

**DATA COMMUNICATION**

**(EE-427-F)**

**LAB MANUAL**

**VII SEMESTER**



**DRONACHARYA**  
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## EXPERIMENT NO. 1

**AIM: - To Study Different Types of Transmission Media**

**THEORY: -**

**Transmission Media - Guided**

There are 2 basic categories of Transmission Media: Guided and Unguided.

Guided Transmission Media uses a "cabling" system that guides the data signals along a specific path. The data signals are bound by the "cabling" system. Guided Media is also known as Bound Media. Cabling is meant in a generic sense in the previous sentences and is not meant to be interpreted as copper wire cabling only.

Unguided Transmission Media consists of a means for the data signals to travel but nothing to guide them along a specific path. The data signals are not bound to a cabling media and as such are often called Unbound Media.

There 4 basic types of Guided Media:

- Open Wire
- Twisted Pair
- Coaxial Cable
- Optical Fiber

Coaxial cables have a copper wire running through the middle encased in plastic insulation. The plastic insulation is itself encased in a metal braid which is covered by an outer layer of plastic insulator. The electrical signals run through the central wire and the metal braid acts as both an earth and as a shield against electromagnetic interference.

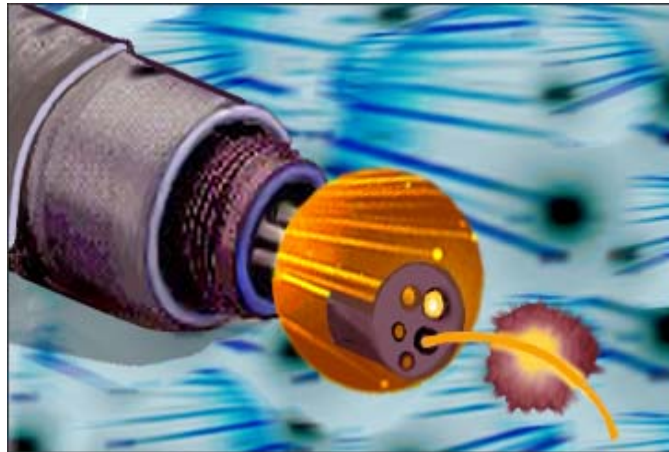
**DIAGRAM**



**A BNC connector on a network card**

Coaxial cables are connected to devices by means of a special plug with a bayonet connection. This is called a BNC plug.

Fiber optic cables have a thin strand of glass in the centre that carries the light pulses.



<i>Cable Type</i>	<i>Bandwidth</i>
Open Cable	0 - 5 MHz
Twisted Pair	0 - 100 MHz
Coaxial Cable	0 - 600 MHz
Optical Fiber	0 - 1 GHz

### **Transmission Media - Unguided**

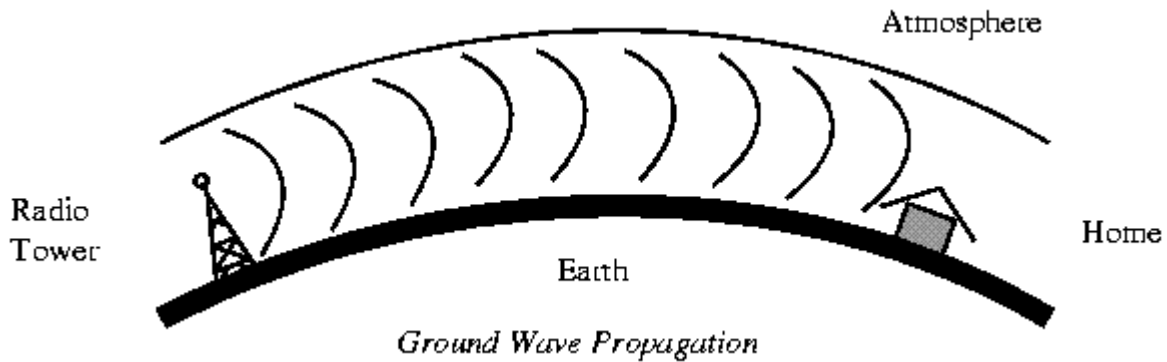
Unguided Transmission Media is data signals that flow through the air. They are not guided or bound to a channel to follow. They are classified by the type of wave propagation.

### **RF Propagation**

There are 3 types of RF (Radio Frequency) Propagation:

- Ground Wave,
- Ionospheric and
- Line of Sight (LOS) Propagation.

**Ground Wave Propagation** follows the curvature of the Earth. Ground Waves have carrier frequencies up to 2 MHz AM radio is an example of Ground Wave Propagation.



**RESULT:** - Thus different types of transmission media are studied

**QUESTION /ANSWERS:-**

Q1. What are the four basic types of guided media?

A1. Open wire, twisted pair, Coaxial cable and optical fiber.

Q2. Give three advantage of optical fiber?

A2. Higher bandwidth, less attenuation, and immunity to electromagnetic interface

Q3. What are the disadvantages of optical fiber?

A3. Installation / maintenance, Unidirectional, and cost

Q4. What are the application of twisted pair cable?

A4. They are used in telephone lines, DSL line, and Local area network.

Q5. What is the applications of fiber optical cable?

A5. The fiber optical cable is used in cable TV, local area network Wide band network

Q6. What are the different types of propagation modes in optical fiber?

A6. The different types of propagation modes are multimode step and graded Index, single mode

Q7. What is the frequency range of microwave?

A7. The frequency range of microwave is 1 and 300 GHz

Q8. What is max data capacity for optical fiber cable?

A8. 1000 mbps

Q9. Define ground wave propagation?

A9. The propagation which follow the curvature of the earth. They carry frequencies up to 2Mhz. AM is an example of Ground waves

Q10. Give two examples of unguided media?

A10. the two examples of unguided media are Wireless and Radio waves

## EXPERIMENT NO – 2

**AIM: - To Study Quadrature Phase Shift Keying Modulation.**

**APPARATUS REQUIRED: -** CRO, experimental kit, power supply, connecting leads.

**BRIEF THEORY:-**

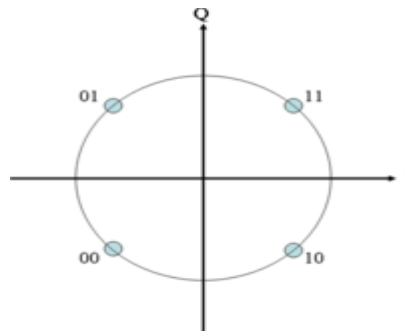
PSK: - PSK involves the phase change at the carrier sine wave between 0 to 180 in accordance with the data stream to be transmitted.

PSK modulator is similar to ASK modulator both used balanced modulator to multiply the carrier with balanced modulator signal. The digital signal with applied to modulation input for PSK generation is bipolar i.e. equal positive and negative voltage level.

When the modulating input is positive the output at modulator is a sine wave in phase with the carrier input whereas for positive voltage level, the output of modulator is a sine wave which is switched out of phase by 180 from the carrier input.

**Quadrature Phase-shift Keying (QPSK)**

QPSK: - In QPSK each pair at consecutive data bit is treated as a two bit code which is switch the phase of the carrier sine wave between one at four phase 90° apart. The four possible combinations at bit code are 00, 01, 10, and 11 each code represents either a phase of 45°, 135°, 225°, and 315° lagging, relative to the phase at the original un modulated carrier QPSK offers an advantage over PSK is a no carrier that how each phase represents a two bit code rather than a single bit. This means that either we can change phase per sec. or the same amount of data can be transmitted with.



