Assignment - 2

1. Draw the schematic diagram of a cellular telephone system and define its basic components.

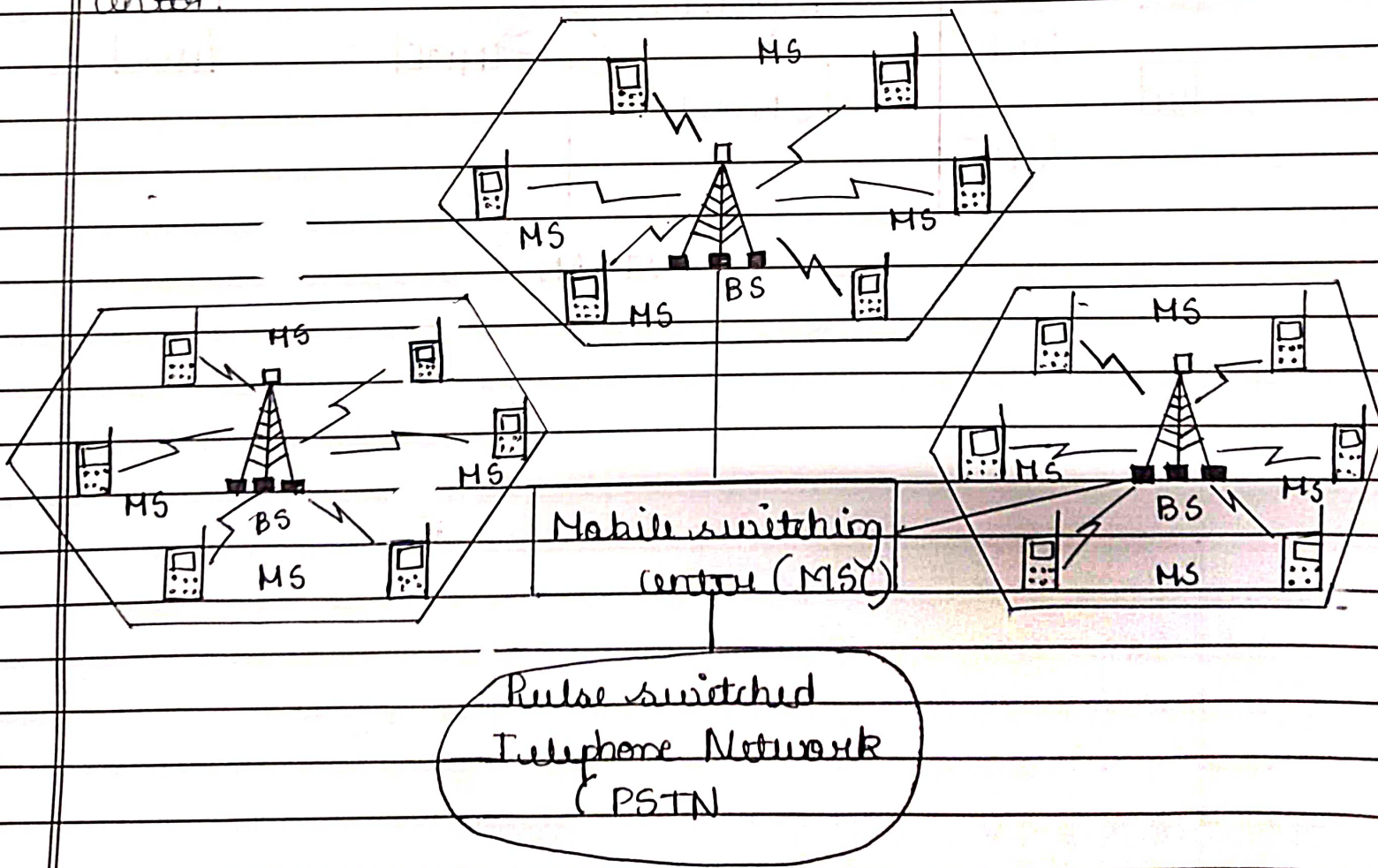
Cellular system comprises of the following components:

i) Mobile station (MS): This is the mobile handset, which is used by a user to communicate with another user.

ii) Cell: Each cellular service area is divided into small regions called cell (5 to 20km).

