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Electromagnetic wave

→ A EM wave is a wave where electric field and magnetic field are created.
→ These two fields are perpendicular to other and direction of the wave is in motion.

It is generated when an electric charge is accelerates (change its position our direction) our when an electric current ossilates (move back & forth), produces electromagnetic waves.

* EM wave can travel in any medium. Vaccum (empty space) they do not need any natural medium to move.
In a vaccum they travel at the speed of light

$C = 3 \times 10^8$ m/s.

Nature Of EM wave:—

- They are transverse waves (the electric and magnetic field are perpendicular to the direction of travel)
- They carry energy and momentum.

Example
- Radio waves (used in mobile phones)
- Microwaves (used in microwave ovens)
- Infrared waves (used in remote controls)
- visible light (what we can see with our eyes)

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Generation.

- Accelerating charges :- When an electric charge (like an electron) moves with acceleration, it disturbs surrounding electric and magnetic field.

- This disturbance create changing in electric and magnetic field and creates electromagnetic wave.

Antenna example -
A common way to waves through oscillating current in an antenna, which accelerate electron back and forth. Varying electric and magnetic field that radiate outward.

~~X~~ properties
→ Transverse Nature :- Electric fied, magnetic fied and the direction of propagation are perpendicular to each other.
→ Travel in vacuum
→ Speed ↑
→ No medium require
→ Wave equation satisfied | $c = \lambda \cdot f$
→ Carry energy and momentum.
→ spectrum range - EM waves low to high and formed electromagnetic spectrum.

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Electromagnetic Spectrum :—

The electromagnetic spectrum is the full range of all types of electromagnetic waves, classified based on their wavelength or frequency.

It starts from low-frequency (long wavelength) waves like radio waves and goes up to high-frequency (short wavelength) waves like gamma rays.

* Classification.

1. Radio waves
   - Longest wavelength, lowest energy
   - uses :- Radio, TV, Mobile signal (walkie-Talkie)

2. Microwaves
   - Shorter wavelength than radio waves
   - uses in microwave ovens, satellite comm., radar

3. Infrared - Shorter than above.
   uses in Remote control, night vision,

4. Visible light :- The part we can see with our eyes.
   Colour :- violet to Red (VIBGYOR)
   uses :- vision, lights, Cameras.

5. Ultraviolet (UV)
   - Shorter than ↑
   uses for kills germs, make vitamin D, used in forensic labs.

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6. X-Rays
- Even shorter wavelength.
uses to see bones and teeth, airport security

7. Gamma Rays -
- shortest wavelength, highest energy.
- Cancer treatment, nuclear reaction.

Radio → Microwave - Infrared - visible → Ultraviolet → X rays - Gammarays.

Synchronous & Asynchronous.

Asynchronous
→ Data is sent one byte / or characters at a time with start and stop bit to identify when data begins and ends.
Key features: -
→ No common clock is needed.
→ Slower but simpler
→ Good for occasional or small data transmission
→ used in: Serial Communication, Keyboard & mouse signals etc.

eg -
Each Keypress sends data separately.

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Synchronous

→ Data sent continuous stream.

→ It takes help of a common clock b/w Sender and Receiver.

Key

→ clock is shared b/w Sender and Receiver.

→ fast and efficient for large data transfer.

→ Data is sent blocks or frames.

→ used for high speed data transmission like LANs.

	Synchronous	Asynchronous.
Clock	Required (Shared)	not required
Speed	Fast	Slower
Data sent	In blocks/ frames	Byte by byte
Start/ stops bits	Not needed	Needed
Use case	High speed system (LANs)	Low speed system (Keyboard)

Q. How data transmit using twisted pairs.

(I) Create electric signals (0-low, 1-high) voltage

(II) Send signals through twisted wires, which help to reduce noise.

(III) Receive signals at other end. (Receiving device computer, switch, router) read voltage, change electric signal into (0 and 1s)

Why external noise reduce data and keeps it error-free.
It protect your

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Computer A → Digital signal → Electrical signal → Twisted pair Cable → Electric signal → Digital signal → Computer B.

* SoHoLANs

A SoHoLANs is a local Area network set up on a small office or home office environment, typically supporting fewer than 10-15 no users. It is used to connect computers, printers, mobile devices and other hardware to share files, access the internet and use network resources.

Key features:

- Simple setup
- Low cost
- Limited users
- Internet Sharing
- Basic Security.

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Hierarchial Network Design.

† physical and logical Addresses :-

- A physical address refer MAC address which is a hardware address which is fixed in NIC.

→ A logical address refers to an IP address, which can change based on the network configuration and is used for routing packets across networks.

* Benefits

Hierarchial network design divides the network in multiple layer (Access, distribution and core)

It provides

→ Scalability - Network can grow without major chang.
→ manageability - Easier to manage and troubleshoot.
→ performance - Reduce network congestion (traffic) and improve efficiency

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Access layer -

1. Core layer (Backbone layer)
→ ~~core~~ as a ~~de~~
Topmost layer
→ fastest path for data across the network.
→ connect multiple distribution layer.
→ Focus: High speed, reliability.

Ex- High speed router, backbone switches.

2. Distribution layer:
→ Middle layer
- Control and filtering traffic.
- Route b/w VLANs and Subnets.
- Applies policies (security, access control) etc

Ex - Layer 3 Switches, routers.

3. Access layer:
- Bottom layer
→ In this Layer the devices is connected (PC)
→ control user access to the network.
Ex - Switches, access points.

DD

* Hierarchial network design uses 3 layer to make network faster, secure and easier to manage.

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Sending in Modern Ethernet LANs.
- Full duplex
→ Half duplex

* Ethernet access layer Devices.

Hub:- A Hub is a simple networking devices that connect multiple device in a LAN. It broadcast all the incoming data to every connected devices, regardless the destination.

MAC address Table:- (Switch)
MAC address Table in switch is used to make the record of MAC address of all devices connected to each switch port.
using this table the switch forward the data by finding the frames only on the table.

* UDP (User Datagram protocol)

→ UDP is a connectionless transport layer protocol used to send data quickly over a network without establishing a connection.
→ It is a part of the TCP/IP suite and operates at layer 4 (Transport layer of the OSI model.

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features
→ Connectionless (no handshake)
→ Fast
→ Unreliable (no guarantee of data travel correct or not)
→ No acknowledgement
→ lightweight

* packet format
→ Source port
→ Destination port
→ Length
→ Checksum

Used?
- Streaming (audio/video)
→ VoIP (voice over IP) → Zoom, whatsapp
→ Online gaming
→ DNS (Domain Name System)
→ TFTP (Trivial file Transfer protocol)

UDP vs TCP

	TCP	UDP
Connection	Yes	No
	Slower	Faster
	Guarantee delivery	not guarantee
	Email, file transfer	Streaming, gaming

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ARP helps devices on a local computer network find each other's MAC addresses using their IP addresses.

ARP (Address Resolution protocol):

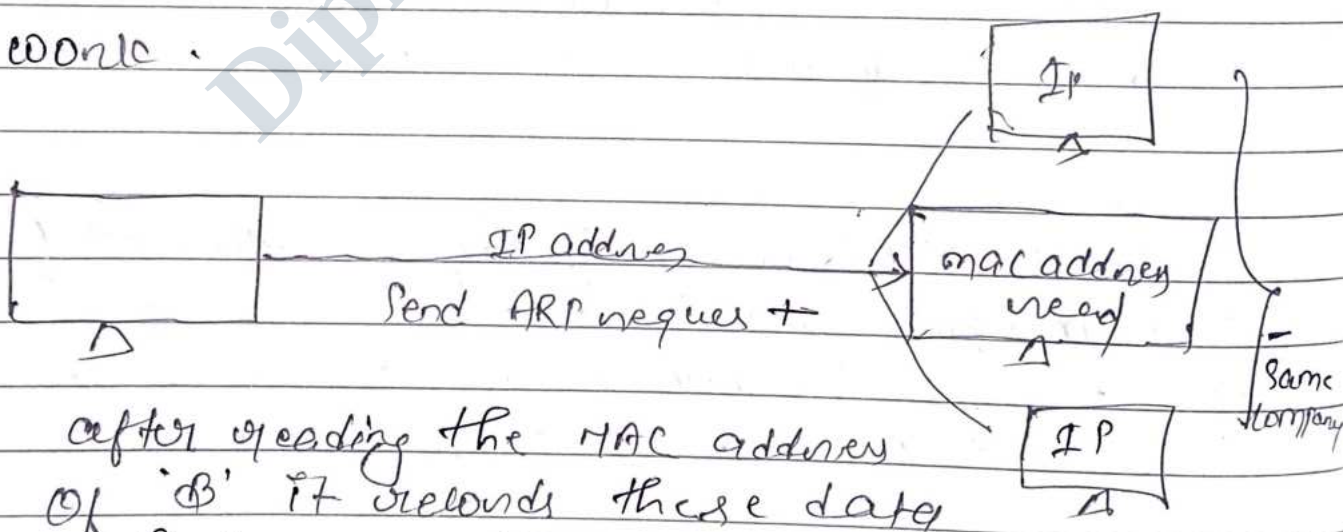
ARP is a network used to map an IP address to a MAC address in local network.

- IP address - Logical address (used for routing)
- MAC address = physical address (used to deliver data on local network.

Why ARP

When a device 1 want to to share some data with device 2 on the same device it knows the IP address but needs the MAC address to deliver data.

Work:



after reading the MAC address of 'B' it records these data of Cache and then send the data

ARP request (who has this IP address) →.
ARP reply (I have that IP then it is my MAC.

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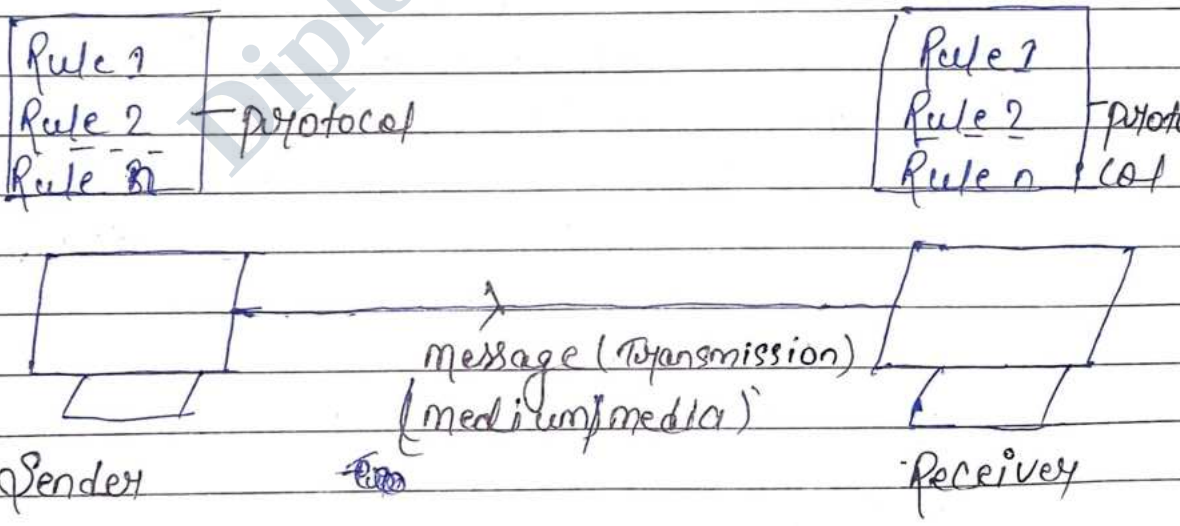
Data

Data refers to the raw-fact that are collected from different sources.

Representation of data is following:-

i) Text
ii) Numbers
iii) Images
iv) Audio
v) video
vi) Biological data:- Retina, Fingerprint, DNA, RNA etc.

Data Communication



Data communication are the exchange of data between two or more devices via medium- wire or wireless medium.

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Sagar

For Data communication to occurs the Communicating Devices must be part of a Communication System made up of a Combination of Hardware and Software.

A Data Communication System depends on four fundamental properties:-

i) Delivery
ii) Accuracy
iii) Real-Time Transmission
iv) Jitter

b- bits
B- Bytes

*

i) Delivery:- The system must deliver data to the correct destination.
ii) Accuracy:- The system must deliver the data accurately.
iii) Timelines:- The system must deliver data in a timely manner.
iv) Jitter :- * Jitter refers to the variation in the packet arrival time.
* It is the uneven delay in the delivery of audio or video packets.

* Latency is the time takes for data to travel across a net-work. (Low latency is better)

* packet loss is when data packets fail to reach their destination on a network.

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* Data Communication Components:-

* message:-

The message is the information (data) to be communicated. Popular forms of information include text, number, picture, audio and video etc.

* Sender:-

The Sender is the device that sends the data message.

* Receiver:- The Receiver is the device that receives the message.

* Transmission medium:-

Transmission medium is the physical path between Sender and receiver.

* protocol:-

A protocol is setup of rules that govern data communications. Without a protocol two devices may be connected but not communicating.

For example:- Just as a person speaking hindi cannot be understood by a person who speaks only telgue.

Ex- HTTP, FTP, SMTP, DHCP etc.

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IEEE

IEEE :- Institute of electrical & electronic Engineers.
* Institute which control protocol.

* It is a professional association with a non-profit organization with its headquater in New york in USA.

Frequency Band	IEEE Standard	
IEEE	802.11	wifi
IEEE	802.15	Bluetooth
IEEE	802.15.2	for bluetooth & wifi co-existence
IEEE	802.15.4	for wireless sensors or controls
IEEE	802.15.6	for wireless Body Area Net i.e. Bluetooth
IEEE	802.16	WiMax (wireless Network)
IEEE	802.24	Coordinate among all IEEE 802 stand.
IEEE	802.10	Security implementation in LAN/MAN
IEEE	802.9	Integrated Service i.e. voice-app video
IEEE	802.8	Fibre-optics connection
IEEE	802.7	Broadband LAN Cable
IEEE	802.6	Exchanging information b/w system
IEEE	802.5	standard token ring access, LAN/MAN
IEEE	802.4	Token passing bus access
IEEE	802.3	CSMA/CD
IEEE	802.2	Logical link control Connectivity ~~Connectively~~
IEEE	802.1	LAN/MAN management, bridging, remote
IEEE	802	For LAN/MAN network

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Sagar

Date
Page

Computer memory

Binary digit — 0 and 1
bit — Any one of 1 and 0
Nibble — 4 bits
Bytes — 8 bits = 2 Nibble
1 KB (Kilo Bytes) — 1024 Bytes
1 MB (Mega Bytes) — 1024 Kilo Bytes
1 GB (Giga Bytes) — 1024 Mega Bytes
1 TB (Tera Bytes) — 1024 Giga Bytes
1 PB (Peta Bytes) — 1024 Tera Bytes
1 EB (EXA Bytes) — 1024 Peta Bytes
1 ZB (Zetta Bytes) — 1024 EXA Bytes
1 YB (Yotta Bytes) — 1024 Zetta Bytes
1 BB (Byonto Bytes) — 1024 Yotta Bytes
1 GB (Geop Bytes) — 1024 Byonto Bytes

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Network PORT / PORT No.

port number :— A computer port number is a 16-bit integer that serves as a unique identifier for a specific process or service on a networked device.

It allow multiple application to communicate simultaneously over the same IP address by directing incoming date to the appropriate application.

* port number range 0 to 65535.