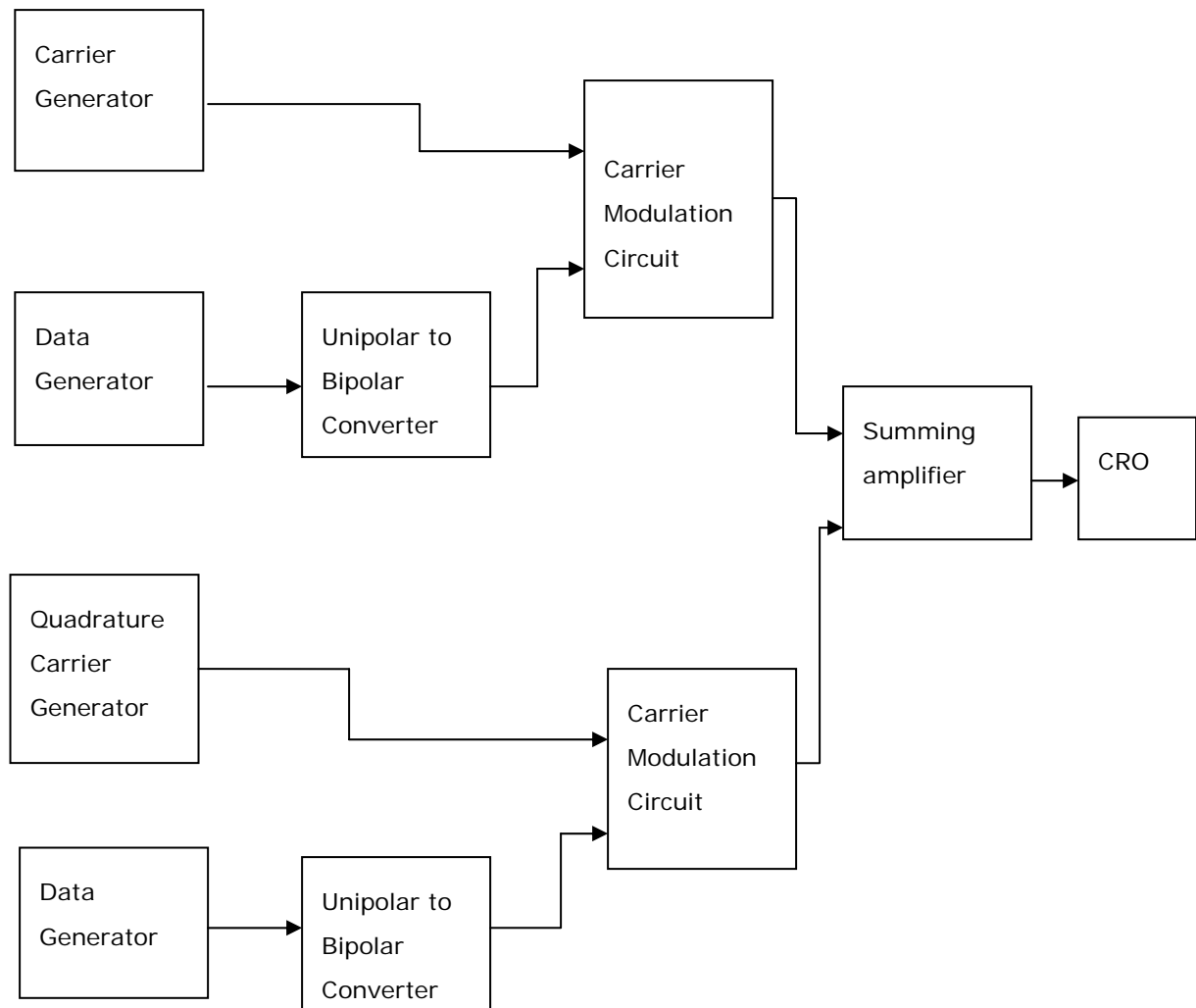
Constellation diagram for QPSK with Gray coding. Each adjacent symbol only differs by one bit.

Sometimes known as quaternary or quadriphase PSK or 4-PSK, QPSK uses four points on the constellation diagram, equispaced around a circle. With four phases, QPSK can encode two bits per symbol, shown in the diagram with Gray coding to minimize the BER — twice the rate of BPSK. Analysis shows that this may be used either to double the data rate compared to a BPSK system while maintaining the bandwidth of the signal or to maintain the data-rate of BPSK but halve the bandwidth needed.

Although QPSK can be viewed as a quaternary modulation, it is easier to see it as two independently modulated quadrature carriers. With this interpretation, the even (or odd) bits are used to modulate the in-phase component of the carrier, while the odd (or even)

bits are used to modulate the quadrature-phase component of the carrier. BPSK is used on both carriers and they can be independently demodulated

**BLOCK DIAGRAM:-**

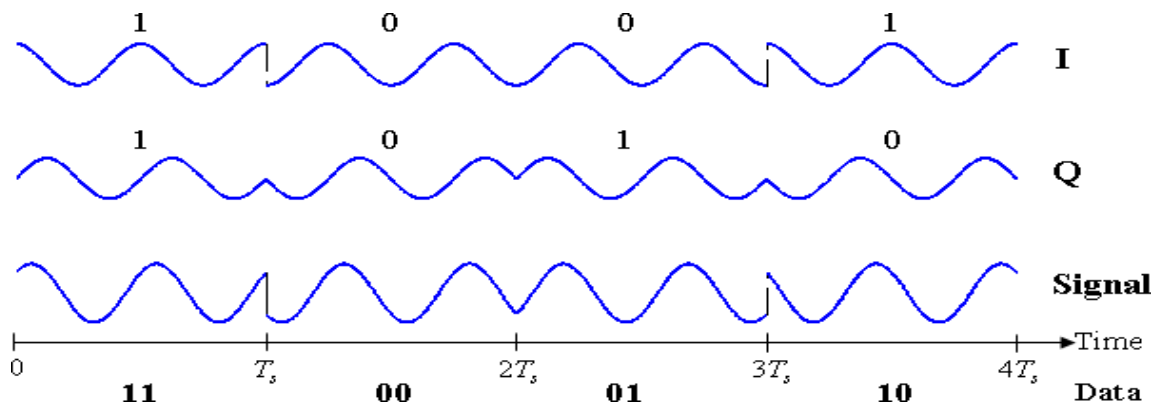


**Block diagram of QPSK**

**PROCEDURE:-**

1. Keep pins SW3, SW5, SW6, SW7, and SW9 in off mode
2. Switch on the power supply
3. Connect the Test point TP6 on Channel 1 & TP7 on Channel 2 of Oscilloscope
4. Set I&Q Channel data with the help of DIP switch SW5, SW6, SW7.
5. Switch on all the DIP switches on SW3.
6. Press SW8 (reset) Switch and then Press SW4 (start) Switch
7. Connect channels of oscilloscope to TP2 & TPI
8. Observe the wave form on the CRO

**WAVE FORM:-**



**RESULT: -** QPSK output is obtained on CRO

**QUESTION /ANSWERS:-**

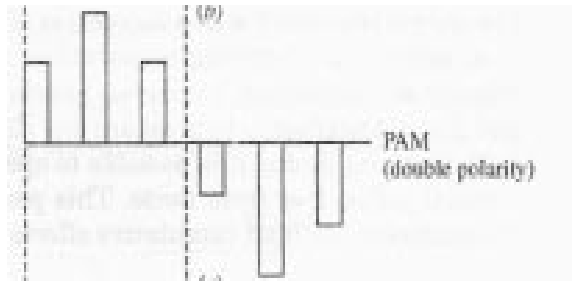
Q1: .In digital communication, why PCM (Pulse Code Modulation) is preferred than PAM (Pulse Amplitude Modulation).

