to the variations of the sound waves.

☞ **Modulation**: It is the process of superimposing or mixing AF signals on RF waves.

☞ **Demodulation**: Detector separates RF from AF signals. The process of separating RF waves from AF waves is called demodulation.

☞ **Speaker**: The AF signals are amplified and fed to the speaker to reproduce the original sound. Speaker works in the reverse manner of a microphone.

➢ **Intelligence in radio communication**

☞ Music, speech or weather bulletin consist of sound waves which are produced by vibrations. This information is called intelligence.

➢ **Audio frequency**

☞ Music, speech or weather bulletin consist of sound waves which are produced by vibrations.These sound waves are converted into electrical signals, called Audio Frequency waves or AF in its short form. Microphones convert the vibrations into AF.
☞ The variations in AF are according to the variations of the sound waves.AF signals are weak. They are strengthened by electronic devices. The process of strengthening the AF signals is called amplification.The amplified AF signals even if they are strengthened cannot travel long distances.

➢ **Block diagram of radio transmitter and radio receiver**
➢ **Radio Frequency**

☞ To day there are variety of receiving sets. To listen to the particular station the radio should be tuned to that station. Built in antenna receives the modulated waves.Detector separates RF from AF signals.The Speaker process of separating RF waves from AF waves is called demodulation.
The AF signals are amplified and fed to the speaker to reproduce the original sound. Speaker works in the reverse manner of microphone.In this the coil starts vibrating when AF signals are passed through it. The vibrations are transferred to a diaphragm to produce sound waves.

➢ **Radio frequency**

☞ Radio frequencies range from 300 GHz to as low as 3 kHz, and wavelengths range from 1 millimeter to 100 kilometers.

➢ **Noise**

☞ Noise is an unwanted energy which interferes with the transmitted signal. Noise in the signal is generated at transmitter, channel and the repeater. It is undesirable and deteriorates the quality of the signal. Several techniques are used to reduce the effect of noise. Noise can be caused due to various sources like imperfection in medium, natural causes like lightning, thermal noise in the electrical devices, etc.

➢ **Transmitter**

☞ Transmitter converts the message signal to a form suitable for transmission (electrical signal) and sends the signal to the receiver via channel. Electrical signal is first processed into a suitable waveform and then it is amplified (given extra energy) to a large magnitude. It is then sent to a transducer which transmits the signal to the channel in the desired manner. Example: transmitters are used in cell phones, Radio antennas, etc.

➢ **Communication through Mobile**

☞ The working of mobile is similar to the working of radio. Mobile is a two-way radio system. It consists of both radio transmitter and receiver.It also consists of a portable microchip called a sim card (Subscriber Index Module).The sound waves are converted into radio frequency waves and travel without the help of cables and reach a receiver at the nearby base station. The base station sends the radio waves which are detected by the receiver.

➢ **Features in telephonic and mobile communications**

☞ STD: Subscribers Trunk Dialing
☞ ISD : International Subscriber Dialing
☞ SMS: Short Service Message or Internet services
☞ MMS: Multimedia Message Service
☞ Roaming: Roaming means transferring the service of a home network to another service provider.It means interlinking two networks.

➢ **Growth in telecommunication technology**

☞ Early means of communicating over a distance included visual signals, such as beacons, smoke signals, semaphore telegraphs, signal flags, and optical heliographs.

☞ Other examples of pre-modern long-distance communication included audio messages such as coded drumbeats, lung-blown horns, and loud whistles. 20th and 21st century technologies for long-distance communication usually involve electrical and electromagnetic technologies, such as telegraph, telephone, and teleprinter, networks, radio, microwave transmission, fiber optics, and communications satellites.

➢ Line Communication

☞ Line Communication Transmission lines are used to interconnect points separated from each other. For example interconnection between a transmitter and a receiver or a transmitter and antenna or an antenna and a receiver are achieved through transmission lines.