Types of Network PORT

- Well-Known ports / Reserved port : 0 - 1023
- Registered port : 1024 - 49151
- Dynamic / private ports : 49152 - 65535

FTP - Port 21
HTTP - Port 80
HTTPS - Port 443
IMAP - Port 143
POP3 - Port 110
Telnet - Port 23
SMTP - Port 25
DNS - Port 53
SSH - Port 22
SMB - Port 445
NTP - Port 123
SNMP - Port 162

MySQL - Port 3306
NFS - port 2049
RDP - port 3389
SSL - port 443

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Full forms Related to Computer Network

OSI layers

A	HTTP	Hypertext Transfer protocol
A	HTTPS	Hypertext Transfer protocol Secure
N	IP	Internet protocol
T	TCP	Transmission control protocol
P A	SMTP	Simple mail Transfer protocol
	IMAP	Internet message Access protocol
P	SSH	Secure shell
A	POP	post office protocol
A	DNS	Domain Name System
A	FTP	File Transfer protocol
	SMB	Server Message Block
	SNMP	Simple Network management protocol
P	SSL	Secure Socket layer
	NFS -	Network File System
	RDP -	Remote Desktop protocol
	MySQL -	My Structured Query language.
A	Telnet -	Telecommunication NETwork
	NFC -	Near field communication
	RFID -	Radio Frequency Identification
	DOT -	Department of Telecom
	TRAI -	Telecom Regulatory Authority of India.
	NTP -	Network Time protocol
	ICMP -	Internet Control message protocol
	TLDS -	Top level domains (.com, .org, .mil, .in)
D	MAC -	media Access Control

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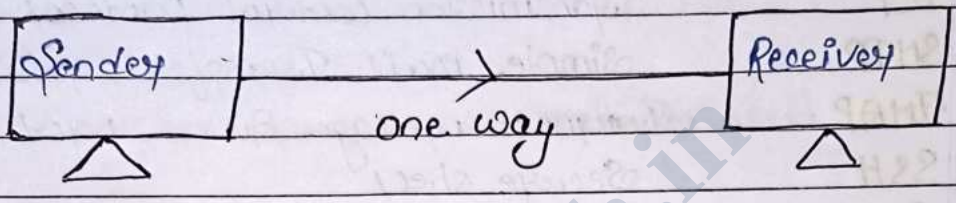
Communication mode

Communication between two devices can be Simplex, Half Duplex or full Duplex

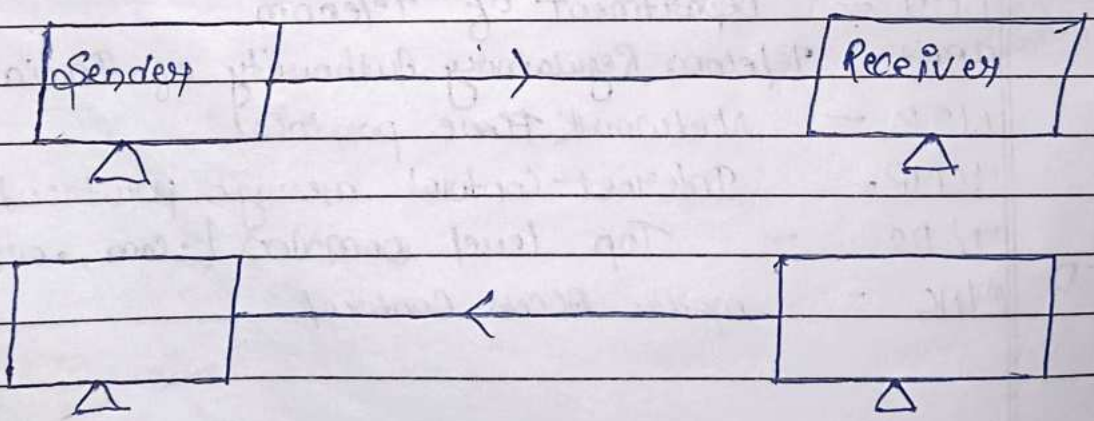
① Simplex



In Simplex mode the communication is unidirectional as a one way street. Only one of the two devices on a link can transmit the other than can only receive.

Example:- Keyboard, Traditional monitor, mouse, printer, Radio board casting etc.

② Half Duplex:-



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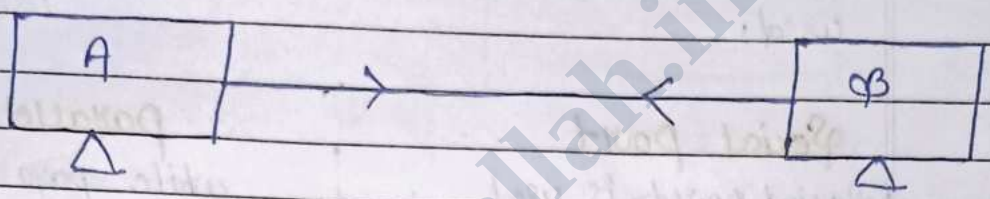
In half duplex each node can both transmit and receive but not at the same time. When one device is sending the other can only receive.

Example:- Walkie-Talkie, CB Radio, Talkback Radio etc.

(iii) Full Duplex



In Full Duplex (also called Duplex) both nodes can transmit and Receive ~~Sym~~ simultaneously.

Example:- mobile Communication, Telecommunication etc.

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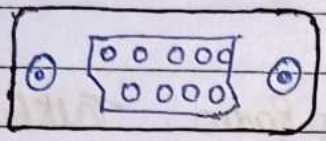
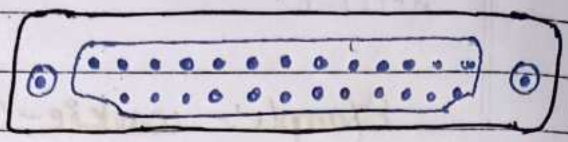
Communication

Serial port



→ External interface
- Speed of transmission is higher
- more number of wire are used.

parallel port



- Serial communication interface
- Speed of transmission is slower
- less number of wires are used.

Serial port	parallel Port
Serial port is used to achieve serial transmission.	while parallel port is used to achieve parallel transmission.
* The transmission speed of serial port is comparatively low as compared to parallel port transmission speed.	while transmission speed of parallel port is higher than serial port transmission speed.
* A serial port is capable of delivering the single stream of data.	while parallel port is capable of delivering multiple streams of data.
Serial port send a bit after another byte at a time.	while parallel ports send multiple bits at once.
* used in modems, security cameras, device controller.	used in printers, Hard Drives, CD drives.

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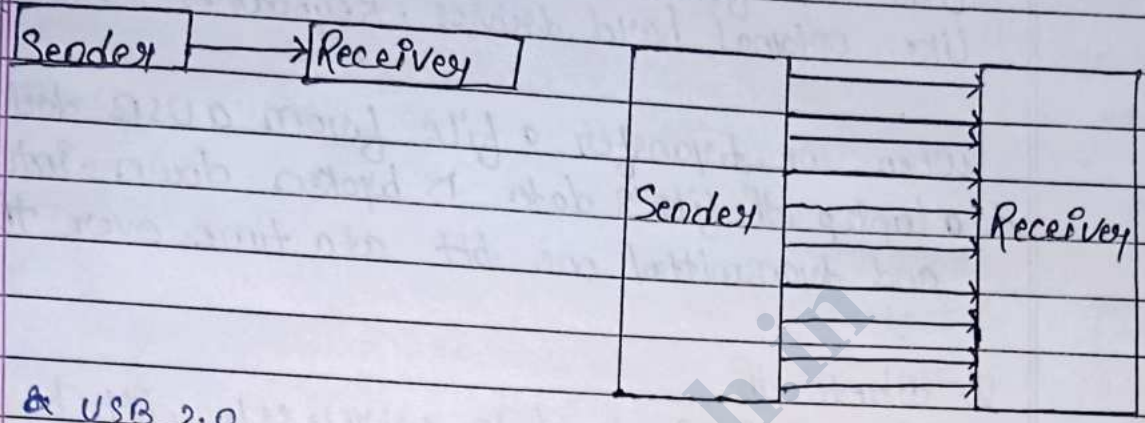
Data Transmission

Serial Transmission

Parallel Transmission



Serial Transmission	Parallel Transmission
* USB 2.0	VGA Connection
* A single communication link is used to transfer data from one end to another.	* In this type, multiple parallel links used to transmit the data.
* Serial transmission, data (bit) flows in bi-direction	* In parallel transmission, data flows in multiple lines.
* Serial Transmission is slow in comparison of parallel Transmission.	* parallel Transmission is fast in comparision of Serial Transmission.
* Serial Transmission is used for long-distance.	* parallel Transmission is relatively complex.
* Serial Transmission is full duplex as Sender can send as well as receive the data	* parallel Transmission is half-duplex since the data is either send or receive.
* Ex- Computer connected to a smartphone, etc.	Ex- Computer connected to a printer, etc.

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Some example of Serial and parallel communication:

1. USB (universal Serial Bus)

USB transfer data sequentially between devices like external hard drives, keyboards, and computers.

When we transfer a file from a USB drive to a laptop, the file's data is broken down into bits and transmitted one bit at a time over the USB.

2. Bluetooth

Bluetooth sends data wirelessly, bit by bit, b/w two devices (eg. smartphone and wireless earphones).
The audio data is transmitted in a continuous stream of bits, ensuring smooth playback.

parallel communication:

1. Communication Between CPU and RAM

The CPU communicates with RAM using a parallel data bus, where multiple bits (usually 64) are transmitted simultaneously.
This parallel transmission allows fast data transfer, which is essential for efficient computing

2. parallel port (old printers)

printers used parallel ports to receive data from a computer, transmitting 8 bits at a time over 8 parallel wires.
This allowed faster data transfer compared to Serial communication.

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Noise/unwanted Signal

Some value are stop of server.

MAC (media access control)

Transmission media/medium

Guided (wired)

Unguided (wireless)

Twisted pair

plastic

→ Copper used
→ upper part is plastic material.
* Why twisted?

For radio signal

Analog signal

Digital signal +3V 0V

Data

Analog Data

Digital Data

10:20

↳ Repeater (boost the network connection)

* Amplifier boost the slow signal to high.

RJ-45 - Registered jack 45

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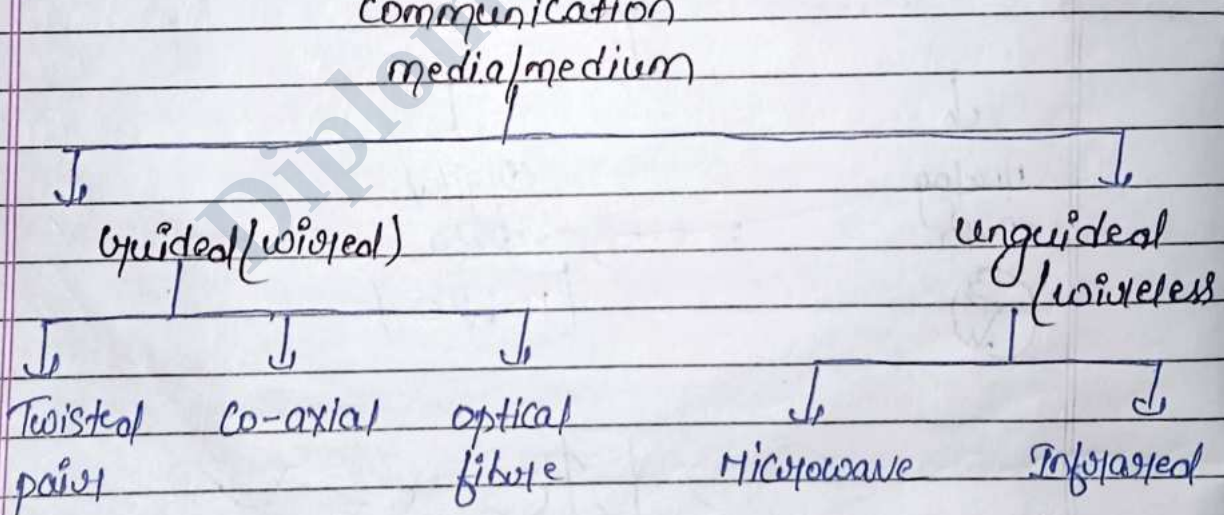
Transmission Media/medium

Transmission media/medium is the physical path between transmitter and receiver.

In other words a transmission medium can be broadly defined as anything that can carry information from source to a destination.

A transmission medium are actually located below the physical layer and directly controlled by the physical layer.

Transmission media can be divided into two broad categories— guided and unguided



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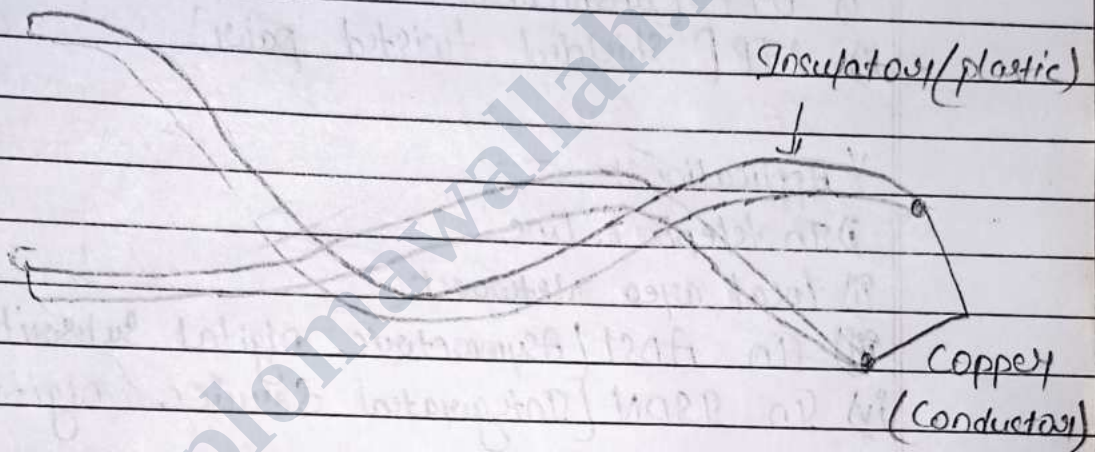
* Twisted pair cable :-

A twisted pair cable consist of two conductors (normally copper) each with its on plastic insulation twisted together. one of the wire is used to carry signals to the receiver and the other is used only as a ground reference. The receiver uses the difference between two.

The recei



Twisted pair

Why to twist the wire?

→ Twisting of wire is will reduced the effect of noise (unwanted signal) or external interfrance. Number of Twist per unit length will determined the quality of cable. More twist means better quality.

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AT&T Bell Lab
↳C

Twisted pair cable may be used to transmit both analog and digital transmission. For analog signal amplifiers are required for about 5 to 6 Kilometers. For digital transmission (using either analog or digital signal) repeaters are required ~~every~~ every 2 to 3 Kilometers.

The two commonly used types of twisted pair cable are following:-

i) UTP (unshielded twisted pair)
ii) STP (Shielded twisted pair)

* Applications:-
i) To telephone line
ii) local area Network
iii) In ADSL (Asymmetric digital Subscriber Line)
iv) In ISDN (Integrated Service digital Network)

* Categories of UTP cables

	Bandwidth	Data Rate	Type	Application
CAT 1	Very low	< 100 Kbps	Analog	Telephone
CAT 2	< 2 MHz	2 Mbps	Analog/digital	T1 Line, LAN
CAT 3	16 MHz	10 Mbps	Digital	LAN
CAT 4	20 MHz	20 Mbps	Digital	LAN
CAT 5	100 MHz	100 Mbps	Digital	LAN
CAT 6	200 MHz	200 Mbps	Digital	LAN
CAT 7	606 MHz	600 Mbps	Digital	LAN

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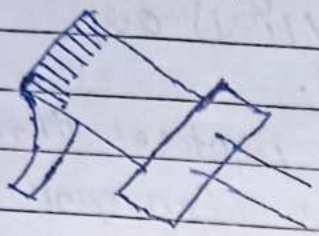
Radio
AM FM

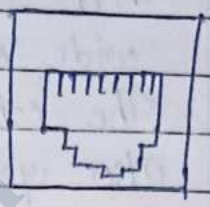
BNC (connector)

RJ-45 Connector

male connector



female connector



Colour code of RJ-45

(I) White/orange
(II) Orange
(III) White/green
(IV) Blue
(V) White/Blue
(VI) Green
(VII) White/Brown
(VIII) Brown

Q.d. 20

Advantage of Twisted pair cable.

→ Reduced Electromagnetic Interference.
→ cost-effective
→ Ease of Installation.
→ modern cable (CAT5e, CAT6, CAT7) support high speed data transmission.

Disadvantage.

→ Limited Bandwidth
→ Short distance communication
→ Durability Issues.
→ lower Security

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RJ-45

~~Male connector:-~~

RJ-45:-

A Ethernet ~~or a tea~~ is a technology that allows the connection of multiple devices in a local Area Network (LAN) or wide Area Network (WAN).
The ethernet has also some protocol that are also responsible for effective communication between the devices in the wired Network.
RJ stands for Registered jacks.
They are generally used for Registered jacks.

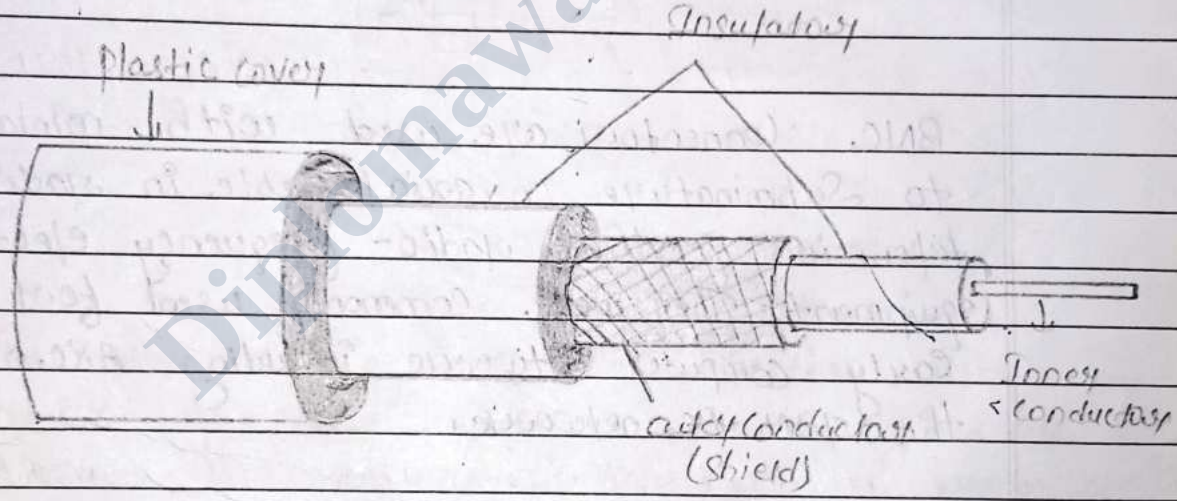
* Color code of RJ-45

pin	T568B	T568A
1	white with orange stripe	white with green stripe
2	orange	green
3	white with green stripe	white with orange stripe
4	blue	blue
5	white with blue stripe	white with blue stripe
6	green	orange
7	white with brown stripe	white with brown stripe
8	brown	brown

* Advantage
→ provide much greater speed
→ They are very reliable.
* Disadvantage:
→ Have compatibility issue.
→ Connector neither weatherproof therfore they do not have much durability.