- A1. (i) PCM is free from noise in interfering signals. It is also coded electrical signal.  
 (ii) It permits use of repeater for long distance transmission.

Q2. Define Pulse Amplitude Modulation:

A2. Amplitude of the pulse varies in accordance with the modulating signal





Q3. Define Pulse Position Modulation. :

A3 Time of rise or fall of the pulse changes with the modulating signal



Q4. Define QAM?

A4. It is the form of modulation where the digital information is contained in both the amplitude and phase of the transmitted carrier

Q5. Define the bandwidth efficiency?

A5. Band width efficiency = Transmission rate (bps)/ Minimum band width (Hz)

Q6. Define QPSK - Quadrature Phase Shift Keying

A6. Quadrature Phase Shift Keying employs shifting the phase of the carrier plus an encoding technique. QPSK is used in almost all modems. The digital information is encoded using 4 (Quad) level differential PSK. The data is encoded as follows:

DIBIT	PHASESHIFT
00	+90
01	0
10	180
11	270

Q7. What are the three basic type of modulation technique used in modems?

A7. The 3 basic types of modulation used in modems:

- FSK - Frequency Shifted Keying
- QPSK - Quadrature Phase Shifted Keying
- QAM - Quadrature Amplitude Modulation

Q8. Write the truth table of QPSK

BINARY OUTPUT		QPSK OUTPUT PHASE
Q	I	
0	0	$-135^{\circ}$
0	1	$-45^{\circ}$
1	0	$135^{\circ}$
1	1	$45^{\circ}$

Q9. What is another name of Quadrature PSK?

A9. Quaternary Phase shift keying.

Q10. What does the word Quaternary Signify?

A10. Quaternary means "4". QPSK is a M\_ary encoding technique where M=4

## EXPERIMENT NO – 3

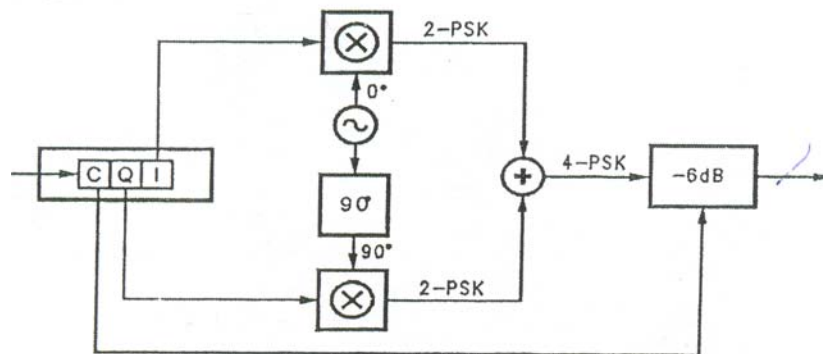
**AIM: - Study & Analysis of QAM Modulation.**

**APPARATUS: -** QAM kit, DATA GENERATOR kit, connecting leads and power cord

**THEORY:**

### Quadrature Amplitude Modulation (QAM)

The QAM is a digital modulation where the information is contained into the phase as well as the amplitude of the transmitted carrier.



### 8-QAM:

In the 8-QAM the data are divided into groups of 3 bits (Tribit), one of which varies the amplitude of the carrier, the last two the phase. The modulated signal can take 4 different phases and 2 different amplitudes, for a total of 8 different states.

### 16-QAM:

In the 16-QAM the data are divided into groups of 4 bits (Quad bit). The 16 possible combinations change amplitude and phase of the carrier, which can take 16 different states. At the moment we reach to a data subdivision into groups of 9 bits, obtaining constellations with 512 modulation points.

Main aspects

The main aspects characterizing the QAM are:

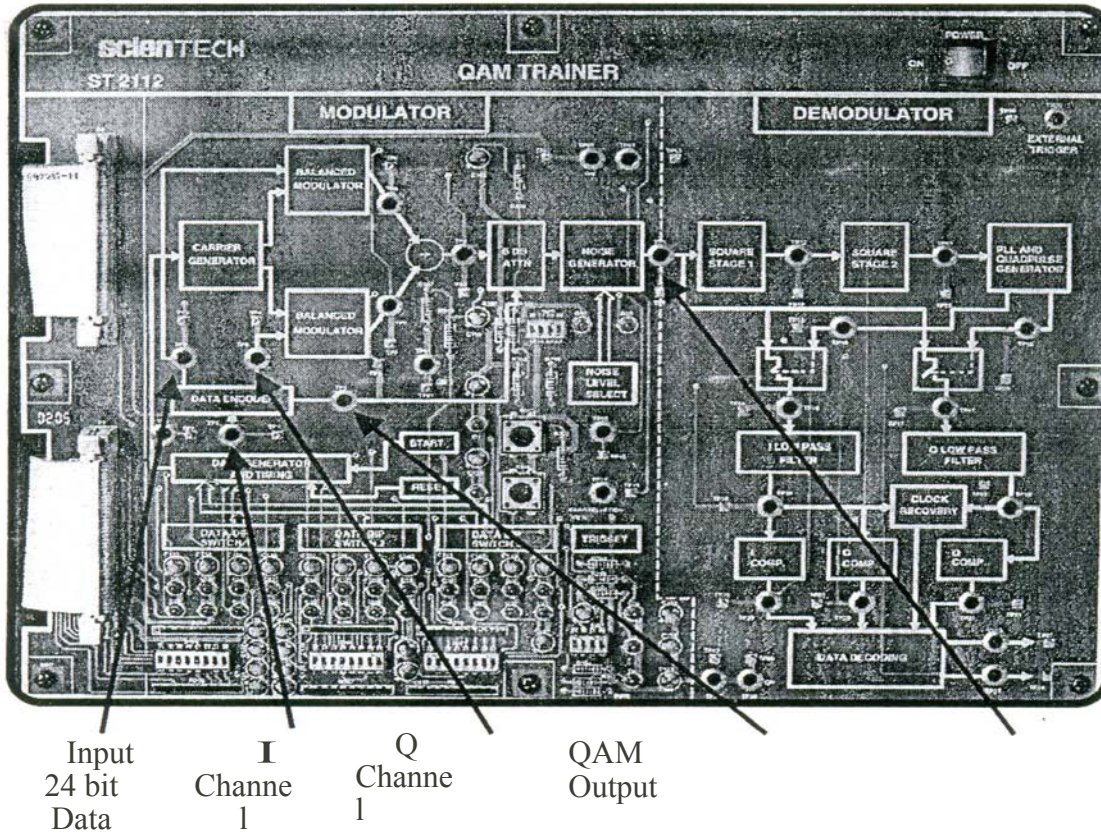
Applications in modems for high speed data transmission (ITU-TV22bis, V29, V32, V32bis, V33, V34, V34bis, BELL 209) and digital radio transmission. It needs circuits of high complexity