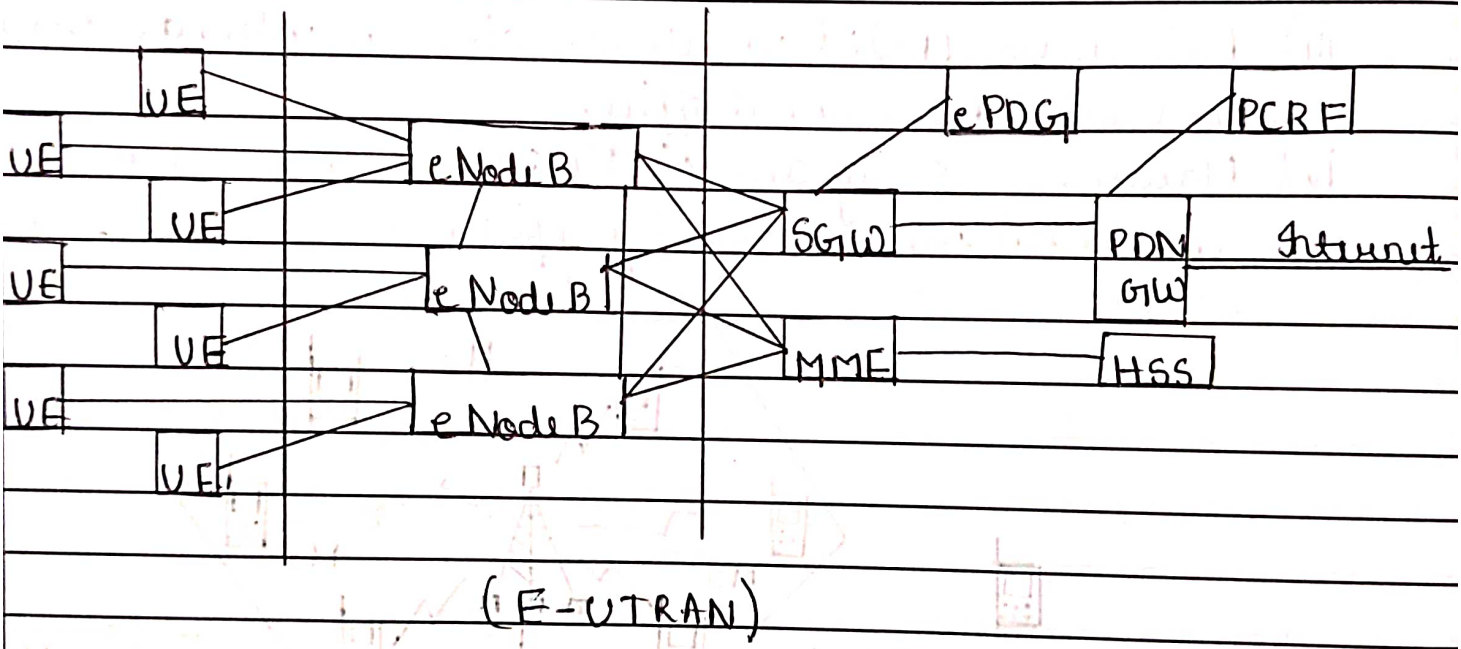
iii) Base station (BS): Each cell contains an antenna, which is controlled by a small office.

iv) Mobile switching center (MSC): Each base station is controlled by a switching office, called mobile switching center.