* Co-axial cable :- (or coax):

It carry signal of higher frequency ranges then twisted pair cable. Co-axial cable have two wires, Co-axial has a central core conductor (Inner Conductor) of solid or standard standard wire (usually copper) enclosed in an outer conductor of metal foil or a combination of the two. The outer metallic wrapping serves as a shield against noise and the second conductor The outer conductor is also enclosed in an insulating and the whole cable is protected by a plastic cover.



Application

* Cable TV
* Analog and digital telephone network
* Digital transmission
* Thin Ethernet

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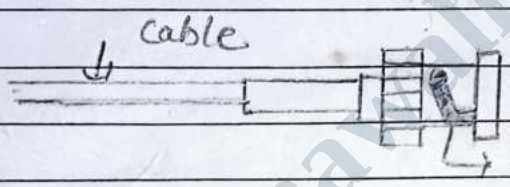
Impedance - Disturbance (Pagers)
PDA - Personal digital Assistant

Co-axial cable are categorized by the radio government (RG ratings)

Category	Impedance	use
RG-59	75 Ω	Cable TV
RG-58	50 Ω	Thin Ethernet
RG-11	50 Ω	Thin Ethernet

* BNC (Bayone - Neill - Concelman)



BNC Connectors are used with miniature to Subminature co-axial cable in radio, television & other radio-frequency electronic equipment. They were commonly used for early computer networks including ARCnet, the IBM PC network.

* Advantages
→ Long-distance single transmission
→ High bandwidth
→ High speed Internet connections, cable TV networks

* Disadvantages
→ Higher cost
→ Network failure

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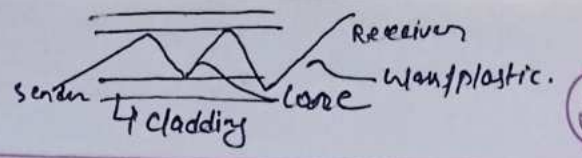


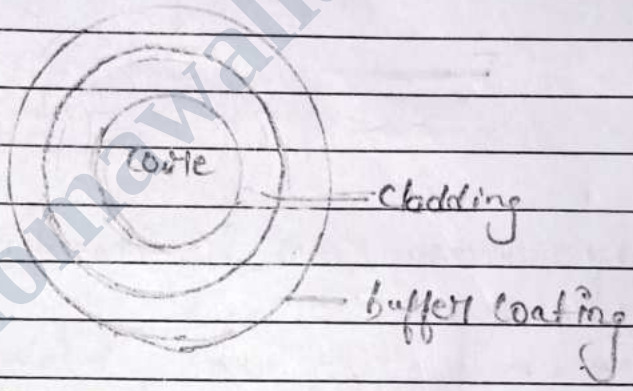
Optical Fibre:-

A fibre optic cable is made of glass or plastic and transmits signals in the form of light.

An optical fibre is a theme, flexible medium capable of guiding and optical ray.

An optical fibre strand (also called an optical wave guide) has a cylindrical shape and consist of three concendric section — The core, The cladding and the buffer coating.

~~The core is the~~



The core is the inner most section and consist of ~~theme~~ thin strands made of glass or plastic. The core has a diameter in the range of 8 to 62.5 μm. The core is surrounded by a cladding which is a glass of or plastic coating that has optical properties different from those of core and a diameter of 125 μm.

The interface b/w the core and cladding acts as a reflector. The outermost layer is the buffer coating which is a hard plastic coating that protects the glass from moisture and physical damages.

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There are three types of connectors for optical fibre cable:-

(i) Subscriber channel connector (SC connector)
(ii) Straigh tip (ST connector)
(iii) Mechanical Transfer-RJ (MT-RJ connector)

myself.

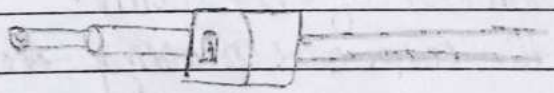
* Subscriber Channel :-

A Subscriber connector is a type of electrical connector used to connect a cable or wire to a device. The SC is design to provide a secure & reliable connection & easy installation & removal.

SC Connector

Straight Tip :-

It is a connector used in fibre optics cables that utilize a bayonet style plug and socket. The ST connector set up allows for unidirectional communication.



ST Connector

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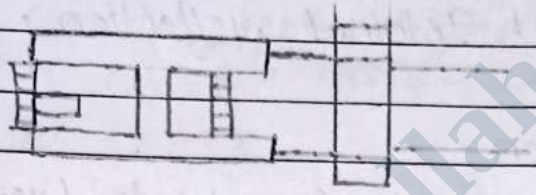
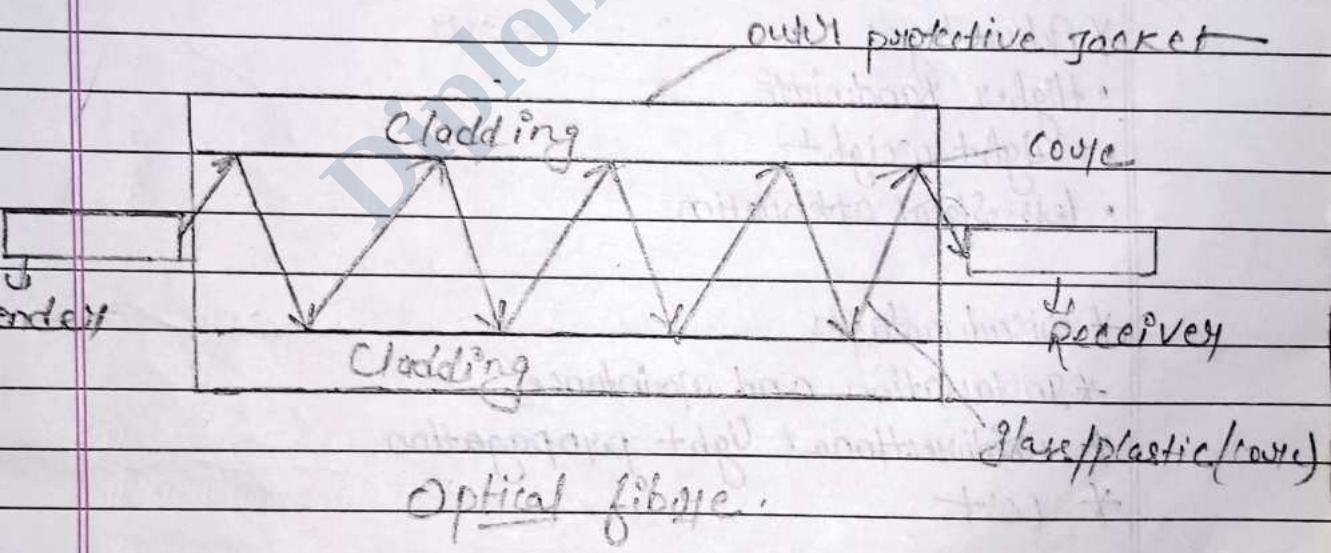
* MT-RJ (mechanical Transfer - RJ)

A MT-RJ is a fibre optic cable connector popular with small form factor device due to its small size; the connector houses two fibres and mates with locating pins on the plug.



MT-RJ connector



Optical fibre.

* Core:- Core is the piece through light travels. It is generally made up of glass or plastic.

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2) Cladding:- It is the covering of the core and reflects the light back to the core.

3) Sheath:- It is the protective covering that protects the cable from the environment.

* optical fibre works on the principle of Total Internal reflection.

* Application
- Telecommunication companies to transmit telephones signals.
- Internet communication
- Cable Television signals.

* Advantages
- Higher bandwidth
- Light weight
- less signal attenuation

* disadvantages
* Instavation and maintance
* unidirectional light propagation
* cost

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By Sir

* Subscriber Channel:-

The Subscriber channel connectors (SC) is used for cable TV. It uses a push or pull locking system.

* Straight tip:

The Straight tip (ST) Connector is used for connecting cable to Networking Devices.

* mechanical Transfer Registered Jack: (MT-RJ)

It is a Connector that is the same size as RJ-45.

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AM Radio - Ionosphere

RFID, NFC, - Ka & Ku band

Frequency Bands

Band	Range	propagation	Application
VLF (very low frequency)	3-30 KHz	Ground	long-range radio navigation.
LF (low frequency)	30-300 KHz	Ground	Radio beacons and navigational locators.
MF (middle frequency)	300 KHz - 3 MHz	Sky	AM Radio
HF (High frequency	3-30 MHz	Sky	Citizent Band (CB) ship/Aircraft
VHF (very High frequency)	30-300 MHz	Sky, line-of-sight	VHF TV, FM Radio
UHF (ultra high frequency)	300 MHz - 3 GHz	line-of-sight	UHF TV, Cellular Home, pager, Satellite
SF (super High frequency)	3-30 GHz	line-of-sight	Satellite
EHF	30-300 GHz	Liner-of-sight	Radar, Satellite

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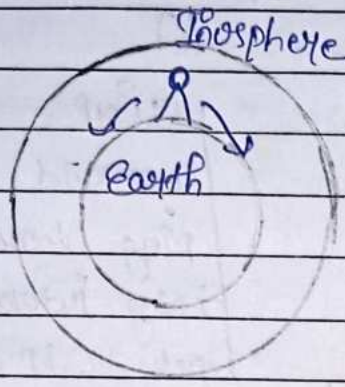
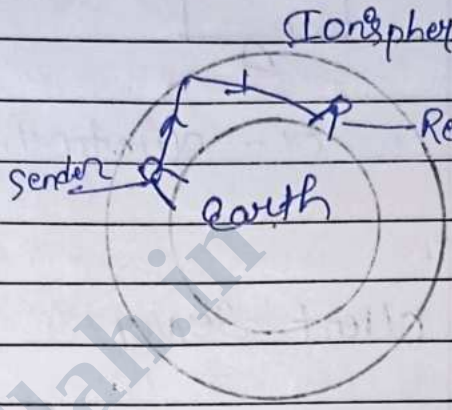
propagation



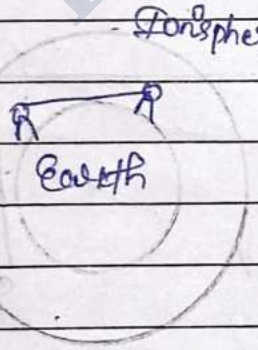


Ground propagation

- Travel along earth surface.
- Received directly by receiving antena.
- effective for short distance.

Sky propagation

- Radio wave travelling from an antena upward in the sky.
- used for long distance.



line of sight

- Directly travel and receiving antena without reflection.
- used for short range communication.

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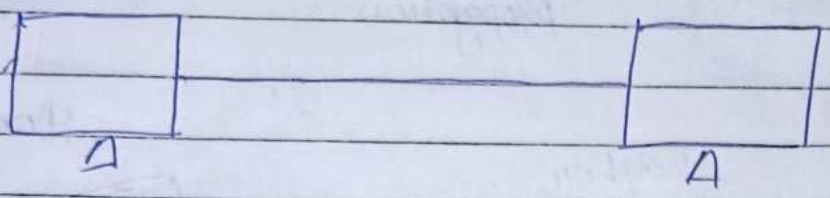
Infrared - Remote, CCTV, Infrared blaster (300.6THz - 400THz)

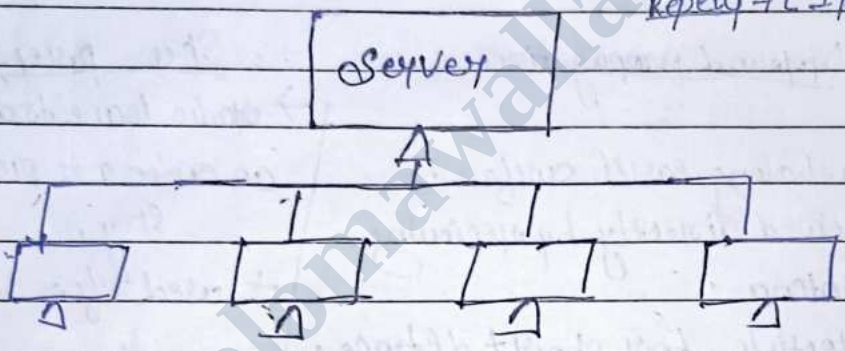
peer to peer



Ex- Bluetooth.

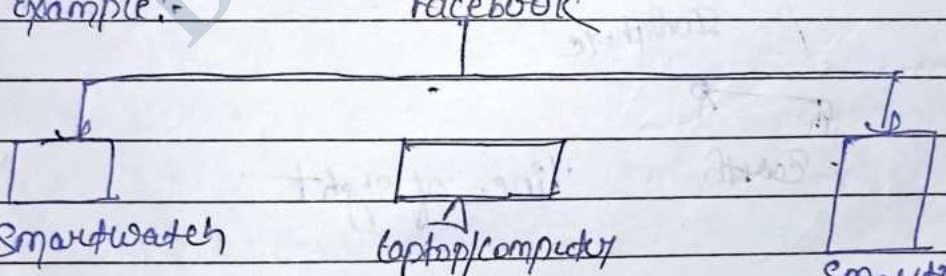
ICMP
Command
ping domainname/IP add.
→ ping futuranchi.ac.in
Reply → [IP address]

client - Server



Client

Example:-



* High frequency → low wavelength

low frequency → High wavelength

wifi

Single band (2.4GHz)

dual band (4.8GHz)

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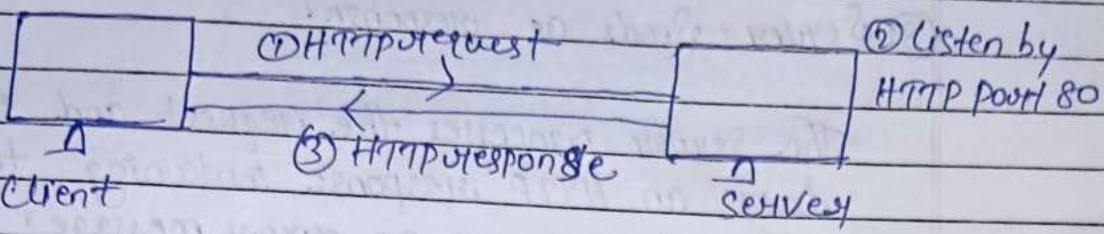
HTTP
(Hyper Text Transfer protocol)



HTTP port is also known as Request and Response protocol.

HTTP (Hypertext Transfer protocol) is the foundation of data communication on the internet.
It is a protocol that allows web browsers and servers to communicate with each other.

It defines how web browsers (clients) communicate with web servers to fetch and send data such as HTML pages, images, videos and more.

How HTTP works

1. client makes a Request.
A client send an HTTP request to a server.

Example: when you type www.facebook.com, the browser asks the server for that webpages.

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(2) Listen by HTTP port 80

(3) Server Sends as response:

The server processes the request and sends back an HTTP response containing the requested data or an error message.

HTTP Status Code

Informational (100-199)	
100	Continue
101	Switching protocols
102	processing
103	Early Hints

Success (200-299)	
200	OK
201	Created
202	Accepted
203	Non-Authoritative
204	No Content
205	Reset Content
206	partial Content
207	multi-Status
208	Already Reported

Redirection (300-399)	
301	moved permanently
302	found
303	see other

Client Error (400-499)	
400	Bad Request
401	unauthorized
402	payment required
403	Forbidden
404	Not found
405	method not allowed

Server Error (500-599)	
500	Interval Serve Error
501	Not implemented
502	Bad Gateway
503	service unavailable
504	Gateway Timeout

✗ Advantage
→ simplicity
→ widely supported
→ Versatility

✗ Disadvantage:- (1) Not Secure
(11) poor network Connection

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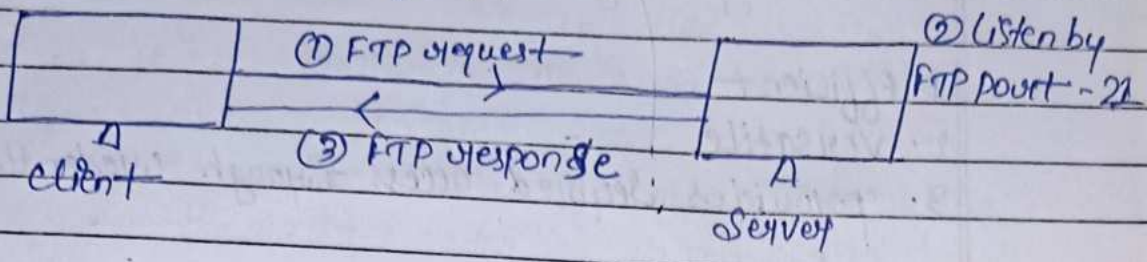
FTP
(File Transfer Protocol)



FTP (File Transfer protocol) is a standard network protocol used to transfer files between a client and a server over a network (eg: the Internet).
It allows users to upload, download, or manage files on a remote server.

How FTP works
FTP uses a client-server model, meaning one computer (client) request files from another computer (server). The protocol operates over the TCP/IP network layer for reliable data transfer.

1. Client sends a Request:
The FTP Client (software like filezilla) connects to an FTP Server.

2. Listen by FTP port 21

3. Server sends a response.

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*Advantage of FTP

1. Efficient
2. versatile
3. provides secured access through credentials.

* Disadvantages of FTP

1. lack of encryption
2. obsolete. (modern alternative like. SFTP (Secure FTP) and FTPS (FTP Secure) are safer.