Possibility of error higher than the PSK called  $F_b$  the bit transmission speed and "n" the number of bits. Considered for the modulation, the minimum spectrum BW of the modulated signal is equal to  $F_t/n$

The transmission efficiency, defined as the ratio between  $F_b$  and  $B_w$ , is equal to "nil"

### Modulator QAM:

The functional diagram of a 8-QAM modulator,



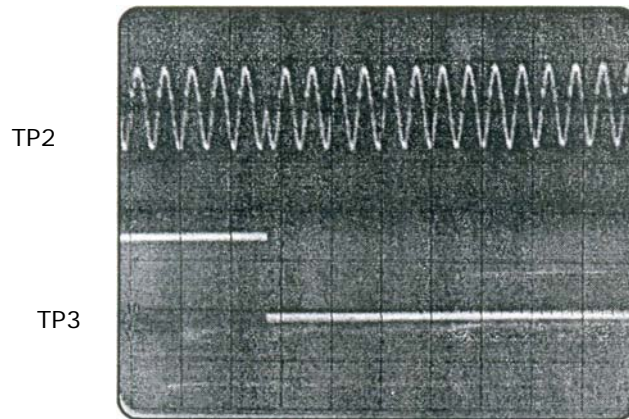
The 8-QAM signal can be seen as 4-PSK signal whose amplitude can take 2 different values. In this way, each "modulation interval" depends on the state of 3 data bits ("I", "Q", "C"): the first 2 ("I" and "Q") determine the phase of the output signal, the third ("C") the amplitude.

### PROCEDURE:

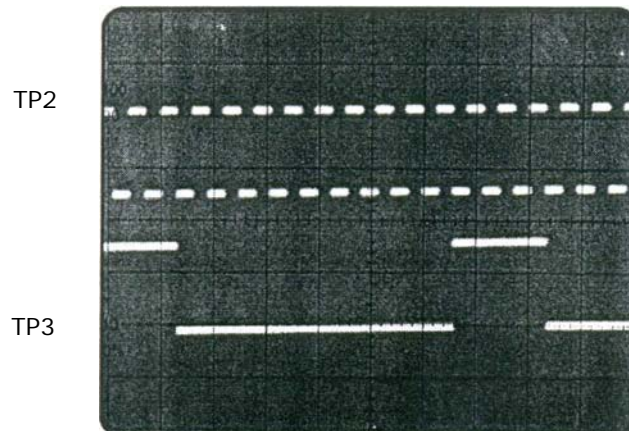
1. Ensure the following initial conditions on ST2112 trainer:
2. SW3, SW5, SW6, SW7, SW9 should be in the OFF mode.
3. Power supply should be OFF.
4. Switch on the power supply.
5. Connect Test point TP6 on Channel 1 & TP7 on Channel 2 of Oscilloscope; you will observe 1 KHz sine & cosine wave.
6. Set I, Q & C Channel data with the help of DIP switch SW5, SW6, SW7. As there are 24 bits data available on the trainer so, first bit is I bit then second bit is Q bit then third bit is C bit. In this experiment you have to use I bit & Q bit & C bit so you can select combination according to your requirement.
7. Switch ON all the DIP switches on SW3.

8. Now press SW8 which is reset switch then press SW4 which is start.
9. Now Channel 1 of Oscilloscope to TP2 & Channel 2 to TP 1, you can observe Clock & Data which you have set. ( if you are using logic analyzer then you are able to see all 24 bits)
10. Now to observe QAM modulated signal with respect to data, connect Channel 1 to TP I & Channel 2 to TP9.
11. You can add noise by using DIP switch SW9 (001/010/111)
12. Turn OFF the power.

a) CIOCK AND DATA:-



b.) I CHANNEL AND MODULATED SIGNAL:-



**RESULT:** QAM has been studied and waveform has been drawn

**QUESTIONS/ANSWERS:**

Q1.What does QAM stand for

A1.Quadrature –Amplitude Modulation

Q2.In how many groups the data is divided in 8 QAM

A2. Data is divided into three groups

Q3.What is the bit rate of individual group in 8 QAM

A3. The bit rate is divided into one –third of the incoming data rate

Q4.What level of converter is used in I and Q channel?

A4.2to 4 level converter is used in I and Q channel

Q5.What is the difference between 8 QAM and 16 QAM?

A5.In 16 QAM m-array  $M=16$  and in 8QAM  $M= 8$

Q6.In how many groups the data is divided 16 QAM

A6. Data is divided into four groups

Q7. What is the bit rate of individual group in 16 QAM?

A7. The bit rate of a 16 –QAM is divided into one-fourth of the incoming data rate

Q8. Define Band with efficiency

A8.transmission Bit rate/ minimum band width

Q9.How many 2 to 4 level converter is used in 16 QAM

A9.Two 2 to 4 level converter is used in 16 -QAM

Q10. Different parts of communication System?

A10. There are three parts of communication System:

- a) The information
- b) Medium
- c) The carrier

## EXPERIMENT NO – 4

**AIM:** - To Study Serial Interface using Rs - 232.

**APPARATUS REQUIRED:** - Data Communication Kit

**THEORY:** -

### Introduction to Serial Communications

All IBM PC and compatible computers are typically equipped with two serial ports and one parallel port. Although these two types of ports are used for communicating with External devices, they work in different ways

A parallel port sends and receives data eight bits at a time over 8 separate wires. This allows data to be transferred very quickly; however, the cable required is more bulky because of the number of individual wires it must contain. Parallel ports are typically used to connect a PC to a printer and are rarely used for much else. A serial port sends and receives data one bit at a time over one wire. While it takes eight times as long to transfer each byte of data this way, only a few wires are required. In fact, two-way (full duplex) communications is possible with only three separate wires - one to send, one to Receive and a common signal ground wire.

RS-232 stands for Recommend Standard number 232 and C is the latest revision of the standard. The serial ports on most computers use a subset of the RS-232C standard. The full RS-232C standard specifies a 25-pin "D" connector of which 22 pins are used.