☞ Line communication may be in the form of electrical signal or optical signal.

➢ Optical communication

☞ Faithful transmission of information from one place to another place is called communication and optical fibers are used in optical communication.

☞ Light Emitting Diode (LED) and diode laser are preferred sources for optical communication links.*Optical Fibres:*

An optical fibre is a long thread consisting of a central core of glass or plastic of uniform refractive index. It is surrounded by a cladding of material of refractive index less than that of the core and a protective Jacket of insulating material. There are three types of optical fibre configuration

☞ Single mode step index fibre
☞ Multi mode step index fibre
☞ Multi mode graded index fibre.

➢*Applications of Optical Fibres:*

☞ A bundle of optical fibres is called light pipe. This pipe can transmit as image. Since the pipe is flexible, it can be twisted in any desired manner. Hence it is used medical and optical examination of even the inaccessible parts of human body, e.g., in endoscopy.
☞ Optical fibres are used in transmission and reception of electrical signals by converting them first into light signals.
☞ Optical fibres are used in telephone and other transmitting cables. Each fibre can carry upto 2000 telephone messages without much loss of intensity.

➢ Photonics

☞ Photonics is the physical science of light (photon) generation, detection, and manipulation through emission, transmission, modulation, signal processing, switching, amplification, and detection/sensing.

➢ Advantages of Mobile phones

☞ Communication between two persons even if they are moving.
☞ Communication to and from a land line phone.
☞ Voice message, text message facilities.
☞ It can be used as a mini computer.
☞ Linking of entire globe by telecommunication using geostationary satellites.

➢ Block Diagram of Optical Fibre Communication Link

Major elements used in optical fiber communication system are shown in the figure.
Here transmitter stage consists of a light source and associated drive circuitry while the receiver section includes a photodetector, signal amplifier, and signal restorer.

➢ Optical Fibre Communication Link

☞ **Fiber-optic communication** is a method of transmitting information from one place to another by sending pulses of light through an optical fiber. Fiber is generally used when we require high bandwidth and long-distance transmission.
Also it has much lower attenuation and interference.
The optical fiber is used by many telecommunications companies to transmit telephone signals, internet communication, and cable television signals.

➢ Space wave propagation

☞ When the electromagnetic waves from the transmitting antenna reach the receiving antenna directly or after the reflection from earth's surface then the wave propagation is called space wave communication. Hence, it is also called as line-of-sight communication. It is used for transmission of for frequencies more than 30 MHz.

➢ **Satellite communication**

☞ Satellite communication involves communication with the helps of a satellite. Geostationary satellites are most famous for this mode of communication. The radio waves containing information is transmitted to a satellite (uplink) from a transmitter on a earth's surface and then transmitted back to another antenna on the earth from the satellite (downlink).

Some advantages of satellite communications are:
☞ Position of geostationary satellite is fixed when seen from a point on earth's surface. This allows easy orientation of antennas.
☞ The frequency band (VHF-UHF) used in the satellite communication allows the use of small size antenna.
☞ The coverage range increases considerably due to the use of satellite.
The disadvantage is that the installation cost of the system is very high.

➢ **Sky wave propagation**

☞ In sky wave propagation, light rays travel upwards, then reach the ionosphere and are reflected back finally reaching the receiving antenna. Frequencies range used is a few MHz-30 MHz.

➢ **Size of antenna for transmission of signals**

☞ For transmitting a signal, we need an antenna or an aerial. This antenna should have a size comparable to the wavelength of the signal (at least /4 in dimension) so that the antenna properly senses the time variation of the signal. For an electromagnetic wave of frequency 20 kHz, the wavelength is 15 km. Obviously, such a long antenna is not possible to construct and operate. Hence direct transmission of such base band signals is not practical.
☞ We can obtain transmission with reasonable antenna lengths if transmission frequency is high (for example, if is 1 MHz, then is 300 m). Therefore, there is a need of translating the information contained in our original low frequency base band signal into high or radio frequencies before transmission.