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Unguided media:-

The unguided transmission media is a transmission mode in which the signals are propagated from one device to another device wirelessly signals can wave through the air water or vacuum.
It is generally used to transmit signals in all direction.

*Infrared:-

It is the short-distance communication and can pass through (300 GHz - 400 THz) any object.
It is generally used in TV remotes, wireless mouse etc.

*It is a type of electromagnetic radiation that is invisible to the human eye, but can be detected as heat.

*Application
→ In TV Remote
→ use in CCTV (The red light for night vision)
→ use in defence by army (Infrared Glass)
→ Detecting body heat variations.

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Advantages of Infrared

→ Detect heat and movement without physical contact.
→ Use in medical diagnostics, security systems and industrial monitoring.
→ Allow for remote sensing of temperature and movement.
→ Lower power consumption compared to many other sensing technologies.
→ Enable wireless data transmission.
→ Monitor thermal patterns in machinery.

Disadvantages of Infrared

→ Short transmission distances
→ Easily blocked by obstacles or objects.
→ Sunlight, fire, and other infrared emitting objects can disrupt sensors.
- Signal weakness over distance.
- Lower data transmission rates compared to some other wireless technologies.

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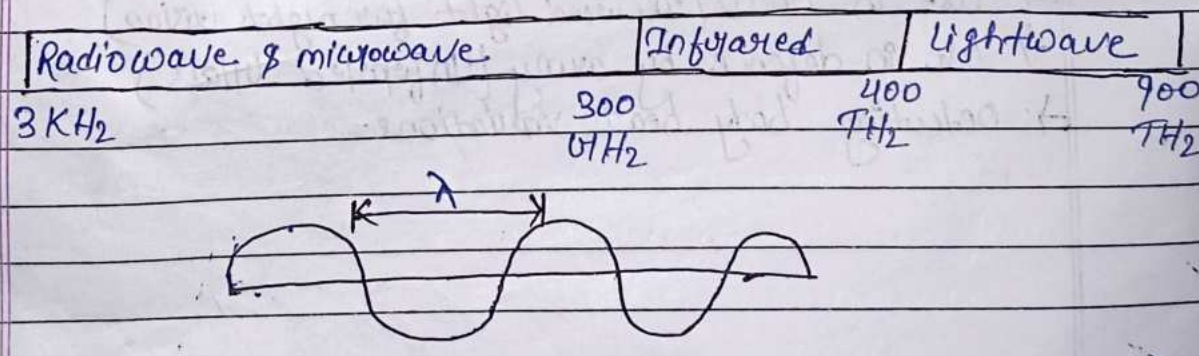


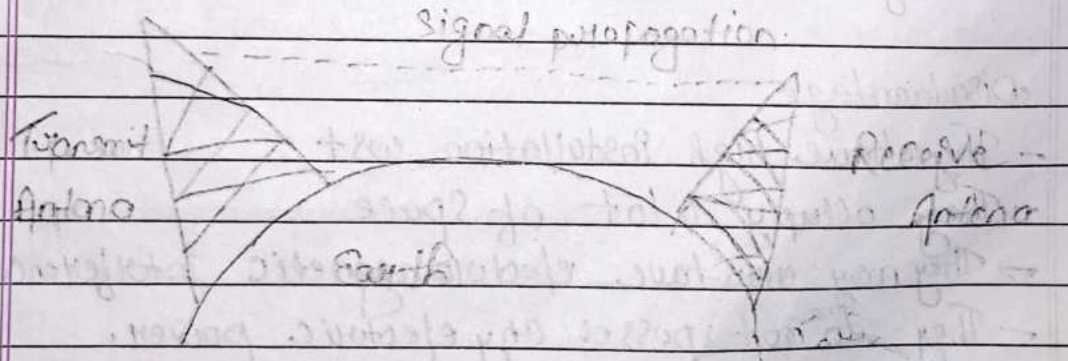
(I) Frequency (III) Time period
(II) wavelength (IV) Amplitude

f = No. of wave / second
(Hz - Hertz)

* High frequency → low wavelength
* low frequency → High wavelength

* microwave :-

microwave offers communication without the use of cables microwave signals are just like radio & television signals. It is used in long-distance communication Microwave transmission consists (3KHz - 300GHz) of a transmitter, receiver & atmosphere. In microwave communication there are parabolic antenn that are mounted on the tower to send a beam to another antena. The higher the tower, the greater the range. (unidirectional)



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Application

→ Communication System :- Allow data transmission over large distance. In the modern communication system.
→ Medical Diagnostics and Treatment.
→ Radar System (Detect nearby regions by their waves like weather forecasting, air traffic control, military)
→ material processing and manufacturing (currently industrial processes are being more processed with microwave technology for ripening, curing and drying of many diverse materials.

Advantages

→ Shorter wavelength and longer frequencies.
→ Have very large bandwidth.
→ They can gain more antennae.
→ They send higher data.
→ They consume very less power.
→ They also provides a very effective reflected region in the RADAR wave system.

Disadvantage

- They have high installation cost.
- They occupy a lot of space.
- They may also have electromagnetic interference.
- They do not posses any electric power.

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Propagation:-

Propagation in wireless communication refers to how signals travel from a transmitting source to a receiving antenna. It involve the physical processes of signal distribution.

Ground propagation:

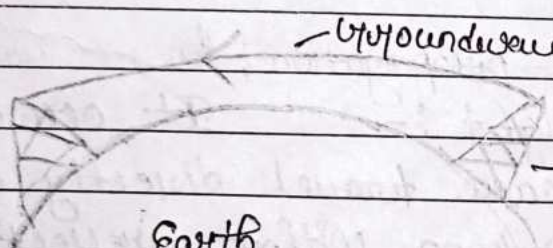
This mode occurs when radio waves travel along the Earth's surface and received directly by receiving antenna.

It is commonly used for short range communication

It is used for AM radio broadcasting and VHF/UHF television.

The range is typically limited to a few hundred kilometers.

Ex - AM, FM, television broadcasting etc.



Ground propagation

* Below 2MHz

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Application :-
→ Radio and television broadcasting.
→ Military communications.
→ Navigation signals.
→ Local radio Communication
→ Amateur radio communication.

Advantages
→ Ground waves can cover long distance due to their lower frequencies.
→ Stable Signal
→ Coverage in Remote areas
→ less affected by weather conditions.

Disadvantage
→ The wave lose energy as they interact with the Earth's surface.
→ Limited range
→ Environmental effects.
→ Low data capacity

~~Space wave propagation~~ :-
Line of Sight :- It occurs when the transmitter wave travel directly to the receiving antenna without reflection or deflection.
Also known as like a line of sight ~~direct wave propagation~~ for short range communication.

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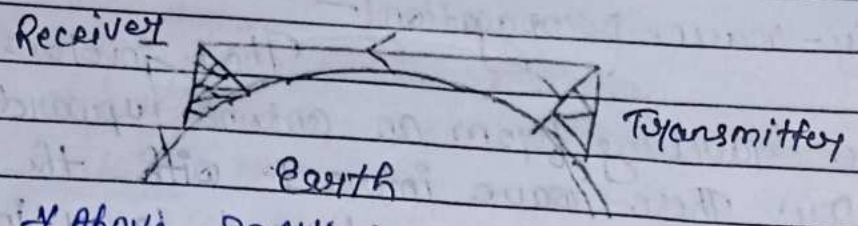

* Above 30 MHz

Application :-
→ Television Broadcasting
→ FM radio
→ microwave links (used in point to point communication system like telecommunication towers)
→ Satellite Communication.
→ mobile Communication.
→ Wi-fi and Bluetooth
→ Radar System

Advantages.
→ High frequency Transmission
→ Line of sight Communication
→ Supports High data Rates.
→ Better Signal Clarity
→ Reliable performance.

Disadvantages.
→ Line-of sight limitation
→ Limited range
→ High infrastructure cost
→ power requirement.
→ limited coverage.

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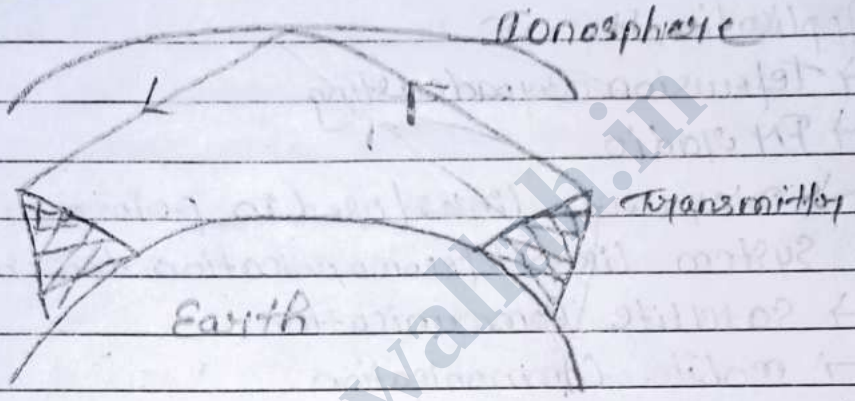
* Sky-wave propagation:-

That involves radio wave travelling from an antenna upward into the sky. These wave interact with the ionosphere an electrically charged layer in the upper atmosphere. used in long distance communication.



* 2-30 MHz

Application

→ used in shortwave radio for transmitting signals across continents.
→ Allows amateur radio operators to establish long-distance communication networks.
→ military communication.
→ disaster management
→ Scientific Research.
→ Broadcasting services.

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FM - 88 - 108 MHz

Advantages
→ Long - distance communication.
→ Signals can travel over mountains, ocean and other obstacles since they reflect off the ionosphere.
→ cost effective for long ranges.
→ wide coverage.
→ useful for emergency communication.

Disadvantage
→ Dependence on the Ionosphere.
→ Limited frequency Range.
→ Signal can weaken or fluctuate due to ionospheric irregularities.
→ Signal take longer to travel due to multiple reflections.
→ Cannot support high-speed data transmission.
→ Not suitable for local communication.

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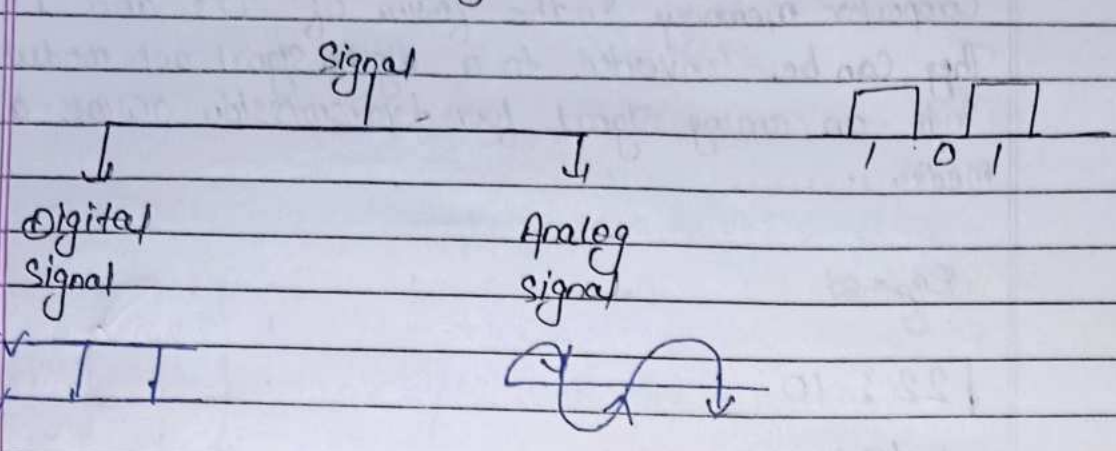
Data Signal



Data

Data can be analog or digital. The term analog "data" refers to information that is continuous; digital data refers to information that has discrete state.

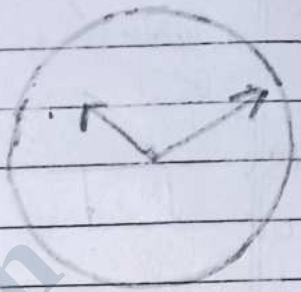
For example an Analog clock that hawes hour, minute and seconds hands gives information in a continuous form. On the other hand a digital clock that reports the hours and the minutes will change suddenly from 12:15 to 12:16.

Analog data such as the sounds made by a human voice take on continuous values. When someone speaks an analog wave is created in the air. This can be captured by a microphone and converted to an analog signal or simpled and converted to a digital signal.

Digital data take on discrete values for example data are stored in a computer

Digital - Square
Analog - Sinewave

Computer memory in the form of 0s and 1s. They can be converted to a digital signal or modulated into an analog signal for transmission across a medium.

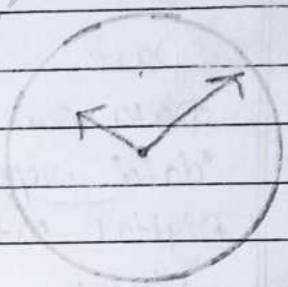


[22 : 10]

to

[22 : 11]

4 change.



Digital data (clock)

Analog data (clock)

Signal

Signal can be either analog or digital. An analog signal has infinitely many levels of intensity over a period of time. As the wave moves from value A to value B it passes through and includes an infinite number of values along its path. A digital signal on the other hand can have only a limited number of defined values. Each value can be any number, it is often as simple as 1s and 0s.

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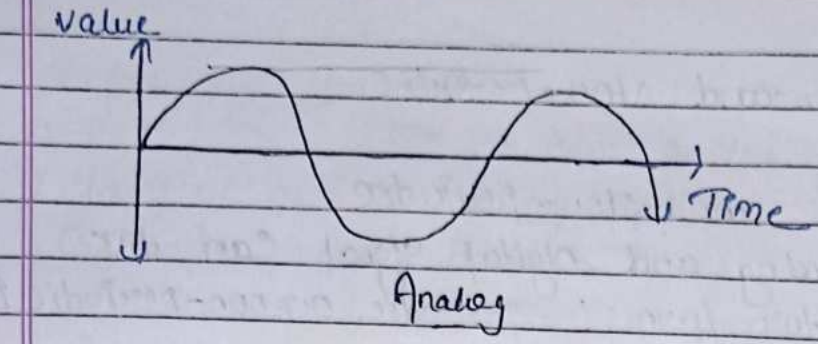
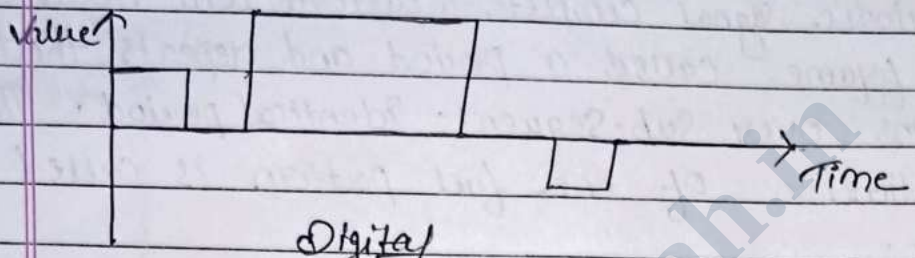


Analog



Digital

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~~Periodic and Non-periodic~~

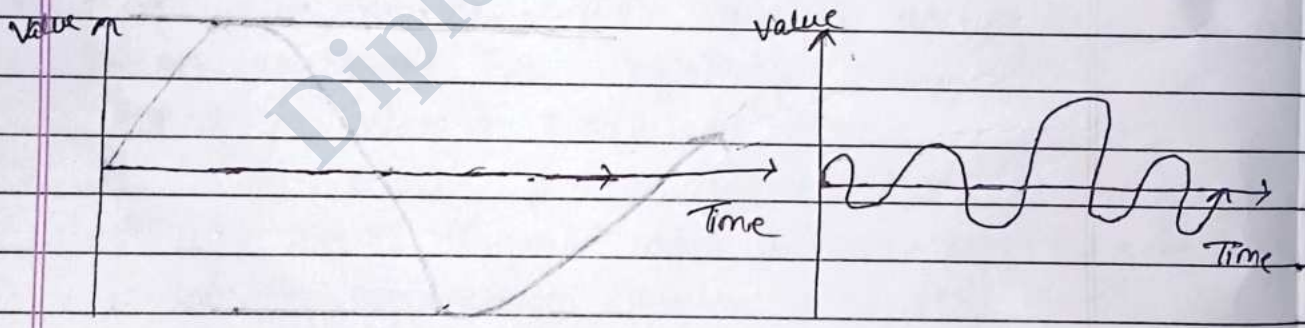
* Periodic and Non-periodic.

Both Analog and digital signal can take one of two forms :- periodic or non-periodic (A periodic).

A periodic signal complete a pattern within a measurable time frame, called a period and repeats that patterns over sub-sequent identical period. The completiodtion of one full pattern is called a cycle.