RS-232-C is divided into four groups

- Data Signal
- Control Signal
- Timing Signal
- Ground Signal

**DIAGRAM:**

25 Pin Connector on a DTE device (PC connection)

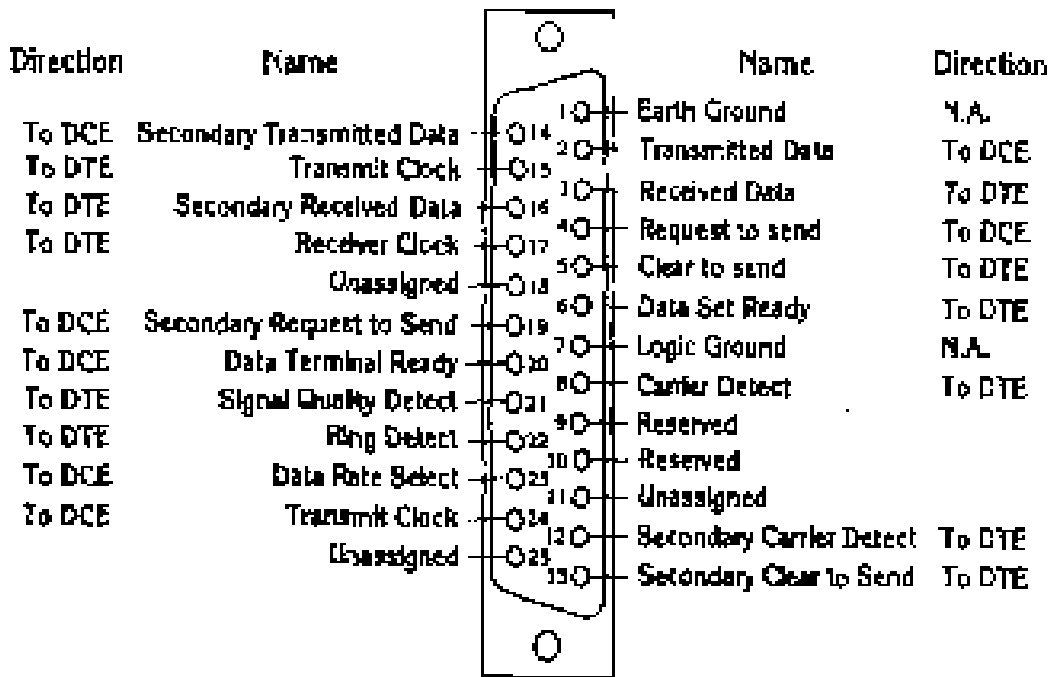
### Male RS232 DB25



**Pin Number**

9 Pin Connector on a DTE device (PC connection)

**Male RS232 DB9**



**PIN DIAGRAM OF RS-232**

**ADVANTAGES:** It is applicable for long distance.

**DISADVANTAGE:** - Comparatively low speed.

**RESULT:** Thus studied RS – 232 standards.



**Question/Answers**

Q1. Name different types of serial interfaces.

A1. RS 232, RS449, RS- 423A etc.

Q2. How many pins RS – 232 consists of?

A2. It consists of 25 pins.

Q3. Give the full form of RS.

A3. It is Recommended Standard

Q4. What are the advantages of Rs – 232?

A4. 1. It provides specific range of voltages for transmit and receive signals.  
2 It can transmit and receive asynchronous and synchronous data.

Q5. State any two differences between Rs 232 and RS 449?

A5.1 RS 232 is 25 pin interfaces while RS 449 is 37 pin interfaces  
2 RS 232 specifies electrical, mechanical and functional specifications.  
While RS 449 outlines mechanical and functional standards

Q6. What is the drawbacks of RS – 232?

A6. Distance Limitation and speed.

Q7. Which are the data pins of RS 232?

A7. Pin number 2,3,14 and 15.

Q8. Which are the timing pins of RS -232?

A8. Pin number 15, 17 and 24 are timing pin

Q9. Which are the unassigned pins of Rs – 232?

A9. Pin number 9, 10, 11, 18 and 25

Q10. How many pins of RS 232 are unassigned?

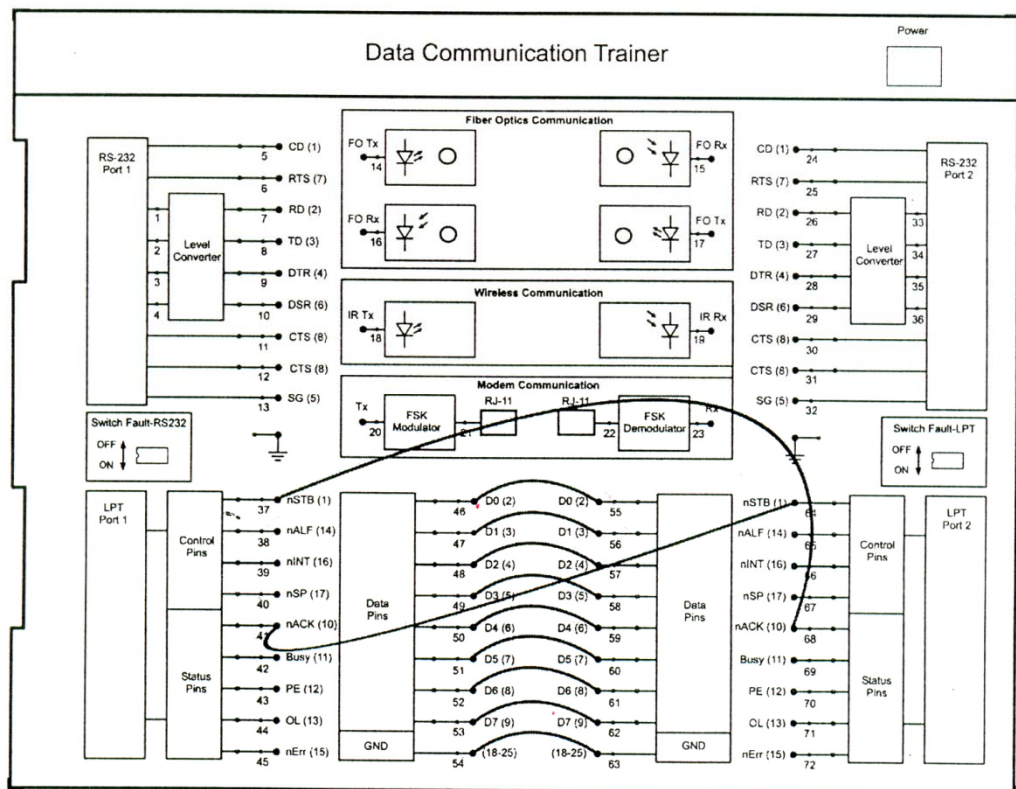
A10. 5

## EXPERIMENT NO – 5

**AIM: - To Study PC to PC communication uses Parallel port.**

**APPARATUS REQUIRED:**

ST5001 Trainer Kit, ST5001 Software, 11 Patch Cords (2mm), 2 Parallel Port Cables, Mains Power Cord



**PROCEDURE:-**

1. Connect mains power cord to the trainer and switch ON the trainer.
2. Connect the parallel port cables to both node 1 & node 2.
3. To open the window, follow the steps. Run ST5001 software on both PCs  
Click "Parallel Port Interface" image/press "Ctrl + P"/click "Options" on menu bar.
4. The very first step is to select the port address of parallel port. Choose one correct option from the given three options.
5. Generally the address is "378", so the window will open with this option selected.

6. To send data to other node enter the text in the window titled as "Enter Data to Transmit". Click on "Send" button to transmit.
7. Transmitted data will be displayed in the "Received Data" window and the ASCII codes of each byte received is displayed in "Received Data in ASCII" window.
8. A small window at sender side is given for transmission of ASCII code. Enter an ASCII code in the window and then click "Send" button.
9. "Clear" buttons are given to clear all windows.

**RESULT:** - The parallel port has been studied.

**QUESTION/ANSWERS:**

Q. 1. What is parallel Interface?

A1. It is the device through which 8 or more bits can be transmitted at a time.

Q2. What are different types of parallel Interfaces?

A2. These are Centronics, IEEE 488 etc.

Q3. What is full form of GPIB?

A3. General purpose Interface Bus.

Q4. What is the advantage of parallel Transmission over serial transmission?

A4. Data are transmitted faster than with serial interface.

Q5. How many pins are there in Centronics

A5. 36 pins

Q6. Give one application of Centronics?

A6. It is used in printers.

Q7. What is the disadvantage of parallel transmission?

A7. Higher transmission cost for transmission lines, especially when there are long distances between the transmitter and receiver.

Q8. What does the term STB stand for?