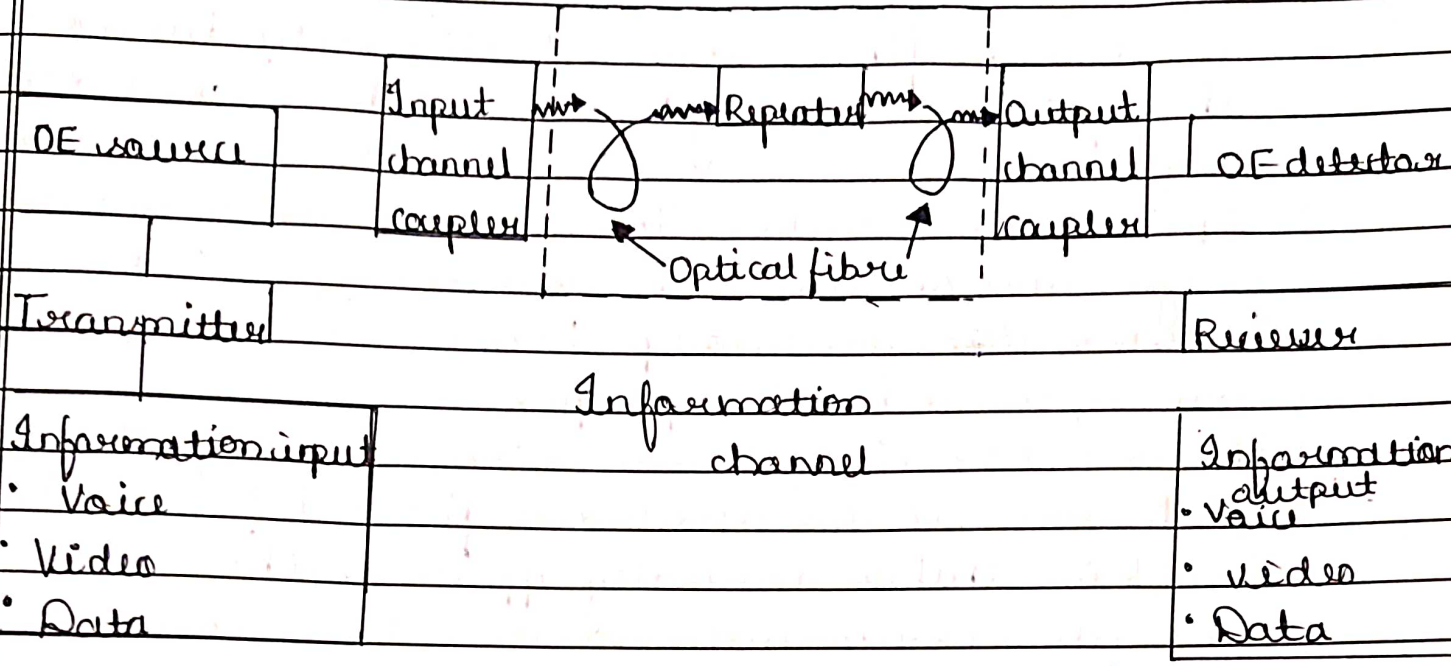


Draw the LTE system architecture and define the important terms.

The figure gives a high level description of the LTE-A network architecture. In the old GSM there were base transceiver stations (BTS), and base station controllers (BSC), and UTRA networks, we have Node BS and radio network controllers (RNC), and several different entities in the core network



3. With the help of a block diagram explain the generalised configuration of a fiber-optic communication system.



Fibre-optic communication consists of:

→ Information input: The information input may be in any of the several physical forms, eg, voice, video or data. Therefore, an input transducer is required for converting the non-electrical input into an electrical input.

→ Transmitter: The transmitter comprises an electronic stage which (i) converts the electric signal into the proper form and (ii) impresses this signal onto the electromagnetic wave generated ~~onto the electr~~ by the optoelectronic source.

→ Optoelectronic source: An optoelectronic (OE) source generates an electromagnetic wave in the optical range, which serves as an information carrier.

→ Channel couplers: In the case of open channel transmission, for example, the radio or television broadcasting system, the channel coupler is an antenna.

→ Fibre-optic information channel: The optical signal

transverses along the cable consisting of a single fibre or a bundle of optical fibres.