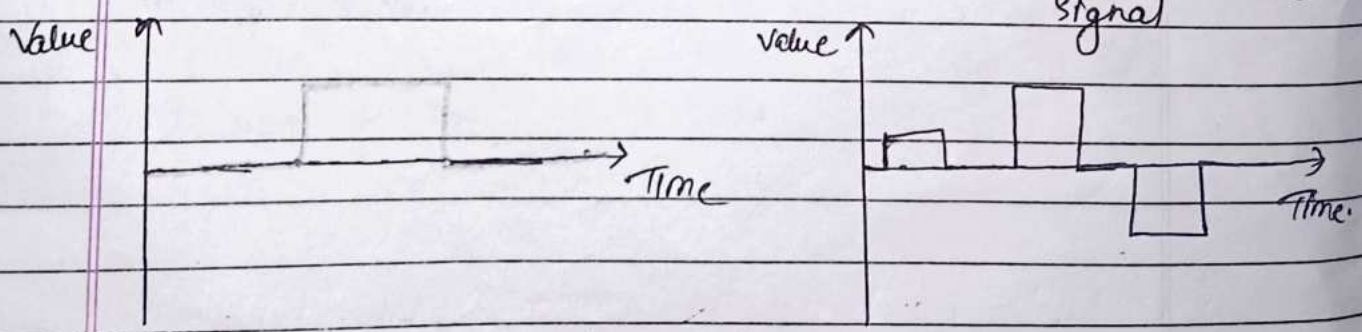
- Non-periodic signal is opposite of periodic signal.

In data communication we commonly use periodic analog signals and non-periodic digital signal



periodic analog signal

Non-periodic analog signal



periodic digital signal.

Non-periodic digital signal

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peak amplitude, frequency, phase, period, units, hertz. wavelength

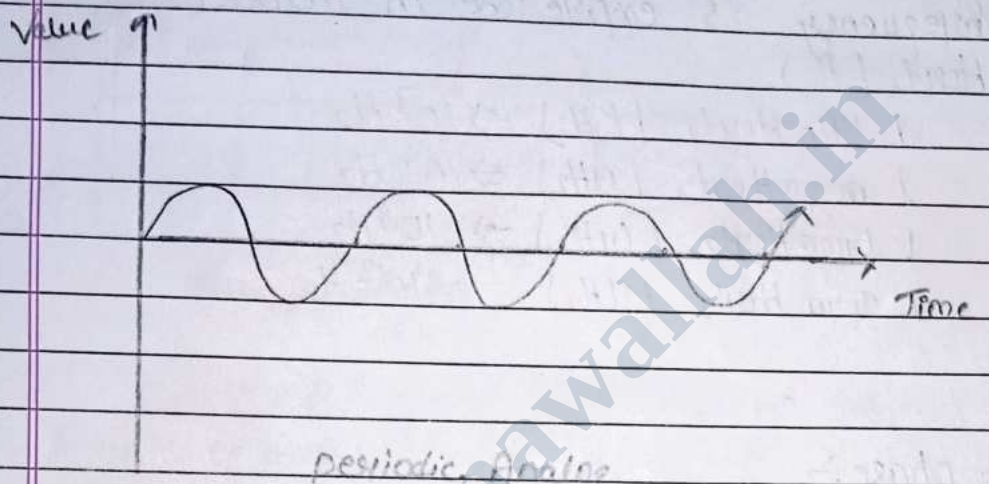
Date Page

* periodic Analog:-

Periodic Analog signal can be classified as simple or opposite.

A Simple periodic Analog signal a sine wave cannot be decomposed into simpler signals.

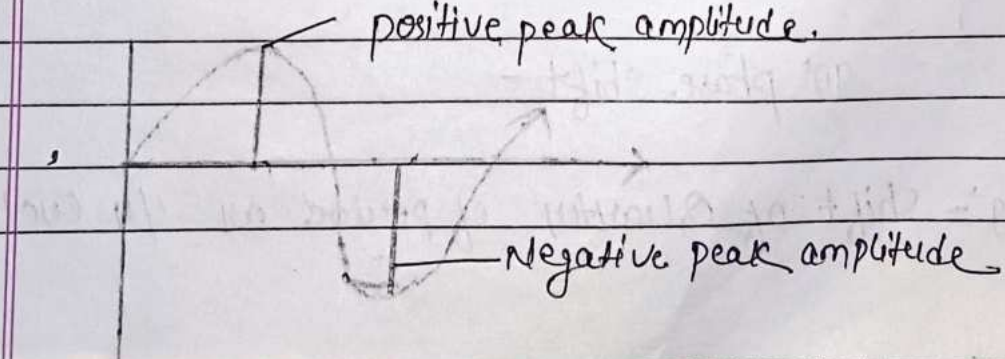
A ~~complete~~ composite analog signal is composed of multiple sine wave.



A sine wave can be represented by 3 parameters:- Peak amplitude, Frequency and phase.

* peak Amplitude:-

The peak amplitude of a signal is the absolute value of its highest intensity, proportional to the energy it carries.



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(ii) Frequency :-

period refers to the amount of time in seconds a signal needs to complete one cycle, frequency refers to the number of periods in one second.

$$f = \frac{1}{T} \quad \text{or} \quad T = \frac{1}{f}$$

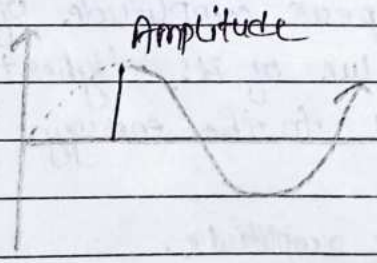
Frequency is expressed in Hertz (Hz)

Hertz (Hz)

1 Kilo Hertz (KHz) $\Rightarrow 10^3$ Hz
1 mega Hertz (MHz) $\Rightarrow 10^6$ Hz
1 Giga Hertz (GHz) $\rightarrow 10^9$ Hz
1 Tera Hertz (THz) $\rightarrow 10^{12}$ Hz

* phase :-

The phase describe the position of the waveform relative to time zero.
or
It describes, how much the waveform shifts forward or backward along the time axis.



90° phase shift

fig :- Shift of Quarter of period or 1/4 cycle.

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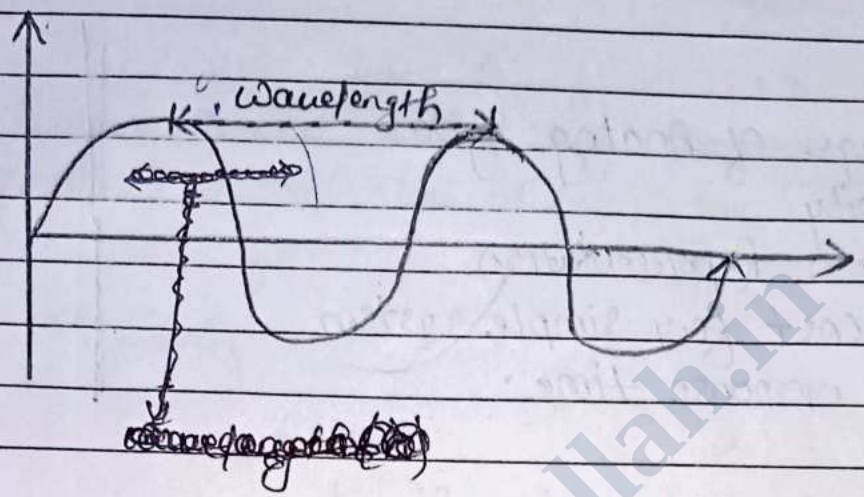
* Wavelength :-

Wavelength refers to the distance between identical points on two successive waves or It is the distance b/w two crests (or through) of a wave. Denoted by 'λ'.



* units of period

unit	Equivalent
Seconds (s)	1 s
Milliseconds (ms)	10^{-3} s
Microseconds (μs)	10^{-6} s
Nanoseconds (ns)	10^{-9} s
picoseconds (ps)	10^{-12} s

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Application of Analog Signal:

→ Audio Transmission
→ Older television and Camcorders.
→ Medical Equipment
→ Communication System.

Advantage of Analog Signal

→ Simplicity
→ Continuous Representation
→ Low cost for simple system
→ faster response time.

Disadvantage of Analog Signal

→ Limited Storage and transmission
→ Lack of Scalability
→ Difficulty in Error Correction.
→ Component drift (resistors, capacitors)

Example:— Audio System, Television Broadcasting, Landlines Telephones, Medical Equipment (Electro-Cardiogram), Cameras (Film) etc.

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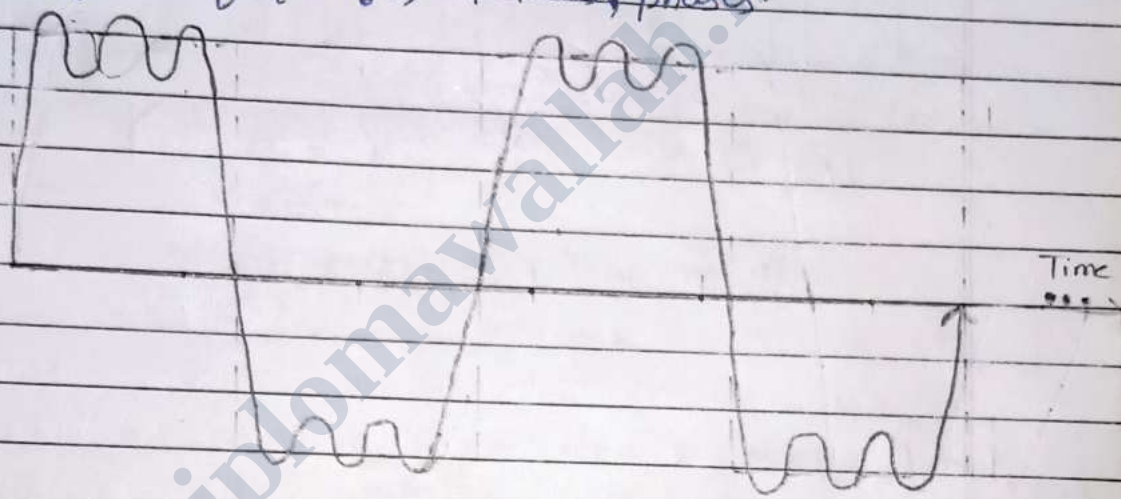
Simple + Composite

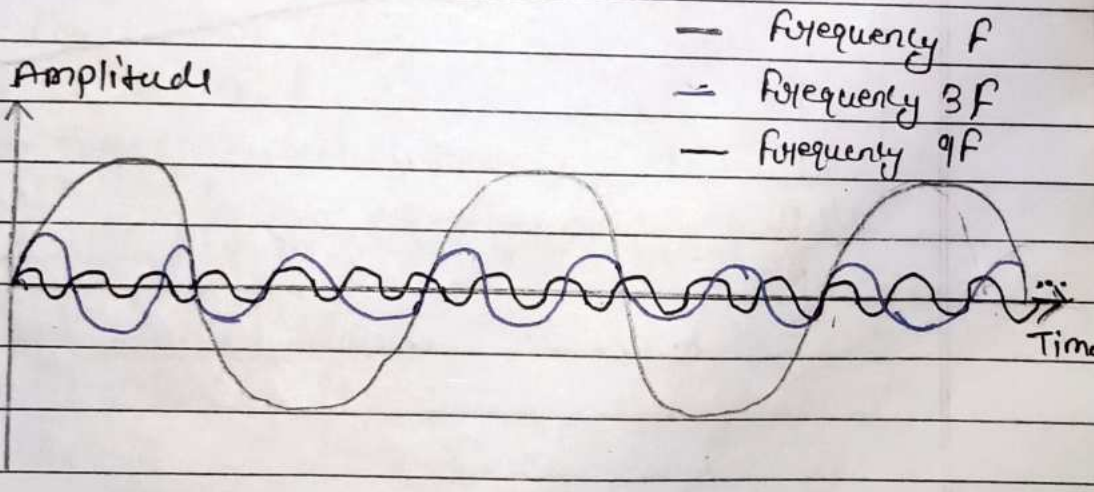
* Composite Signal :-

A single frequency sine wave is not useful in data communication. We need to send a composite signal, a signal made of many simple sine waves.

In the early 1900 the french mathematician Fourier showed that any composite signal is actually a combination of simple sine wave with different frequencies, amplitudes and phases.



A composite periodic signal



Time-domain decomposition of a composite signal

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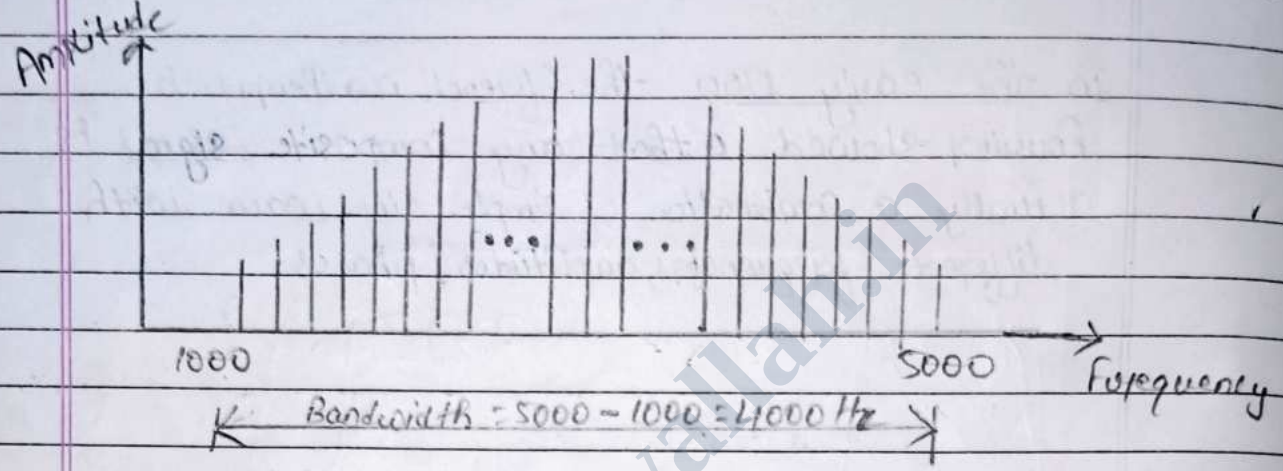
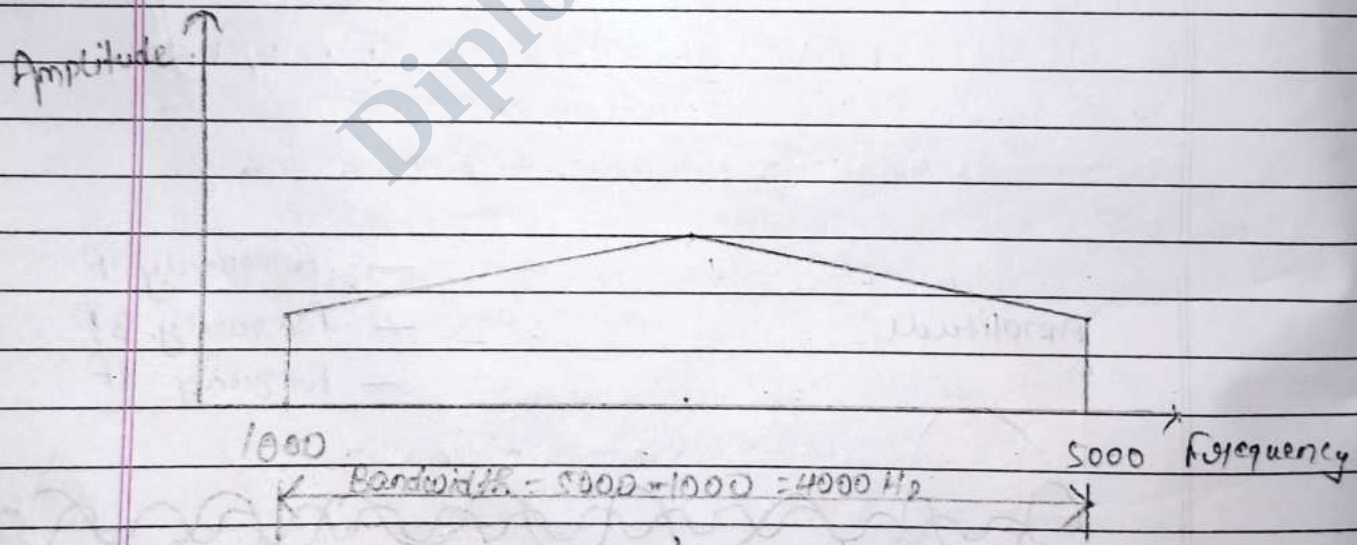
*Bandwidth :-

The bandwidth of a composite signal is the difference between the highest and the lowest frequencies contained in the signal



a. Bandwidth of periodic signal.



b. Bandwidth of non-periodic signal

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Q. A periodic signal has a bandwidth of 20 Hertz. The highest frequency is 60 Hertz. What is the lowest frequency?

Given,

Bandwidth = $20\ H_2$

Highest frequency = $60\ H_2$

lowest frequency = ?

$B = f_h - f_l$

| B = Bandwidth
| f_h = heighest frequency
| f_l = lowest frequency.

$20 = 60 - f_l$

$f_l = 60 - 20$

$f_l = 40\ H_2$

The lowest frequency is $40\ H_2$.

Q. If a periodic signal is decomposed into 5 sine waves with frequencies of 100, 300, 500, 700 and 900 Hz. What is the bandwidth?

We know

$B = f_h - f_l$

f_h = ~~Height~~ heighest frequency = $900\ H_2$

f_l = lowest frequency = $100\ H_2$

$B = 900 - 100$

$\boxed{B = 800\ H_2}$

Bandwidth is $800\ H_2$.