A8. STROBE

Q9. What does the term AF stand for?

A9. Auto feed

Q10. What is the function for PRIME

A10. It is an active low signal outputted by the computer to clear the printer memory, including the printer programming and the printer buffer.

## EXPERIMENT NO – 6

**AIM:** - To Study LAN using Star Topology.

**APPARATUS REQUIRED:** - Four to Five computers, cables

**THEORY:** -

LAN: When two or more computers are connected directly within the small well defined area such as room, building etc. The physical topology of a network refers to the configuration of cables, computers, and other peripherals.

### Main Types of Network Topologies

In networking, the term "topology" refers to the layout of connected devices on a network.

Network topologies are categorized into the following basic types:

- Star Topology
- Ring Topology
- Bus Topology
- Tree Topology
- Mesh Topology
- Hybrid Topology

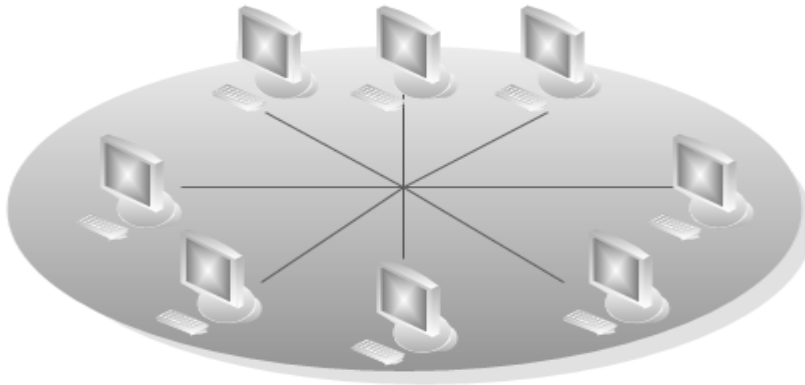
More complex networks can be built as hybrids of two or more of the above basic topologies.

### Star Topology

Many home networks use the star topology. A star network features a central connection point called a "hub" that may be a hub, switch or router. Devices typically connect to the hub with Unshielded Twisted Pair (UTP) Ethernet.

Compared to the bus topology, a star network generally requires more cable, but a failure in any star network cable will only take down one computer's network access and not the entire LAN. (If the hub fails, however, the entire network also fails)

**DIAGRAM: -**



**PROCEDURE:-**

1. Create folder of source name in both PC in C or D drive
2. Write text document in one PC (sender)
3. Open Star topology on both PC
4. Write destination IP address on both PC
5. Share folder
6. Open the folder
7. Save the parameters
8. Open the text document
9. Sent data
10. Received data on another PC

**Advantages of a Star Topology**

- Easy to install and wire.
- No disruptions to the network then connecting or removing devices.
- Easy to detect faults and to remove parts.

**Disadvantages of a Star Topology**

- Requires more cable length than a linear topology.
- If the hub or concentrator fails, nodes attached are disabled.
- More expensive than linear bus topologies because of the cost of the concentrators.

The protocols used with star configurations are usually Ethernet or Local Talk. Token Ring uses a similar topology, called the star-wired ring.

**RESULT: -** Star Topology is studied.

## QUESTIONS/ANSWERS

Q1. What are the different types of topology?

A1. Different types of topology are star, bus, ring, tree, mesh.

Q2. What are the advantages of star topology?

A2. Advantages are

- Easy to install and wire.
- No disruptions to the network then connecting or removing devices.
- Easy to detect faults and to remove parts.

Q3. What are the disadvantages of star topology?

A3. Disadvantages are:

- Requires more cable length than a linear topology
- More expensive than linear bus topologies because of the cost of the concentrators

Q4. What are the protocols used for the star topology?

A4. The protocols used with star configurations are usually Ethernet or Local Talk.

Q5. What type of transmission media is used in star topology?

A5. The transmission media used is twisted copper pair or optical fiber cable

Q6. Which topology can experience Contention and Collision?

A6. The topology which can experience Contention and Collision is Star topology.

Q7. Define the term Contention?

A7. When two or more stations attempt to access a network at the same time.

Q8. What is a network?

A8. A network is a system of interconnected communication

Q9. Define Node?

A9. Entry or exit point of the network

Q10. Define protocols?

A10. Set of rules for the successful communication between two or more nodes in a network

## EXPERIMENT NO – 7

**AIM: - To Study LAN using Bus Topology.**

**APPARATUS REQUIRED: -** Four to Five computers, cables

**THEORY: --**

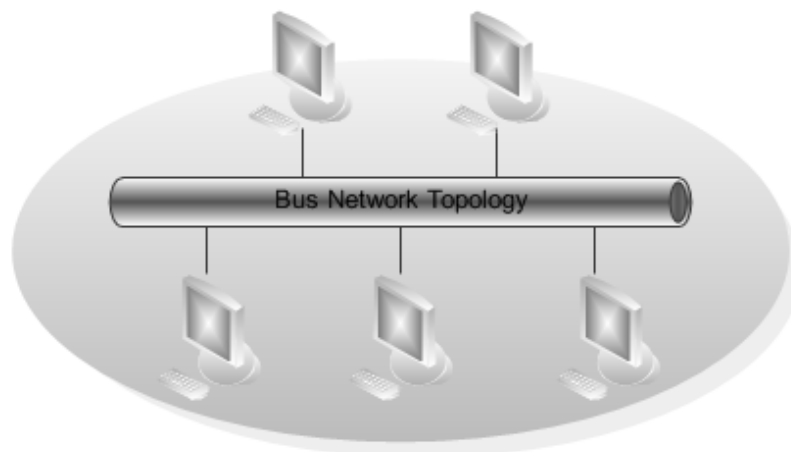
**LAN:** When two or more computers are connected directly within the small well defined area such as room, building etc. The physical topology of a network refers to the configuration of cables, computers, and other peripherals.

**Bus Topology:**

A bus topology consists of a single cable connecting all nodes on a network without intervening connectivity devices. The single cable is called a bus and can support one channel for communication. Each node shares the bus's total capacity.

On bus topology network devices share the responsibility for getting the data from one point to another. Ethernet bus topologies are relatively easy to install and don't require much cabling compared to the alternatives. 10Base-2 ("ThinNet") and 10Base-5 ("ThickNet") both were popular Ethernet cabling options many years ago for bus topologies. However, bus networks work best with a limited number of devices. If more than a few dozen computers are added to a network.

**DIAGRAM: -**



**PROCEDURE:-**

1. Create folder of destination node (ECE COM 1, ECE COM 2) name in both PC.
2. Click IPX protocol to enable it
3. Select server on one PC.
4. Select connect to network on another PC
5. Open the text document
6. Type the data on one PC
7. Sent data
8. Data is received on another PC

**Advantages of a Linear Bus Topology**

- Easy to connect a computer or peripheral to a linear bus.
- Requires less cable length than a star topology.

**Disadvantages of a Linear Bus Topology**

- Entire network shuts down if there is a break in the main cable.
- Terminators are required at both ends of the backbone cable.
- Difficult to identify the problem if the entire network shuts down.
- Not meant to be used as a stand-alone solution in a large building

**Result:** - Data is transferred from one PC to another PC.

**QUESTIONS/ANSWERS:**

Q1. Define topology?

A1. Physical composition of the network is defined as topology

Q2. What is poll?