➢ **Modulation and Demodulation**

☞ Modulation is the process of varying properties of carrier waveform with the message signal (also called the modulating signal).
☞ Demodulation is the process of recovering the modulating signal (message signal) from the received modulated signal. It is the exactly the inverse operation of modulation.

➢ **Pulse Modulation :**

It refers to a process of transmitting signals in the form of pulses (discontinuous signals) by using special techniques.

Pulse Modulation is of two types namely

➢ Analog Pulse Modulation
  ☞ Pulse Amplitude Modulation (PAM)
  ☞ Pulse Width Modulation (PWM)
  ☞ Pulse Position Modulation (PPM)
➢ Digital Pulse Modulation
  ☞ Pulse Code Modulation
  ☞ Delta Modulation

➢ **Describe HD transmission of media**

☞ HD stands for High Definition transmission. This is decided depending on the maximum number of pixels in each frame. It has a significantly higher image resolution that standard transmission.

➢ **Describe WiFi and its uses**

Wifi is a method in which data is transferred using radio waves to link equipments, without connecting with wires. A system for transmission and reception of waves is essential for this.
The uses of Wifi are as follows:
☞ Using a single Wifi modem, more computers can be linked to the internet without wire connection.
☞ Data transference is possible using mobile phones.

➢ **Advantages of Internet**

☞ With a computer and telephone connection linked to the network of internet service, it is easy to access to any kind of information.
☞ Music, film, encyclopedia, news update, profiles of famous persons are easily accessible.
☞ Downloading any information on any of the subject is possible and a printout can also be taken.
☞ Internet banking.
☞ Online shopping.
☞ Can keep track on results and admission processes of different universities.

➢ **MODEM**

☞ Modem is abbreviation for Modulator Demodulator. Modems are used for data transfer from one

computer network to another computer network through telephone lines. The computer network works in digital mode, while analog technology is used for carrying messages across phone lines.

➢ Bandwidth of signals

☞ Every signal is associated with a range of frequencies called the frequency band. The difference in the highest and lowest frequencies in the band is known as the bandwidth of the signal. It is a characteristic of the signal and signifies the detailing of the information in the signal. Signals with more bandwidth increases the cost of the transmission system.

➢ Bandwidth of channel

☞ Every channel is associated with a range of frequencies called the frequency band. The difference in the highest and lowest frequencies in the band is known as the bandwidth of the channel. It is a characteristic of the channel and signifies the information carrying capacity of the system. Channels with more bandwidth reduces the cost of the transmission system.
☞ Frequency band of the channel is a very important property of the transmission medium as the frequency band of the signal transmitted should lie in it for efficient communication. For example, a radio wave can be supported for transmission through air only and not through any coaxial cable.

➢ Examples of message signals

Some important message signals and their corresponding frequency bands/bandwidths are listed below:

- Human Speech : 300 Hz–3100 Hz
- Music : 20 Hz–20 kHz
- Video signals : Bandwidth of about 6 MHz

➢ Examples of message signals

Some important transmission mediums and their corresponding frequency bands are listed in the table below:

Service	Frequency Bands	Comments
Standard AM broadcast	540-1600 kHz	
FM broadcast	88-108 kHz	
Television	54-72 MHz	VHF (very high frequencies)
	76-88 MHz	TV
	174-216 MHz	UHF (ultra high frequencies)
	420-890 MHz	TV
Cellular mobile radio	896-901 MHz	Mobile to base station

	840-935 MHz	Base station to mobile
Satellite communication	5.925-6.425 GHz	Uplink
	3.7-4.2 GHz	Downlink

➢ **Approximation of rectangular wave in terms of harmonics**

☞ A rectangular wave can be represented as the sum of sine waves of different frequencies and amplitude. The fundamental frequency (fo)(same as the frequency of the rectangular wave) is the lowest of the frequencies of sine waves. Frequencies of other harmonics is given by 3fo,5fo,7fo,.... This is represented in the attached figure.