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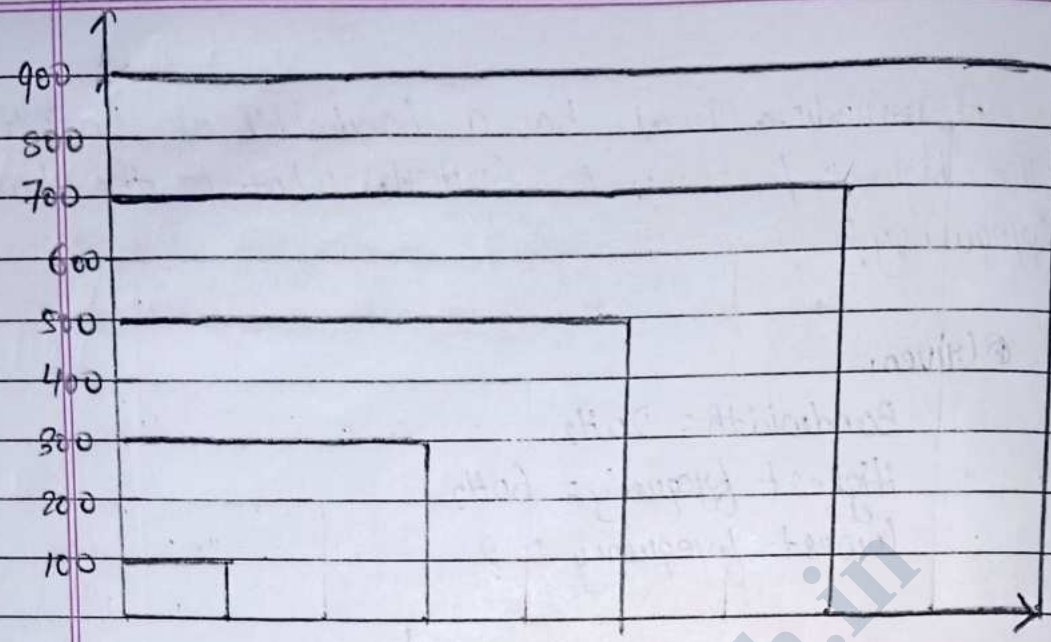

Q. What is the bandwidth of a signal that can be decomposed into 5 sinewaves with frequencies at 0, 20, 50, 100 and 200 Hz.

We have

$$B = f_h - f_l$$

$$f_h = 200$$

$$f_l = 0$$

$$B = 200 - 0$$

$$B = 200$$

Hence, Bandwidth is 200 Hz.

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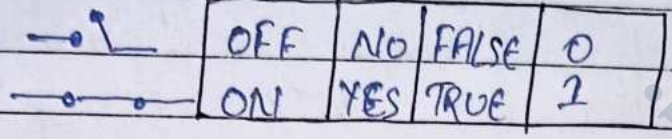
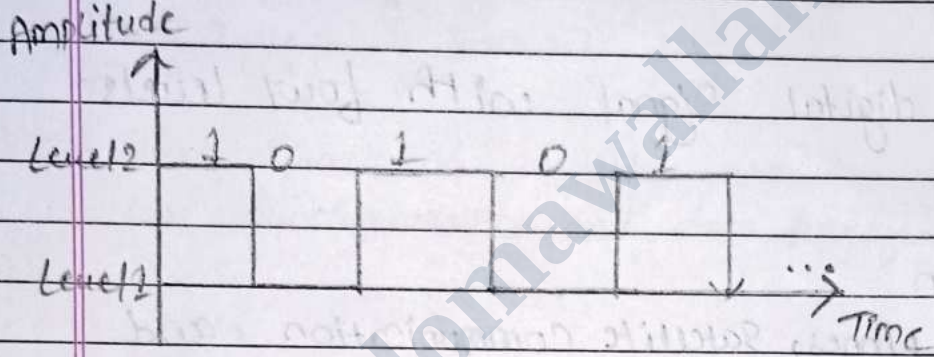
* Digital Signal :-

Information (data) can also be represented by a digital signal a 1 can be encoded as a +ve voltage & a 0 as voltage.

A digital signal can have more than two level.



OFF	NO	FALSE	0
ON	YES	TRUE	1



Digital signals with two levels.

We can sent 4bit for each level.

In general if a signal has L level each level needs $\log_2 L$ bits.

$$\log_2 4$$

$$= \log_2 (2)^2$$

$$2 \log_2 2$$

$$= 2 \times 1 = 2 \text{ bits.}$$

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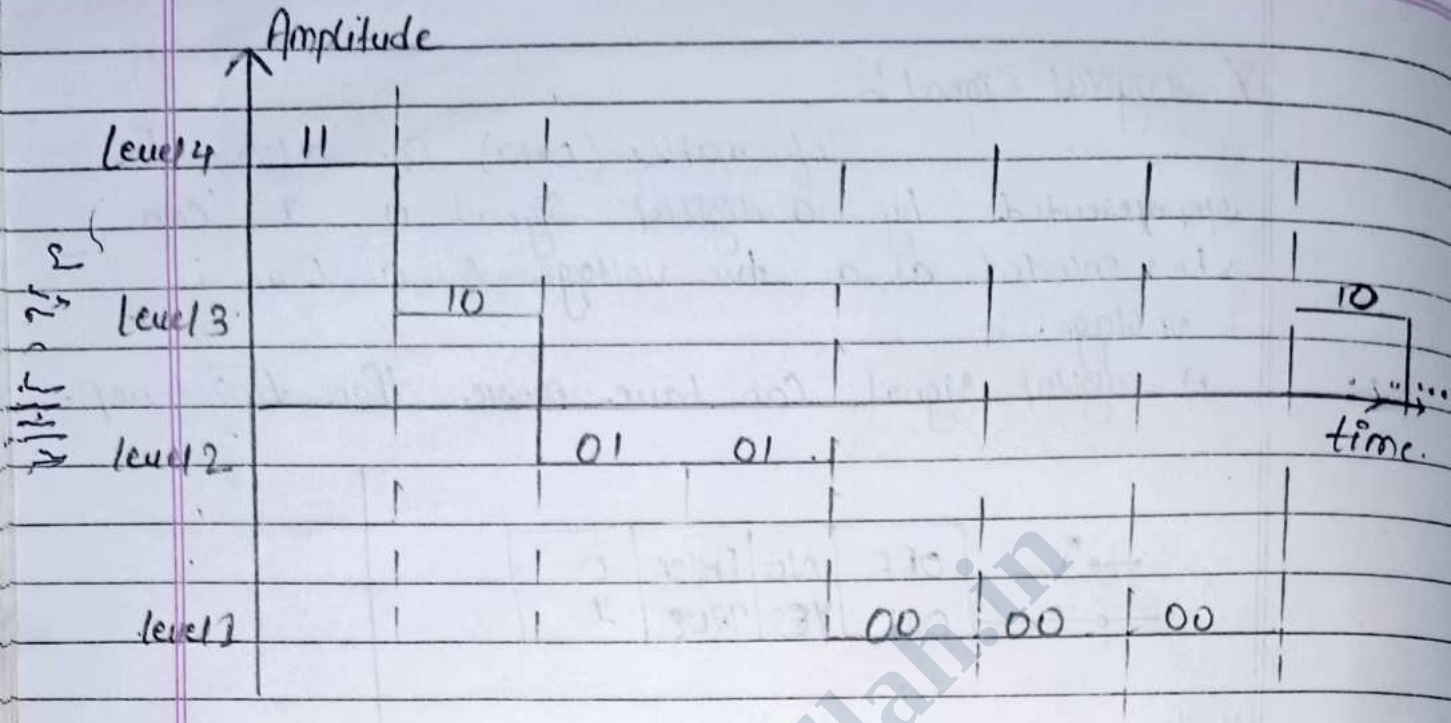

A digital signal with four levels.

* Application
→ mobile phones, satellite communication, and wireless networks like wi-fi and 5G.
→ Secure data transfer
→ multimedia System
→ Control System (automative systems, smart devices)
→ Medical technology

* Advantage
→ High Accuracy and Reliability
→ Easy storage and Transmission
→ Flexibility
→ Error detection and Correction
→ Integration with modern technology.

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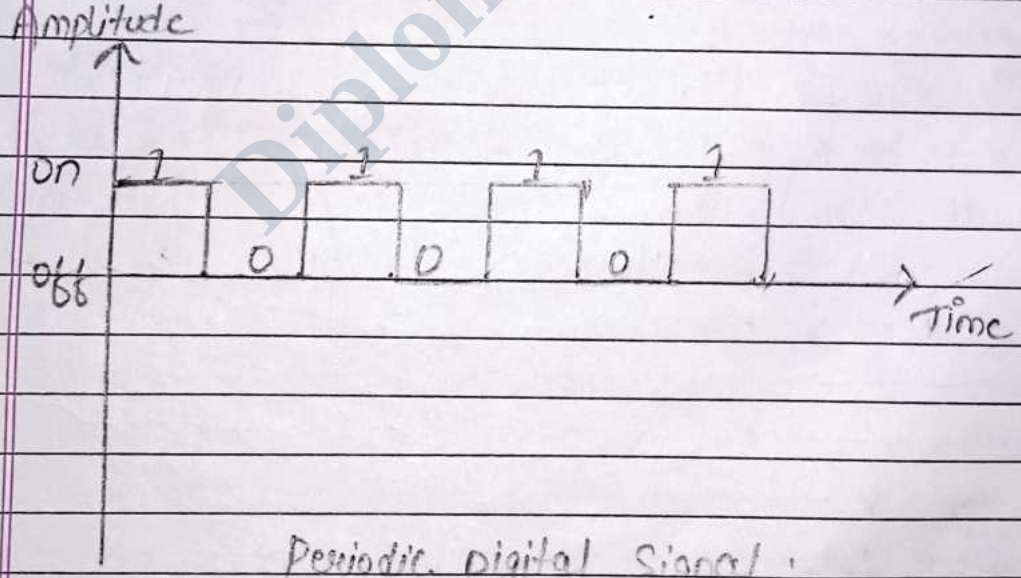
* Disadvantage
→ Complexity
→ High power Consumption
→ Converting analog signal into digital produce error.
→ High initial cost.
→ processing digital signal can be introduce delays.

* periodic digital signal:-
A periodic digital signal is a type of digital signal that repeats itself at a regular interval.

These signals are widely used in digital system for synchronization and data transfer.



Periodic digital signal.

Examples:- Digital Televisions (HDTV), cellphones, data transmission over Internet, Digital Thermometers etc.

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A digital signal has 8 levels how many bit are needed per level.

$\log_2 L$

$= \log_2 8$

$= \log_2 (2)^3$

$= 3 \log_2 2$

3×1

$= 3$ bits.

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Bit rate:-

The bitrate is the number of bits send in one second expressed in bits per second (bps).

Kbps → kilo bit per second (10^3)
Mbps → mega bit per second (10^6)
Gbps → gigabit per second (10^9)
Tbps → terabit per second (10^{12})
Pbps → petabit per second (10^{15})
Ebps → Exabit per second (10^{18})

→ bit rate determine the quality of the audio file. (e.g 128 Kbps, 320 Kbps)

→ Higher bit rates result in better sound quality but larger file sizes.
→ Lower bit rates save bandwidth at the cost of audio fidelity.

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Ethernet

* Kisi value, signal ya data unit ko represent karne ke liye itne bits use kiye gaye hain.

Bit length:-

Bit length represent data or encode information to how many number of bits into digital system.

→ It plays a critical role in defining the precision, range, and efficiency of data processing and transmission.

→ In another words we can say that Bit lengths determines the amount of binary data (0s and 1s) used to store or process a value.

Example:-

8-bit → $2^8 = 256$ values,

16-bit → $2^{16} = 65,536$ values,

32-bit widely used in computer system for integers and floating-point numbers.

* The bit length is the distance one bit occupies on the transmission medium.

Bit length = propagation speed X bit duration.

1. processor architecture

* 32-bit - in one time it transfer data of only 32 bits
* 64-bit processor: transfer the data faster and more memory support.

*used

- Data types
Network packets
CPU architecture.

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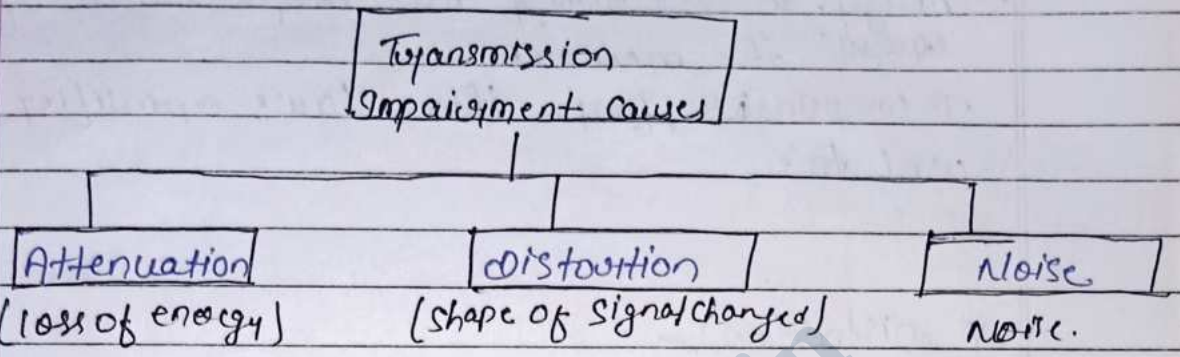
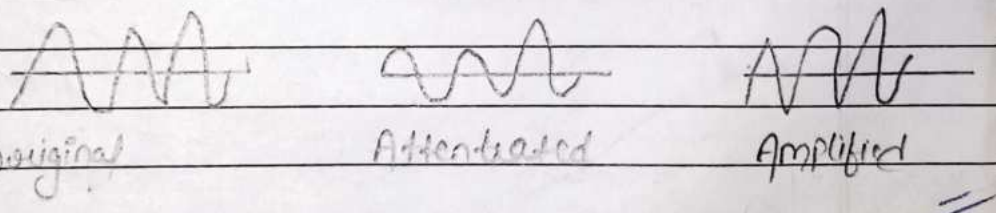
* Transmission Impairment

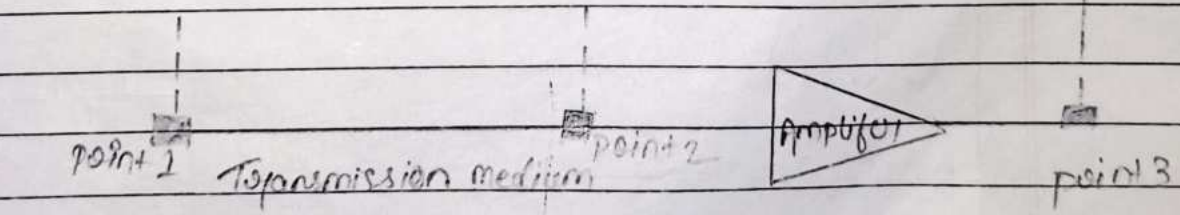


Signals travel through transmission media, which are not perfect. The imperfection causes signal impairment. This means that the signal at the begining of the medium is not same as the signal at the end of the medium. What is sent is not what is received. Three causes of impairment are:-

* Attenuation :-

Attenuation means loss of energy.





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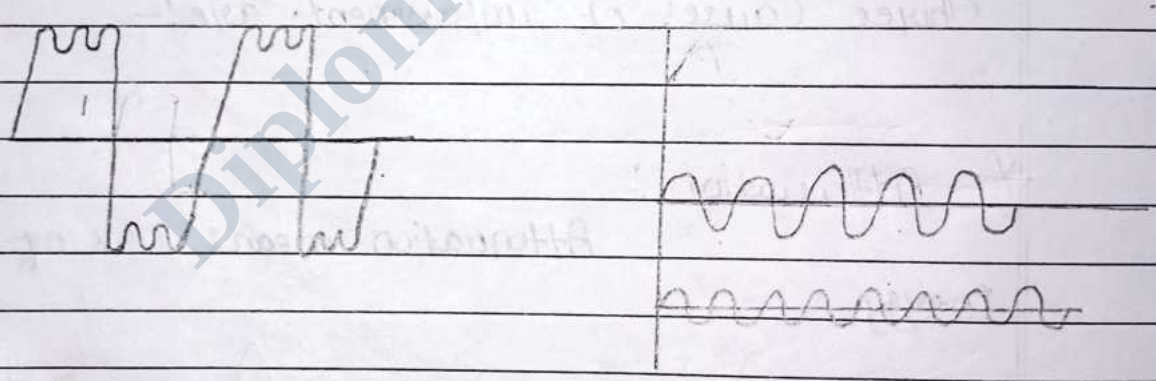
When a signal Simple or composite travel through a medium it losses Sum of its energy. in overcomming the resistance of the medium.
To compensate for this laws apmlifier are used to.