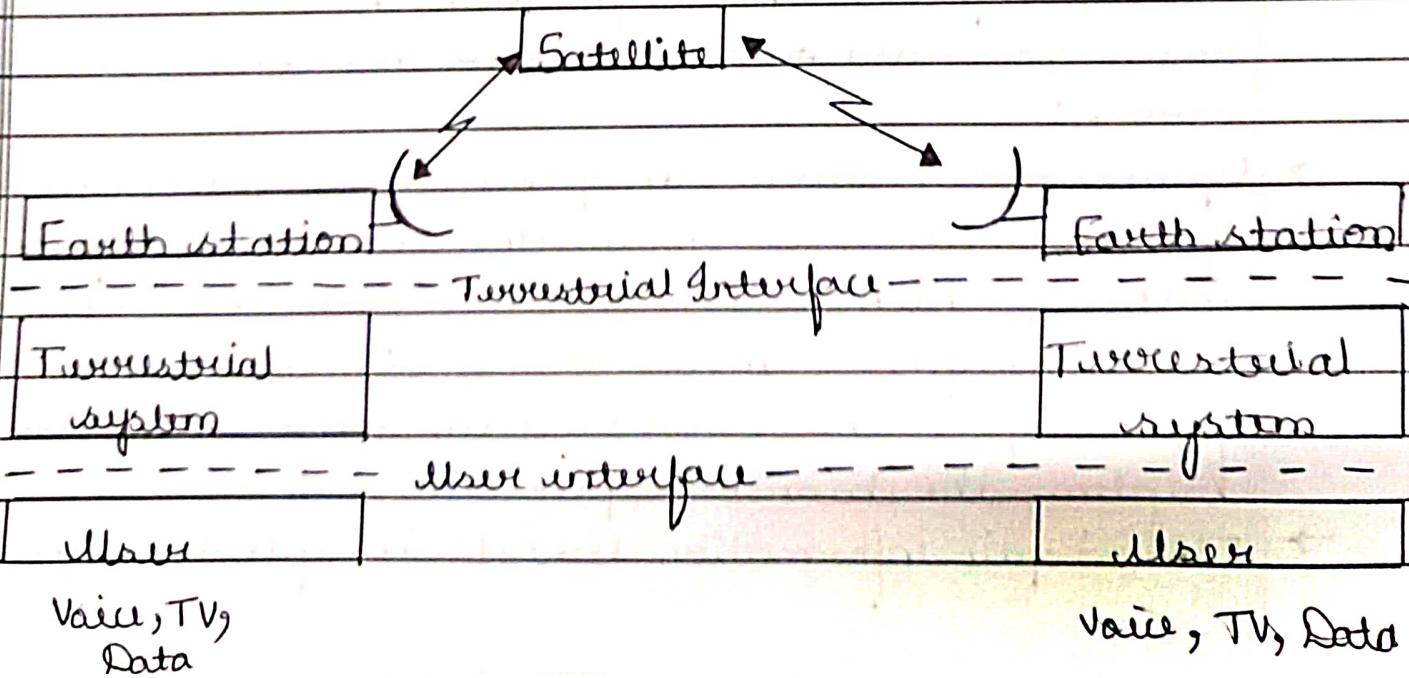
→ Repeater: As the optical signals propagate along the length of the fiber, they get attenuated due to absorption, scattering, etc and broadened due to dispersion.

→ Optoelectronic detector: The reconversion of an optical signal into an electrical signal takes place at the OE detector. Semiconductor p-i-n or avalanche photodiodes are employed for this purpose.

→ Receiver: For analog transmission, the output photocurrent of the detector is filtered to remove the dc bias that is normally applied to the signal in the modulator module, and also to block any other undesired frequencies accompanying the signal

→ Information output: Finally, the information must be presented in a form that can be interpreted by a human observer.

4. Based on orbits, discuss the different types of satellites with the help of a block diagram explain the satellite communication system.



Types- Users, satellite, terrestrial network and earth station are the elements of a satellite communication.

Types of satellites based on orbits.

i) Geostationary Earth orbit (GEO) satellites

- The satellite should be placed 37,786 kms above the surface of the earth.
- These satellites must travel in the rotational speed of earth, and in the direction of motion of earth, that is eastward.
- The inclination of satellite with respect to earth must be 0°.
- Geostationary satellite in practical is termed as geosynchronous as there are multiple factors which make these satellites shift from the ideal geostationary condition.
- Gravitational pull of sun and moon makes these satellites deviate from their orbit. Over the period of time, they go through a drag.
- These satellites experience the centrifugal force due to the rotation of Earth, making them deviate from their orbit.
- The non-circular shape of the earth leads to continuous adjustment of speed of satellite from the earth station.

ii) Low Earth orbit (LEO) satellites

- These satellites are placed 500-1500 kms above the surface of the earth. As LEO satellites circulate on a lower orbit, hence they orbit a much shorter period, that is 95 to 120 minutes.
- LEO systems try to ensure a high elevation for every

spot on earth to provide a high quality communication link. Each LEO satellite will only be visible from the earth for around ten minutes.