A2. Primary message inquiring if secondary has any traffic to send

Q3. What does the term “selection process” signify in bus topology?

A3. Primary message inquiring if secondary is ready to receive traffic

Q4. What are the advantage of bus topology?

A4. Easy to connect, requires less cable

Q5. What are the disadvantages of bus topology?

A5. Entire network shuts down if there is a break in the main cable



Q6. In which topology terminators are required?

A6. Bus Topology.

Q7. What is the central device in star topology??

A7. Hub/switch.

Q8. What are the different types of network?

A8. LAN, GAN, WAN, MAN

Q9. What does the term GAN stand for?

A9. Global area network

Q10. Define the term CAN?

A10. Campus area network

## EXPERIMENT NO – 8

**AIM:** - To Study LAN using Tree Topology.

**Apparatus Required:** Four to five Computers, cables.

**Theory:** --

### Main Types of Network Topologies

In networking, the term "topology" refers to the layout of connected devices on a network.

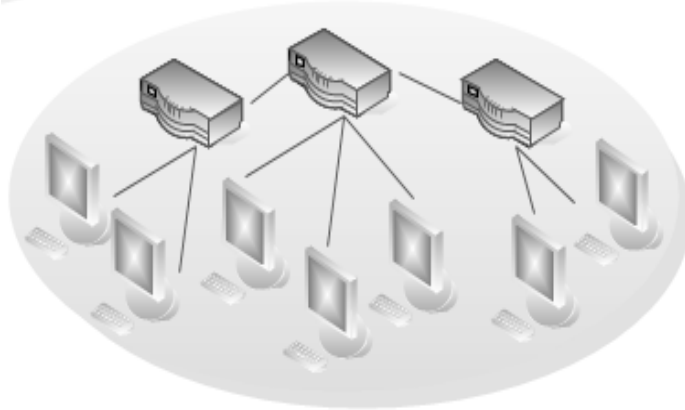
Network topologies are categorized into the following basic types:

- Star Topology
- Ring Topology
- Bus Topology
- Tree Topology
- Mesh Topology
- Hybrid Topology

### Tree Topology

Tree topologies integrate multiple star topologies together onto a bus. In its simplest form, only hub devices connect directly to the tree bus and each hub functions as the "root" of a tree of devices. This bus/star hybrid approach supports future expandability of the network much better than a bus (limited in the number of devices due to the broadcast traffic it generates) or a star (limited by the number of hub connection points) alone.

**DIAGRAM:** -



### **Advantages of a Tree Topology**

- Point-to-point wiring for individual segments.
- Supported by several hardware and software vendors.

### **Disadvantages of a Tree Topology**

- Overall length of each segment is limited by the type of cabling used.
- If the backbone line breaks, the entire segment goes down.
- More difficult to configure and wire than other topologies.

**RESULT:** - Thus Tree Topology is studied.

### **QUESTIONS/ANSWERS**

Q1. Give two examples of hybrid topology?

A1. Star and ring are the two examples of hybrid topology

Q2. What are the four basic type of topology?

A2. Four basic type of topology are star, bus, ring, and mesh

Q3. Give one advantage of tree topology?

A3. Point-to-point wiring for individual segments.

Q4. Give one disadvantage of tree topology?

A4. Overall length of each segment is limited by the type of cabling used

Q5. What is a network?

A5. A network is a system of interconnected communication

Q6. In which topology terminators are required?

A6. Bus topology.

Q7. What is the central device in star topology?

A7. Hub/switch.

Q8. What are the different types of network?

A8.LAN.GAN, WAN.MAN

Q9.What does the term GAN stand for?

A9.Global area network

Q10.Define the term CAN?

A10.Campus area network

## EXPERIMENT NO – 9

**AIM: - To Study Configure Modem of Computer.**

**APPARATUS REQUIRED: - MODEM and Data communication kit**

**THEORY: -**A modem is a device or a program that enables a computer to transmit data e.g. Telephone or cable lines. Computer information is stored digitally whereas information transmitted in the form of analog waves

### **Types of Modem**

#### **Internal**

Internal modems are Compact, Inexpensive but difficult to set-up (if not pre-installed with computer package).

#### **External**

External modems are - Simple to set up, allow flexible usage but are more expensive than internal modems.

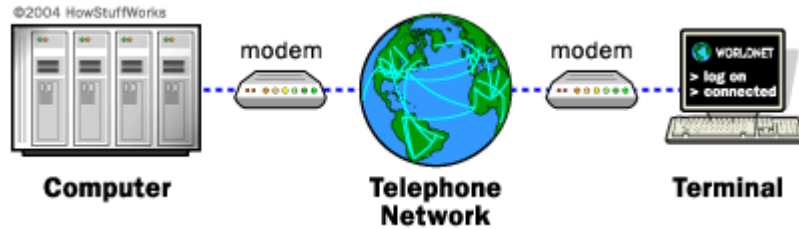
In a configuration like this, a **dumb terminal** at an off-site office or store could "dial in" to a large, central computer. A dumb terminal is simply a [keyboard](#) and a [screen](#). A very common dumb terminal at the time was called the **DEC VT-100**, and it became a standard of the day (now memorialized in terminal emulators worldwide). The VT-100 could display 25 lines of 80 characters each. When the user typed a character on the terminal, the modem sent the [ASCII code](#) for the character to the computer. The computer then sent the character back to the computer so it would appear on the screen.

People got along at 300 bps for quite a while. The reason this speed was tolerable was because 300 bps represents about 30 characters per second, which is a lot more characters per second than a person can type or read. Once people started transferring large programs and images to and from bulletin board systems, however, 300 bps became intolerable.

Modem speeds went through a series of steps at approximately two-year intervals:

- 300 bps - 1960s through 1983 or so
- 1200 bps - Gained popularity in 1984 and 1985
- 2400 bps
- 9600 bps - First appeared in late 1990 and early 1991
- 19.2 kilobits per second (Kbps)
- 28.8 Kbps
- 33.6 Kbps
- 56 Kbps - Became the standard in 1998
- ADSL, with theoretical maximum of up to 8 megabits per second (Mbps) - Gained popularity in 1999

**DIAGRAM: -**



**PROCEDURE:-**

1. Connect the main power cord to the trainer and switch on the trainer
2. Connect the serial port cable between the two ports of the PC
3. Open the window and click on “Modem Communication image” press “CTRL+M”
4. Select the desired band rate
5. Open the port by clicking open port button
6. Transmit data
7. Data transmitted will be received in ASCII window
8. Small window at sender side is given for transmission of ASCII code

**RESULT: -** Transmission of data using modem

**QUESTIONS/ANSWERS:-**

Q1.What does the term MODEM stands for?

A1.MODEM stands for modulation and demodulation

Q2. In sending a binary data over an analog transmission line, what kind of device does the Conversion?

A2.MODEM

Q3 .Cite one example of full –duplex transmission?

A3 standard telephone system is an example of full-duplex transmission

Q4. What are voice modems?

A4. Voice modems are regular modems that are capable of recording or playing audio over the telephone line. They are used for telephony applications

Q5.What are cellular modems?

A5. Modems which use mobile phone lines (GPRS, UMTS, HSPA, EVDO, WiMax, etc.), are known as cellular modems.

Q6. What is a Modem?

A6. Modem is a device or program that enables a computer to transmit data over, for example, Telephone or cable lines.