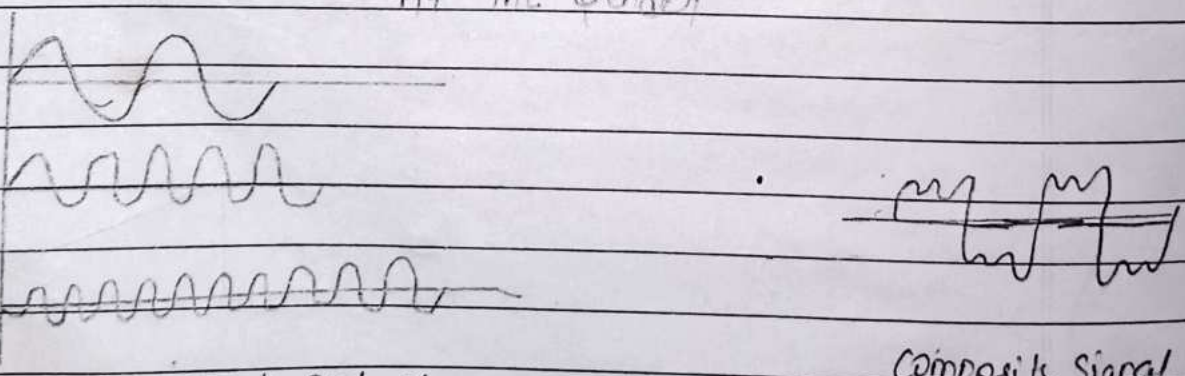
* Distortion :-

Distortion means the signal changes its ~~home offset~~ form or shape.
Signal comprises at the receiver have phases different from what they had at the signal. The set of the composite signal is therefore not the same.



Component in phase

At the Sender



Composite signal received.

Component out of phase

At the Receiver

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Noise:-

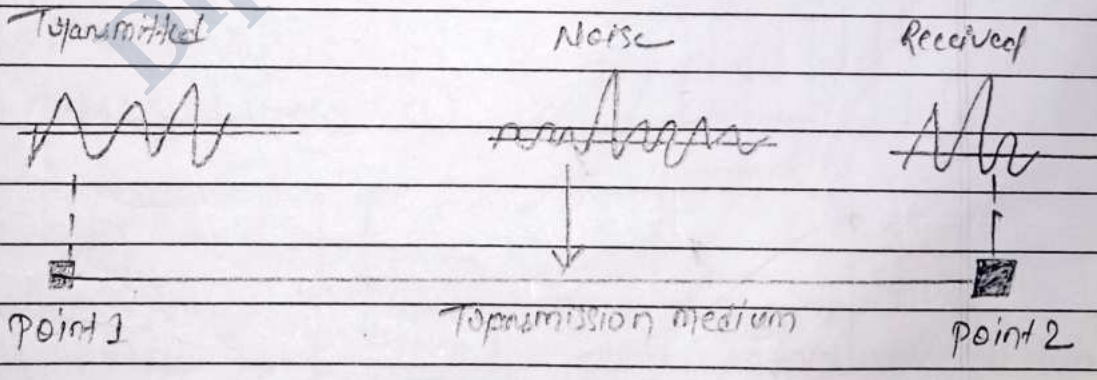
Several types of noise, such as thermal noise, induced noise, crosstalk and impulse noise.

Thermal noise is the random motion of electrons in a wire which create an actual signal not originally sent by the transmitter.

Induced noise comes from sources such as motors and appliances.

Crosstalk is the effect of one wire on the other.

Impulse Noise is a signal with energy in a very short time.



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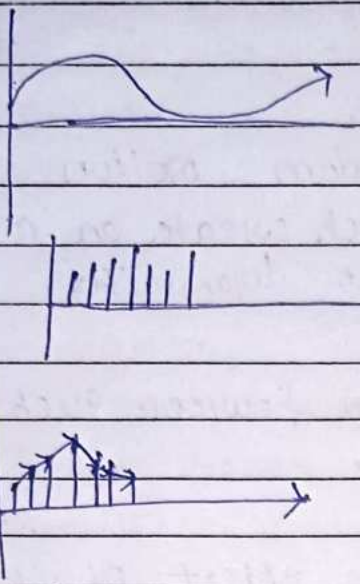
DNS

Domainname ⟷ IP address

Analog signal



Increase - 1

decrease - 0

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Analog to Digital Conversion

The following technique to change an analog signal to digital data (Digitization) :-

i) pulse code modulation (PCM)
ii) Delta Modulation (DM)

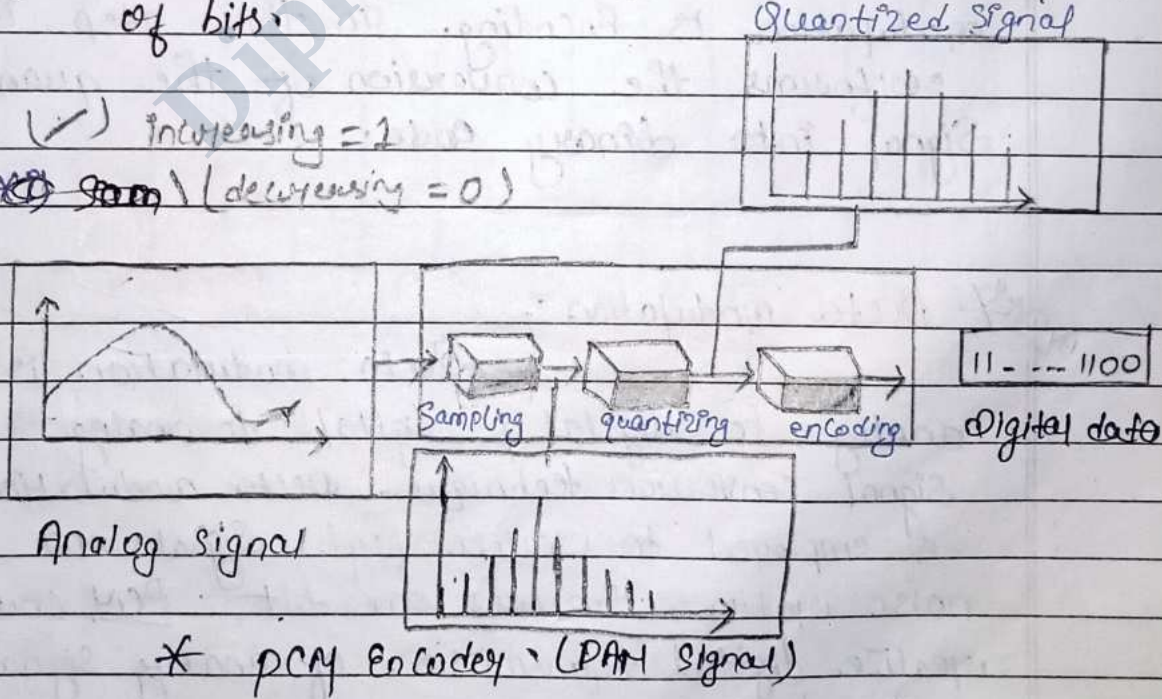
* Pulse Code Modulation :-

The most common technique to change an analog signal to digital data (digitization) is called pulse code modulation.

A PCM encoder has three following processes :-

i) The analog signal is sampled
ii) The sampled signal is quantized.
iii) The quantized values are encoded as stream of bits.

(✓) Increasing = 1
(✗) Same \ (decreasing = 0)



* PCM Encoder (PAM signal)

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i) Sampling:-

Sampling in pulse code modulation is a first step that bridges the gap between continuous time analog signal and discrete time analog signal.

ii) Quantization:-

Quantization in PCM is a crucial step that involves rounding the sampled analog signal values to the nearest pre-defined quantization level.

iii) Encoding:-

The last step in pulse code modulation is Encoding. In this step it performs the conversion of the quantized signal into binary code.

04 ~~oct~~ Delta modulation:-

Delta modulation is an analog to digital & digital to analog signal conversion technique. Delta modulation is employed to realize high signal to noise ratio. It use one bit. PCM code to realize digital transmission of analog signal with delta modulation. Instead of transmit-

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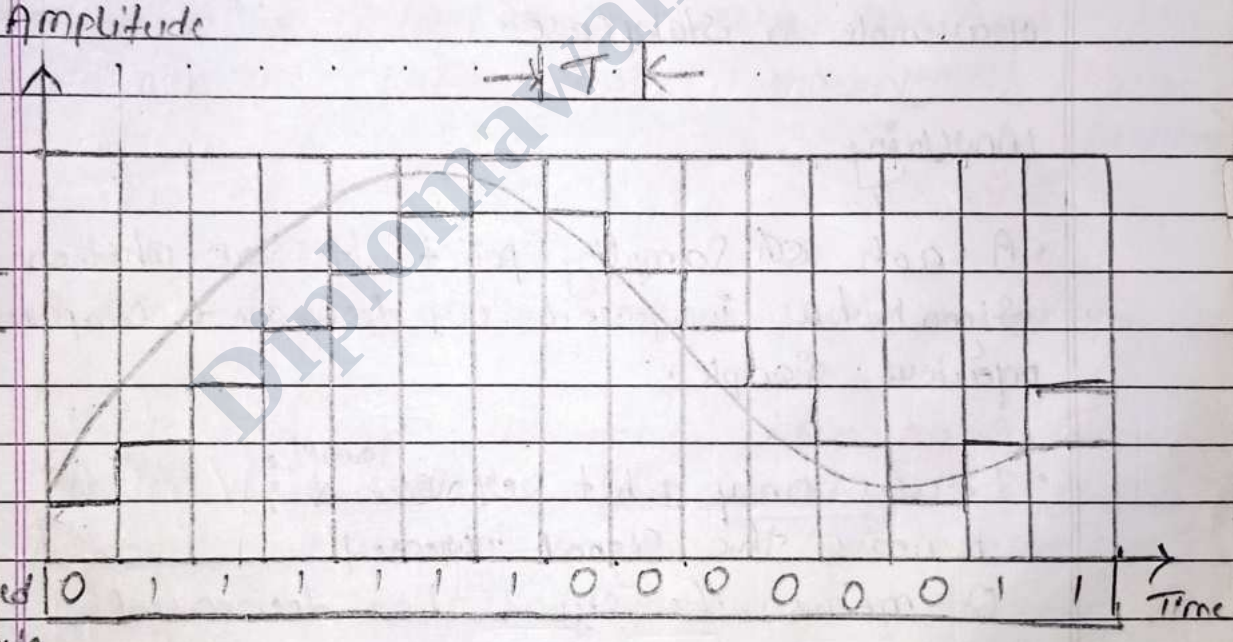
Delta modulation is a simple method of converting analog signal into digital form by tracking the changes in the signal instead of its absolute value.

of analog signal with delta modulation, instead of transmit a coded illustration, ~~instead of transmit~~ of a sample. Solely one bit is transmitted, that indicate whether or not the sample is larger or smaller than the previous sample.

* Delta modulation signal is smaller than pulse code modulation system.



By Sir

Delta modulation :-

PCM is a very complex technique. other techniques have been developed to reduced the complexity of PCM. The simplest is delta modulation. PCM fines the value of the signal

amplitude four its sample, DM finds the change from the previous sample.
Note that there are no code word here, bits are sent one after another.

The modulator is used at the sender side to create a stream of bits from an analog signal. The process record the small positive or negative changes called delta. If the delta is positive the process records a 1., If it is negative the process records a 0.
The modulator builds a second signal that reassemble a staircase.

Working

- A each sampling point, it check whether the signal has increased or decreased compared to previous sample.

- It uses only 1 bit per sample;
  1 means the signal increased.
  0 means the signal has decreased.

So, instead of sending full value it only sends whether the signal went on, down.

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UNICode (understanding language)
4 new gen.

Date ____
Page ____

Computer Network

A computer network is a group of computers linked to each other that enables the computer to communicate with another computer & share their resources, data & application.

* A Computer Network can be categorized by their size:-

Types of Computer Network

- personal Area Network (PAN)
- local area Network (LAN)
- Metropolitan Area Network (MAN)
- wide area Network

* PAN:- (Personal Area Network) (10 meters range)

It is a network arranged within an individual person which is used for connecting devices of personal use is known as PAN. personal Area such as the laptop, mobile phones, media player & play station.

Eg → wifi & Bluetooth etc.

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Advantages

1) It provides the better security compared to other Network.
2) Cost-effective.
3) Data Synchronization is easy in personal area network.
4) PAN requires less power.
5) Easy to use.

Disadvantages

1) PAN has no broadcasting technology, means if one device wants to send the same message to all devices connected to the network at the same time, it can't send the message.
If no. of receiving device gets increase it does not work.
2) unreliable
3) Signal interference.

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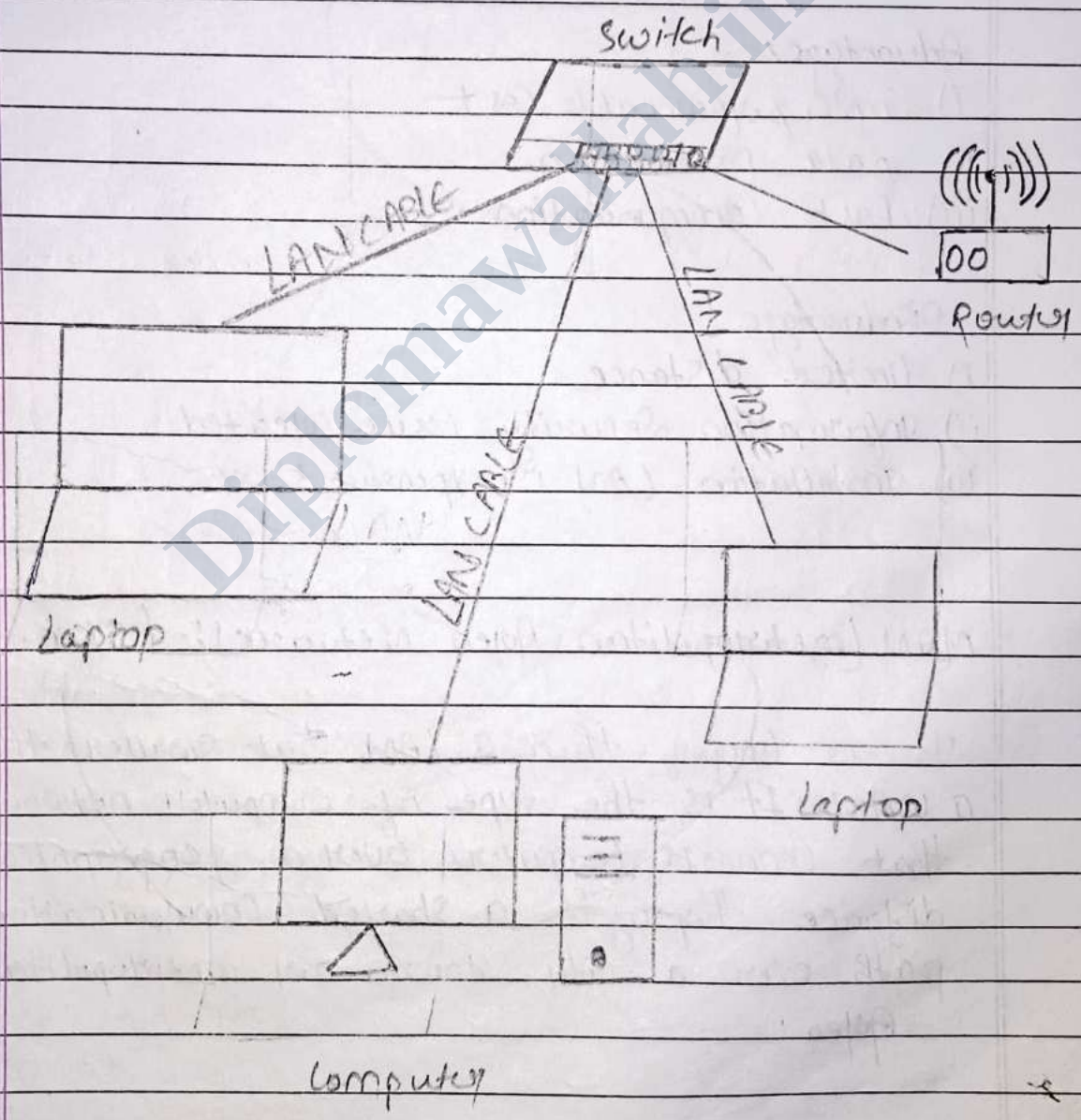
LAN (Local Area Network) (1-10 Kms)

It is a group of computer connected to each other in a small area such as building, office or within a limited area.

It is used for connecting two or more personal computers through a communication medium such as twisted pair, Co-axial cable etc.

e.g → ethernet cables or wifi etc.



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Features:-
* less cost
* Hubs, Network adapter & ethernet cables inexpensive hardware.
* Data transmission faster
* Higher Security
* Technology used/involved i) Ethernet ii) wifi
* Easy maintance
* Range upto 2km.

Advantage:
i) Simple & reasonable cost
ii) Data protection
iii) Fast communication.

Disadvantage
i) Limited distance
ii) Information Security issue created
iii) Installation LAN is expensive.

MAN (metropolitan Area Network):- (5Km - 50Km)

It is longer than a LAN but smaller than a WAN. It is the type of computer network that connects Computers over a geographical distance through a shared communication path over a city, town, or metropolitan Area.