☞ When the rectangular pulse is transmitted through a medium, the harmonics outside the frequency band of the channel are filtered out and the received signal is a distorted rectangular pulse.

➢ **Ground wave propagation**

☞ For efficient transmission, size of antenna should be comparable to the wavelength of transmitted signal. For standard AM broadcast, size of antennas is quite large and ground based vertical towers are used as antennas. Ground has a strong influence on the propagation of the wave and the waves bend round the curvature of the earth. Hence, it is also called surface wave propagation. Its range depends on the transmitted power and frequency. It is used for frequencies upto 1.5 MHz.

➢ **Need of modulation**

☞ Modulation is an extremely important process in the transmission of a signal. As the channel offers very high losses to low frequencies, transmitting a message signal directly decreases the range drastically. Hence, it is used to modulate a high frequency carrier wave and the modulated wave is transmitted.

➢ **Role of modulation in reducing size of antenna**

☞ $v = f\lambda$

$\lambda \propto$ since speed of the wave is a constant based on the medium.

☞For efficient transmission from an antenna, its size should be comparable to the transmitted wavelength. Hence, use of high frequency carrier wave in modulation facilitates the size of antenna to be reduced, hence reducing the cost and improving its efficiency.

➢ **Role of modulation in reducing power loss in channel**

☞ Every medium offers attenuation to the transmitted signal to some extent. A channel provides least attenuation in its frequency band and hence it is desired that the frequency of the modulated signal should lie in this frequency band to reduce power loss in the medium and increase range.

➢ **Role of modulation in multiplexing**

☞ Without modulation, channel can carry only one signal at a time. Otherwise, two signals in the same frequency band will interfere.
☞ With the help of modulation, modulated signal can be transmitted in a desired frequency band. Since the bandwidth of signal is much smaller than the bandwidth of the channel, a channel can carry multiple signals in different frequency sub-bands with the help of modulation. This increases the information carrying capacity and the transmission rate of the signals.

➢ **Carrier Wave**

☞ Carrier wave is a high frequency wave that is modulated with the modulating wave (message signal). In the process of modulation, one of the characteristics (amplitude, frequency or phase) of the carrier wave is modified in accordance with the instantaneous value of the message signal.

➢ **Production of AM**

Block diagram for production of AM is shown in the attached figure. Modulating signal is added to the carrier signal and the resultant signal is passed through the square law device. The output signal from the square law device consists of a dc component and frequencies fm,fc,fc−fm,fc+fm,2fm,2fc The unrequired frequency components are rejected from this signal with the help of a band-pass filter and the resultant is used as the modulated wave.

➢ **Use of bandpass filter in amplitude modulation**

☞ Bandpass filter is used after the square law device in amplitude modulation. It is used to select a frequency band near a central frequency and reject the remaining unwanted frequencies. In amplitude modulation, it selects fc−fm,fc,fc+fm

➢ **Transmission of modulated signal**

☞ After performing the modulation on the signal, the modulated signal is amplified by using a power amplifier. After this, it is fed to the transmitting antenna which serves as a transducer and sends the signal to the channel.

➢ **Advantages of frequency modulation**

☞ **Resilient to noise**: One of the main advantages of frequency modulation that has been utilised by the broadcasting industry is the reduction in noise. As most noise is amplitude based, this can be removed by running the signal through a limiter so that only frequency variations appear.

☞ **Resilient to signal strength variations**: In the same way that amplitude noise can be removed, so too can any signal variations. This means that one of the advantages of frequency modulation is that it does not suffer audio amplitude variations as the signal level varies, and it makes FM ideal for use in mobile applications where signal levels constantly vary.

☞ **Enables greater efficiency than many other modes**: The use of non-linear amplifiers, e.g. class C, etc means that transmitter efficiency levels will be higher - linear amplifiers are inherently inefficient.