iii)

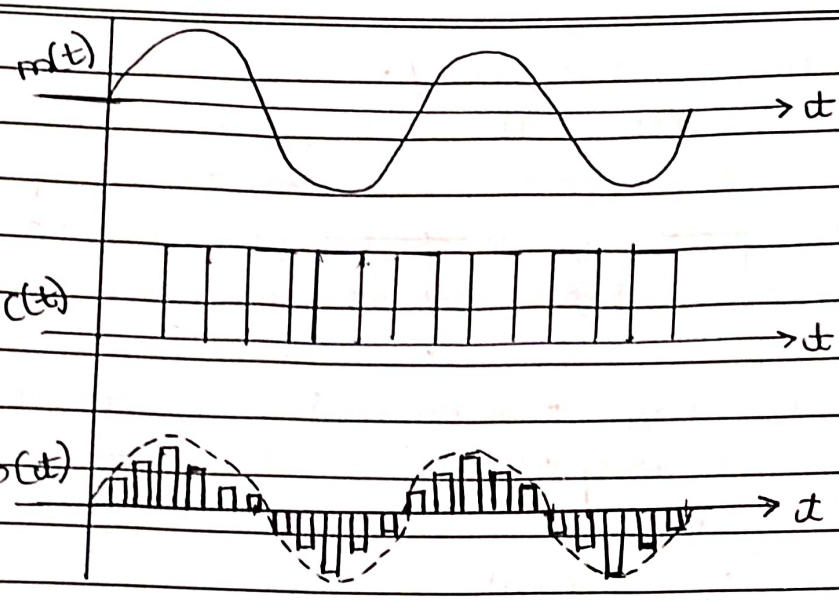
iii) Medium Earth Orbit (MEO) satellites

- MEO satellites can be positioned somewhere between LEOs and GEOs, both in terms of their orbit and due to their advantages and disadvantages.
- Using orbits around 10,000 kms, the system only requires a dozen satellites which is more than a GEO system but much less than a LEO system.
- These satellites move more slowly relative to the Earth's rotation allowing a simpler system design.
- Depending on the inclination, a MEO can cover larger populations, so requiring fewer handovers.

5. Explain the following with the help of waveforms

i) PAM [Pulse amplitude modulation]:

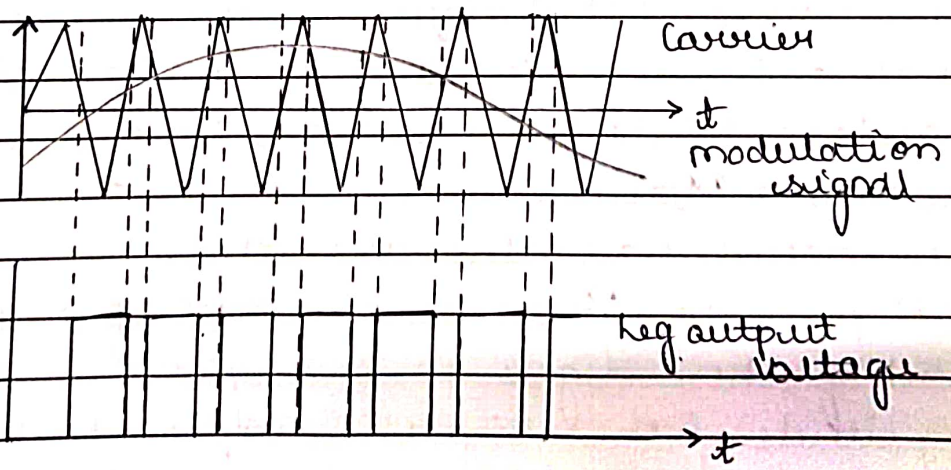
- simplest form of pulse modulation
- signal is sampled at regular intervals and each sample is made proportional to the amplitude of the signal at the instant of sampling.
- PAM acts as a signal converter that helps in encoding the amplitude of the pulse and converts analog signal transmission into a digital version.
- In PAM, the amplitude of the pulses of the carrier pulse train is varied in accordance with the modulating signal.



ii) PWM [Pulse width modulation]: Starting time and amplitude of the pulse are constant but the width or duration of each pulse is made proportional to the instantaneous value of analog signal