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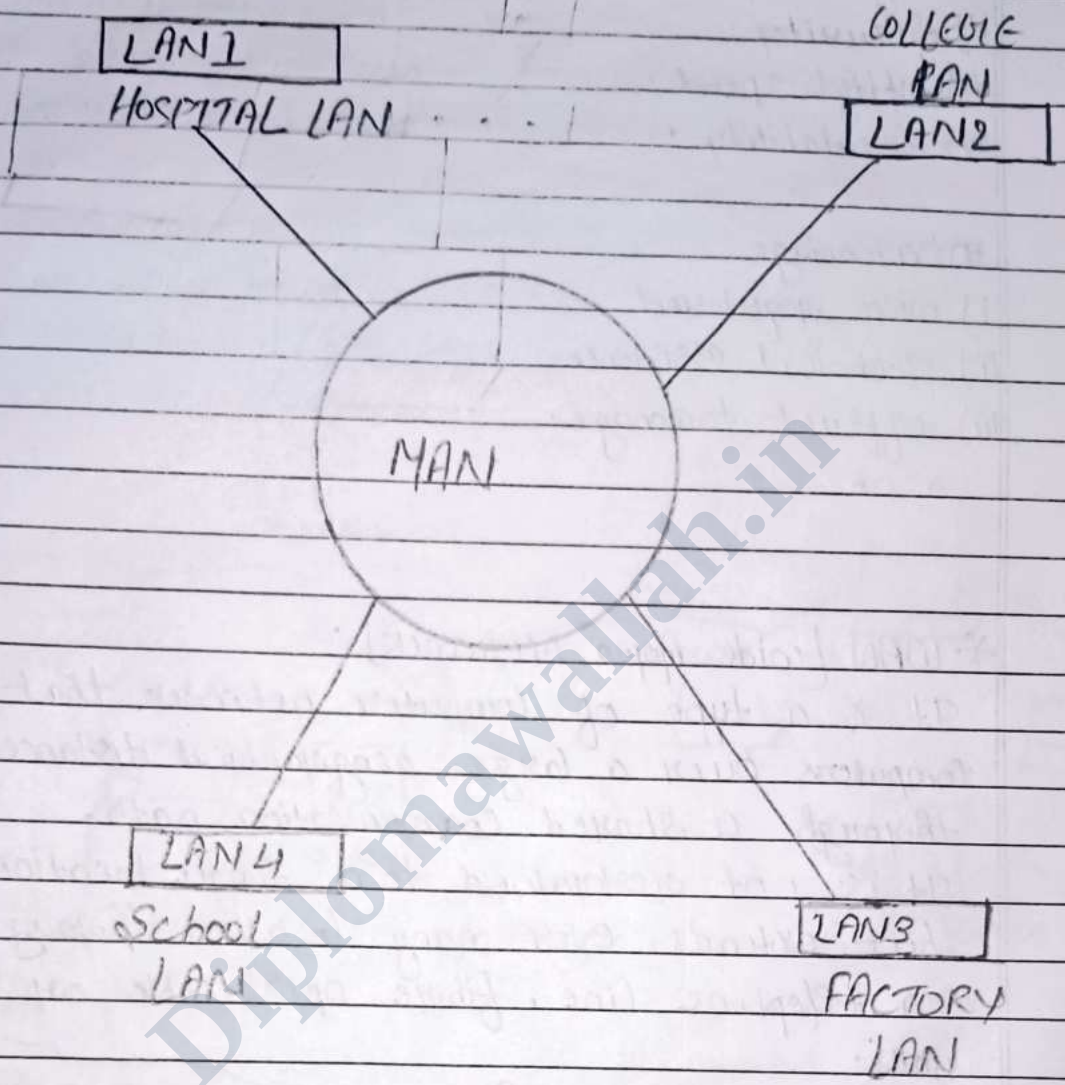

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Features:-

* protocol used RS-232, frame Relay, ATM, OC-3, ADSL etc.
* Higher range than LAN i.e 5Km to 50Km.
* Speed Average
* difficult to maintain
* High cost.

Advantage
i) large area coverage
ii) Security
iii) High speed
iv) Scalability.

Disadvantage
i) wire required
ii) Technical assistance
iii) difficult to manage.

* WAN (Wide Area Network).
It is a type of computer network that connects computers over a large geographical distance through a shared communication path.
It is not restrained to a single location but extends over many location through a telephone line, fibre optic cable or satellite links.

OR

It can also be defined as a group of local area network that communicate with each other.
e.g - Satellite links, fibre optics.

features:-
* ~~Leased line~~ Leased-line & dial-up
* Transmission speed is very low
* Very high maintenance
* Very high cost
* Range above 50 km.

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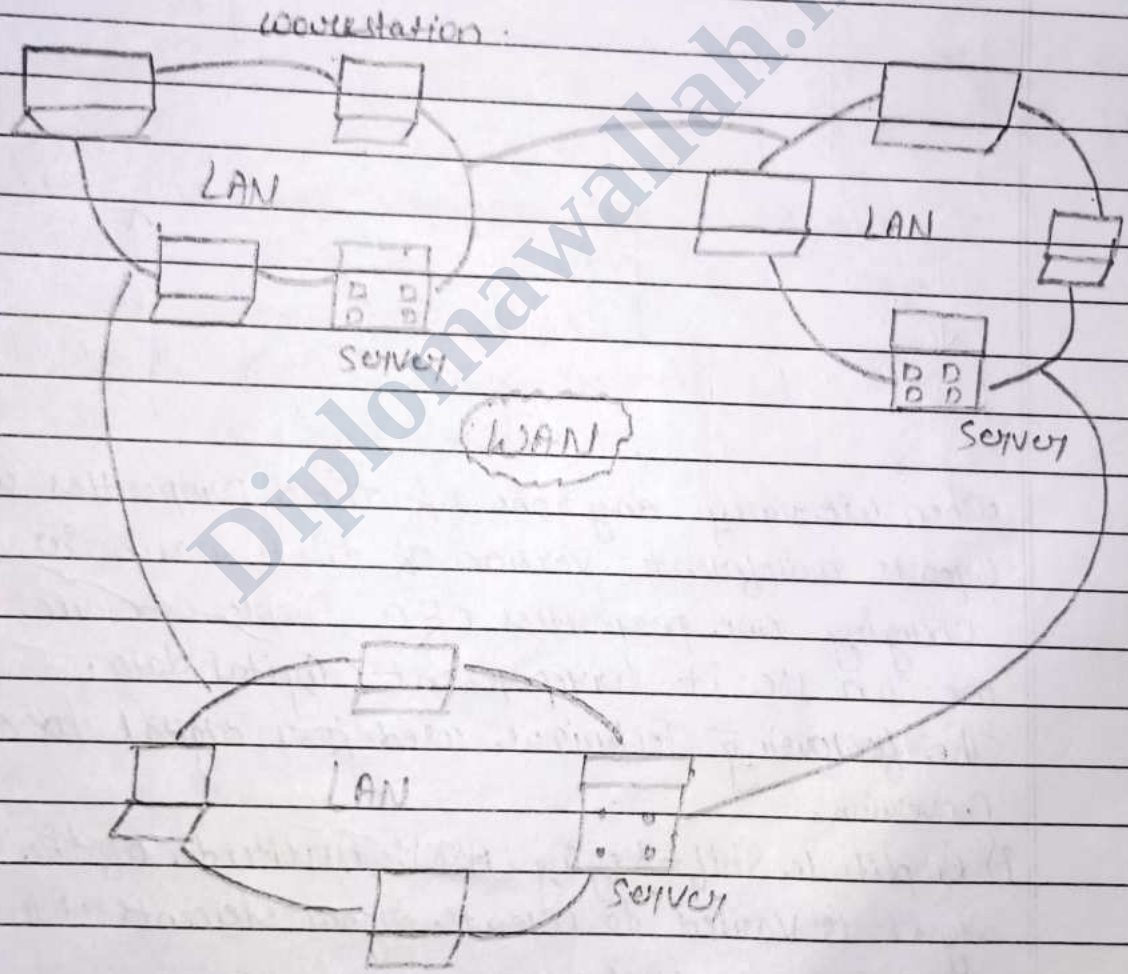
*Advantage
i) Higher Bandwidth
ii) Large area coverage
iii) centralized data.

*Disadvantage
i) Security issue
ii) Installation Cost High
iii) maintanance issue.



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Digital to Analog Conversion

Digital to Analog Conversion is the process of changing one of the characteristics of an analog signal based on the information in digital data. shows the relationship between the digital information the digital-to-analog modulating process, and the resultant analog signal.

When we vary any one of these properties we create a different version of that wave. So by changing one properties of a simple electric signal we can use it to represent digital data.

The following Technique used for digital to analog Conversion.

i) Amplitude Shift Keying (ASK):- Amplitude of the carrier signal is varied to create signal elements, frequency and phase remain constant.

ii) frequency shift keying (FSK): frequency carrier is varied peak amplitude and phase constant.

iii) phase shift keying (PSK): Represent two or more diff signal element. Both peak amplitude and frequency remain constant

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Analog to Analog Conversion

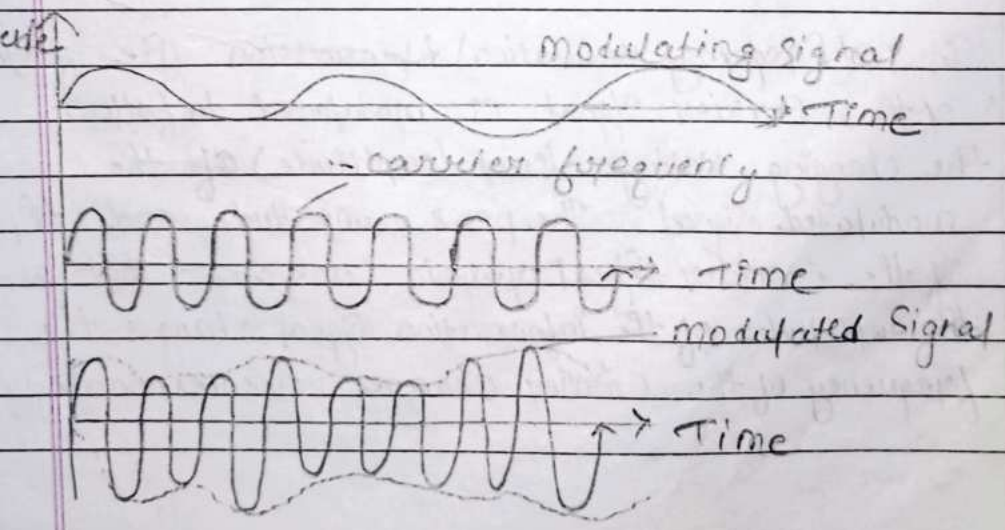
Amplitude modulation	Frequency modulation	phase modulation.
(Amplitude change Frequency, phase Constant)	(Frequency change Amplitude, phase Constant)	(phase change Amplitude, frequency const.)

Analog to Analog Conversion or Analog modulation is the representation of Analog information by an Analog signal.

Analog to Analog conversion can be categorized in three ways:-

i) AM (Amplitude modulation)
ii) FM (Frequency modulation)
iii) PM (Phase modulation)

* Amplitude Modulation:-



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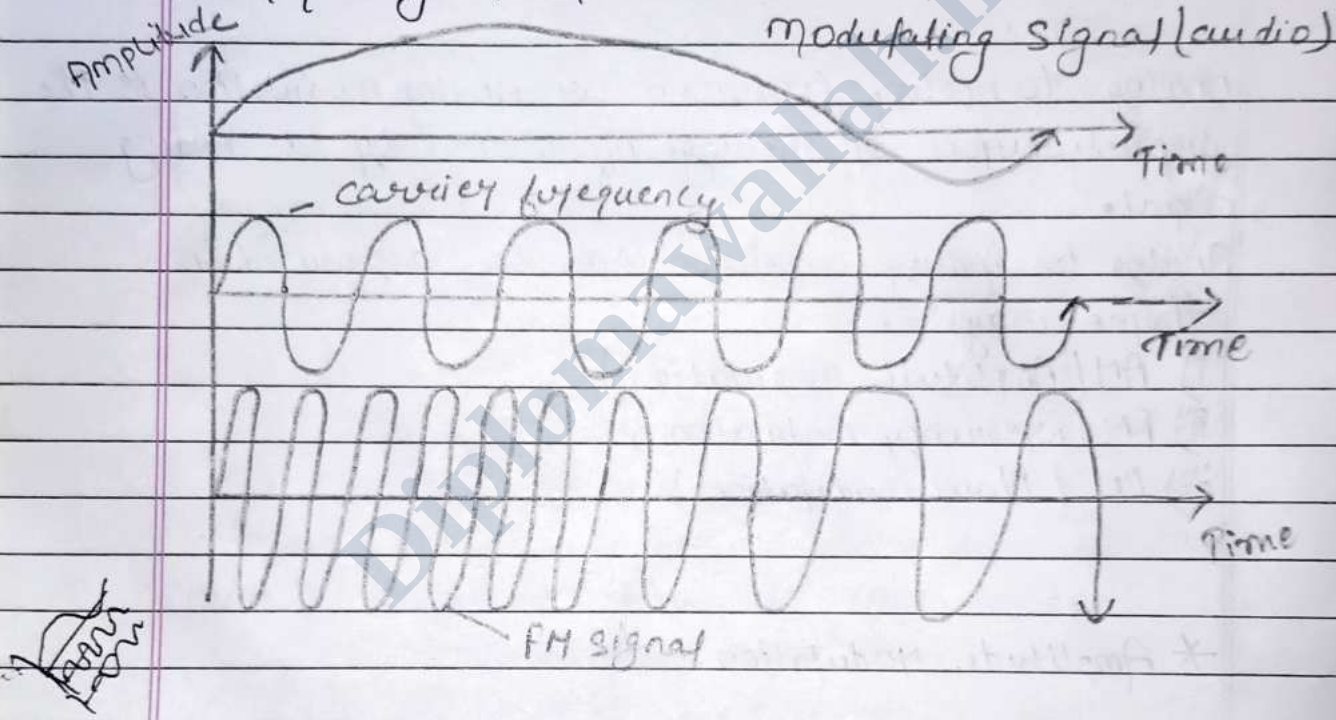
In AM (Amplitude modulation) the carrier signal is modulated so that its amplitude varies with the changing amplitudes of the modulating signal. The frequency and phase of the carrier remain the same only the amplitude changes to follow variation in the information.

* Frequency modulation :-



In FM (frequency modulation) transmission the frequency of the carrier signal is modulated to follow the changing voltage level (amplitude) of the modulated signal. The peak amplitude and phase of the carrier signal remain constant but as the amplitude of the information signal changes the frequency of the carrier changes correspondingly.

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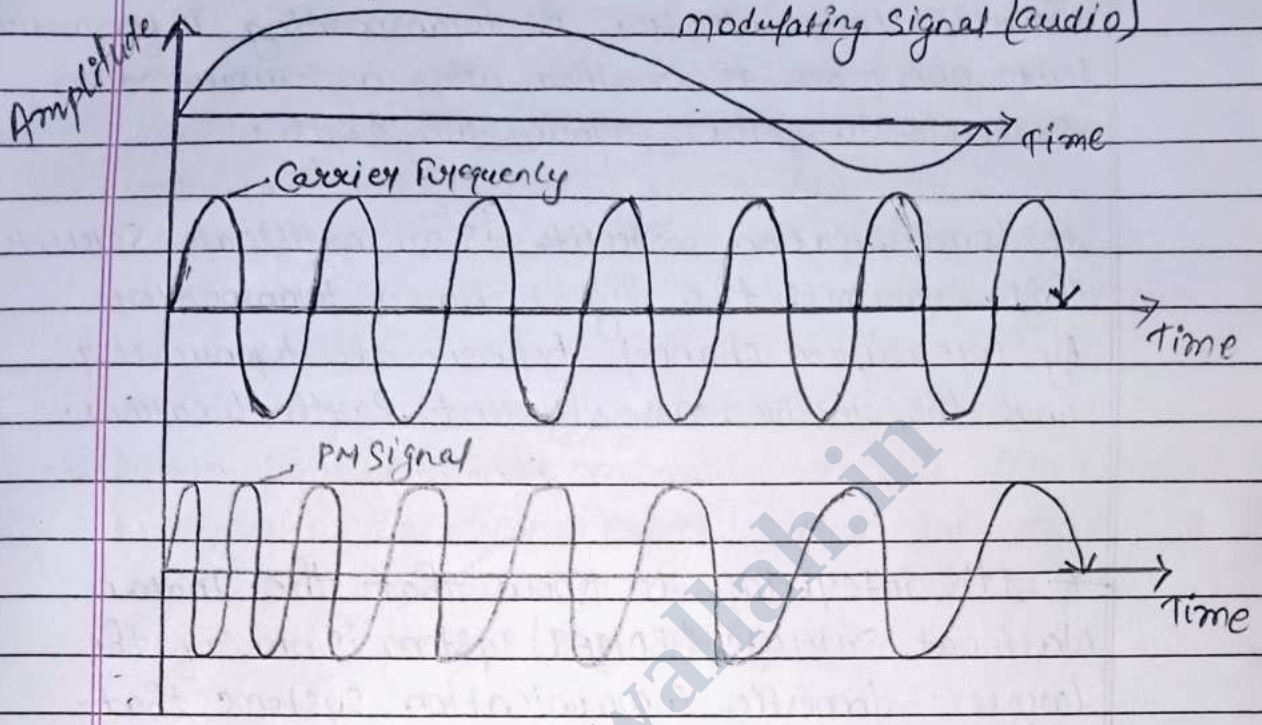
*phase modulation:—



In PM transmission the phase of the carrier signal is modulated to follow the changing voltage level (amplitude) of the modulating signal. The peak amplitude and frequency of the carrier signal remain constant but as the amplitude of the information signal changes, the phase of the carrier signal changes correspondingly.

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