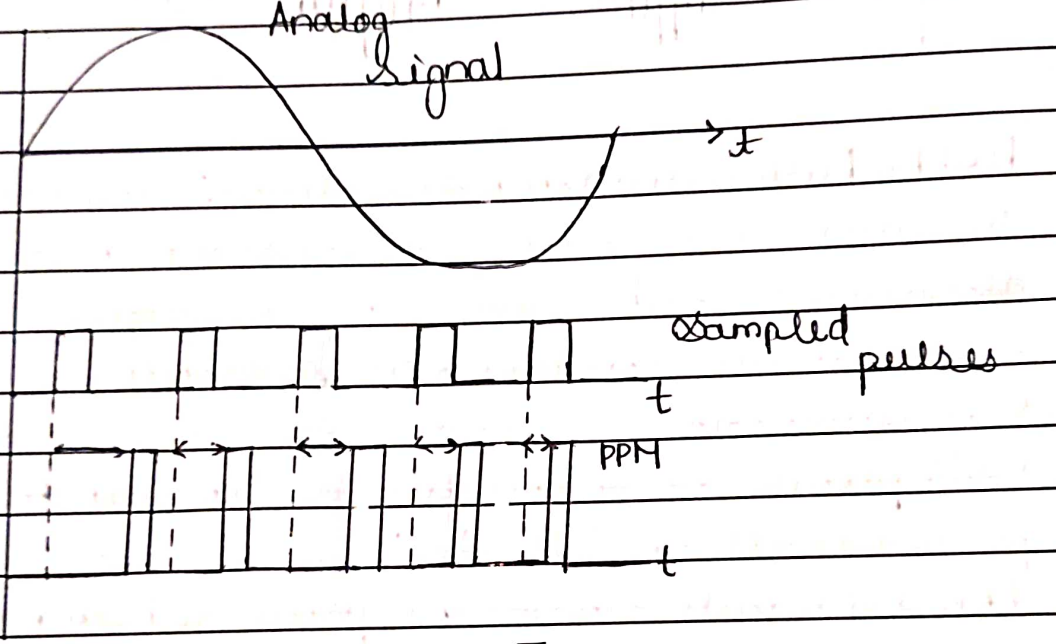
→ Disadvantages:

- PWM pulses are of varying width and hence of varying power content.
- The transmitter must be powerful to handle the maximum width pulses.



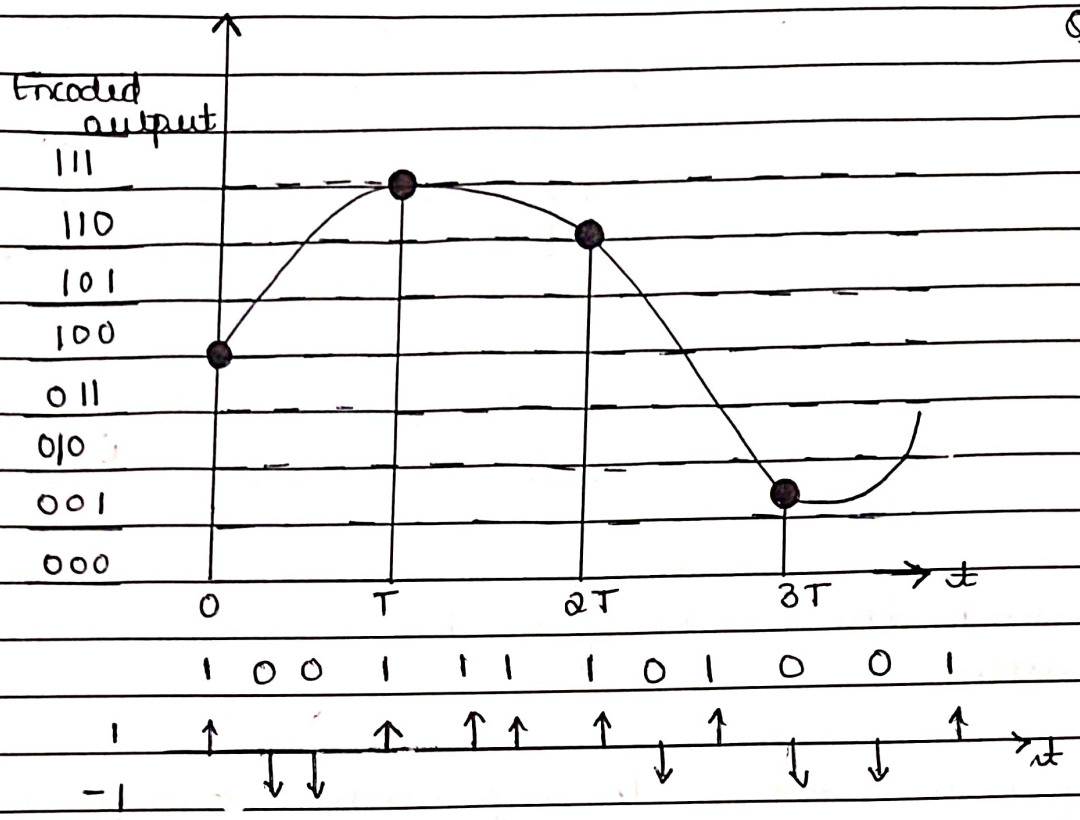
iii) PPM [Pulse position modulation]:

- Amplitude and width of the pulses are constant but the position of each pulse in relation to the position of the reference pulse is varied according to the instantaneous sampled value of the modulating signal
- PPM has the advantage of requiring constant transmitter power output.



iv) PCM [Pulse Code modulation]:

- A standard technique in telecommunications transmis
- A digital process in which the message is sampled and rounded off to the nearest value of a finite set of allowable values.
- The rounded off values are coded.
- PCM generator produces a series of numbers or digits.
- Each of these digits in binary code represents the amplitude of the signal sample at that instant.
- Pulse code modulation is a digital scheme for transmitting analog data. It converts an analog signal into digital form.



6. Define the following terms:

i) Modulation: Process of translating the low frequency baseband signal to higher frequency spectrum by superimposition of the frequencies.

ii) Carrier communication system: The baseband signal, which lies in the low frequency spectrum, is translated to a higher frequency spectrum.

iii) Baseband communication system: The baseband signal is transmitted without translating it to higher frequency spectrum.

7. Describe the blocks of the basic communication system.

- Information source: The information is represented by a message that is originated by an information source, e.g a sentence or paragraph spoken by a person, voice, live scenes, music, written text and email is a message that contains some information.
- Input transducer: It is a device that converts a non-electrical energy into its corresponding electrical energy signal prior it is transmitted. An example of a transducer is a microphone.
- The information produced by the information source is applied to the next stage, termed the information or Function input transducer. This in turn, produces an electrical signal value corresponding to the information as output. This electrical signal is called the base band signal $s(t)$ message information.

There are two types of signals.

i) Analog signal: It is a function of time and has a continuous range of values

ii) A digital signal does not have continuous function values on a time scale, it is discrete in nature.

- The analog signal which is continuous in time is converted to discrete time using a procedure called sampling. The continuous amplitude of the ~~any~~ analog signal is converted to discrete amplitude using a process called quantization
- Transmitter: The base band signal, which is the output of an input transducer, is input to the transmitter. This baseband signal, s(t), is suitable for transmission in the form in which it is generated by the transducer. The transmitter ~~signal~~ section processes the signal prior to transmission.
- Modulation takes place at this stage with the baseband and the carrier signals as two inputs after modulation, the baseband signal is translated to a high frequency spectrum and the carrier signal is said to be modulated by the baseband signal. The output of the modulated stage is called the modulated signal.
- Channel or medium: After the required processing the transmitter section passes the signal to the transmission medium. The signal propagates through the transmission medium and is received at the other side by the receiver section. The transmission medium between the transmitter and the receiver is called a channel. Channels are classified into

→ Hardwired and Softwired channels.

- Noise: It is defined as unwanted electrical energy of random and unpredictable nature present in the system due to any cause. Obviously, noise is an electrical disturbance, which does not contain any useful information. Thus, noise is a highly

undesirable part of a communication system and have to be minimised.

$$\left(\frac{S}{N}\right)_{dB} = 20\log_{10}\left(\frac{V_S}{V_n}\right)$$

signal to noise ratio

- Reciever: The task of the reciever is to provide original information to the user. This information is altered due to the processing at the transmitter side.

Basic model of a Communication System