Q7. Name the interface which is used to connect the external modem with the computer?

A7. RS-232 is the interface which is used to connect the external MODEM with the computer.

Q8. What is a PC card modem?

A8. Some computers have an internal modem which is a built-in modem.

Q9. Define downstream transmission?

A9. Internal computer modems are usually 56K modem which means that the modem is able to

Receive 56 Kbits/s (56 kilobits or 56000 bits per second) of data, this kind of data transmission is called downstream transmission.

Q10. What are cable modems?

A10. The cable modem uses a coaxial cable television lines to provide a greater bandwidth than the Dial-up-computer modem

## EXPERIMENT NO – 10

**AIM: - To Study Configure Hub/Switch.**

**APPARATUS REQUIRED: -** Hub, Switch and Cables

**THEORY: -**

The Hubs are the physical hardware devices placed in central locations. The Hubs can be either multi-port repeaters or concentration. The Hubs can be of two types:-

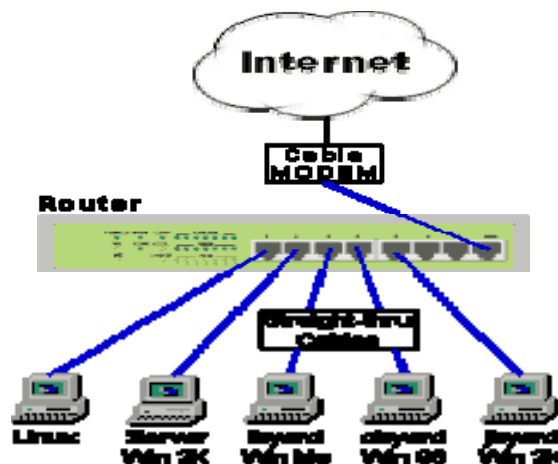
- a) The Hubs with minimum intelligent (i.e. no microprocessors).
- b) Intelligent Hubs which can perform the basic diagnostics and task the nodes to see if they are operating correctly or not.

The third category can be smart Hubs which can be polled and managed remotely

Purpose of Hub

Hubs are used to provide star topology. At the center of a star is the Hub or the switch with the n/w nodes located on the tips of the star. The hub is installed in a central wiring closet with all the cables extending out to the n/w nodes. The advantage of having a central wiring location i.e. it is easier to maintain to troubleshoot large n/w. All n/w cables come to the central hub. So it is especially easy to detect and fix the cable problems. The user can easily move a workstation in a star topology by changing the connection to the Hub at the central wiring closet.

**BLOCK DIAGRAM: -**



**RESULT: -** Thus Hub is studied



## QUESTIONS/ANSWERS

Q1. Define Hub?

A1. Common connection point for devices in a network. Hubs are commonly used to connect segments of a LAN. A hub contains multiple ports. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets.

Q2. Define Switch?

A2. In networks, a device that filters and forwards packets between LAN segments. Switches operate at the data link layer (layer 2) and sometimes the network layer (layer 3) of the OSI Reference Model and therefore support any packet protocol.

Q3. Define Router?

A3. A device that forwards data packets along networks. A router is connected to at least two networks, commonly two LANs or WANs or a LAN and its ISP's network. Routers are located at gateways, the places where two or more networks connect.

Q4. How many pairs of stations can simultaneously communicate on Ethernet LAN?

A4. One

Q5. A modem that is attached to the telephone system by jamming the phone's handset into two flexible receptacles in the coupler?

A5. Acoustic coupler

Q6. On which layer does the hub work?

A6. Hubs work at the physical layer (layer 1) of the OSI model.

Q7. As we know parallel transmission is faster than serial transmission. Name the device which converts parallel to serial transmission.

A7. Multiplexer.

Q8. Give one example of circuit switching?

A8. ISDN

Q9. Give an example of packet switching?

A9. X.25

Q10. What are the different types of network?

A10. LAN, GAN, WAN, MAN

## EXPERIMENT NO –11

**AIM: - To Study Interconnections of Cables for Data Communication.**

**APPARATUS REQUIRED: -** Different types of cables

**THEORY: -**

**Ethernet Cables**

**Comparison between CAT5, CAT5E, CAT6, CAT7 Cables**

In the context of the 100-ohm UTP (Unshielded Twisted Pair) type of cable used for Ethernet wiring the only categories of interest are Cat3, Cat4, Cat5, Cat5e, Cat6, and Cat7. CATx is an abbreviation for the category number that defines the performance of building telecommunications cabling as outlined by the Electronic Industries Association (EIA) standards. Up until the late 1980s thick or thin coaxial cable was typically used for 10-Mbps Ethernet networks, but around that time, UTP cabling became more commonly used because it was easier to install and less expensive. UTP CAT3 and CAT4 were used for a quite limited time since the emergence of 100Base-TX networks meant a quick shift to CAT5. By the year 2000, moves to gigabit (1000Base-TX) Ethernet LANs created a need for another specification, CAT5e. CAT5e is now being superseded by CAT6 cable and there is a developing standard for CAT7.

**Specifications for Cat3, Cat4, Cat5, CAT5E, Cat 6, and Cat 7 Cables**

Category	Type	Spectral B/W	Length	LAN Applications	Notes
Cat3	UTP	16 MHz	100m	10Base-T, 4Mbps	Now mainly for telephone cables
Cat4	UTP	20 MHz	100m	16Mbps	Rarely seen
Cat5	UTP	100MHz	100m	100Base-Tx, ATM, CDDI	Common for current LANs
Cat5e	UTP	100MHz	100m	1000Base-T	Common for current LANs
Cat6	UTP	250MHz	100m		Emerging
Cat7	SCTP	600MHz	100m		

It might seem that CAT5 and CAT5e are the same. Pretty much they are, the CAT5e specification simply included some additional limits over the CAT5 specification. The reality is that most CAT5 cable is in fact CAT5e cable just not certified as such. Here is a comparison of those extra specifications.

CAT5, CAT5E, and CAT6 UTP Solid Cable Specifications Comparison			
	Category 5	Category 5E	Category 6
Frequency	100 MHz	100 MHz	250 MHz
Attenuation (Min. at 100 MHz)	22 dB	22 dB	19.8 Db
Characteristic Impedance	100 ohms ± 15%	100 ohms ± 15%	100 ohms ± 15%
NEXT (Min. at 100 MHz)	32.3 dB	35.3 dB	44.3 dB
PS-NEXT (Min. at 100 MHz)	no specification	32.3 dB	42.3 dB
ELFEXT (Min. at 100 MHz)	no specification	23.8 dB	27.8 dB
PS-ELFEXT (Min. at 100 MHz)	no specification	20.8 dB	24.8 dB
Return Loss (Min. at 100 MHz)	16.0 dB	20.1 dB	20.1 dB
Delay Skew (Max. per 100 m)	no specification	45 ns	45 ns

Some modern hubs don't care if you use crossover cables or straight through cables, they work out what you're using and configure themselves accordingly.

As stated at the outset, the actual difference is in the wiring. Inside the UTP patch cable there are 8 physical wires although the network only uses 4 of them (the other 4 are simply wasted). The 8 wires are arranged in what's known as pairs and one pair is used to send information whilst the other pair is used to receive information.

On a PC, the pair on pins 1 and 2 of the connector sends information, whilst the pair on pins 3 and 6 receives the information. To make PCs talk to each we therefore need to connect the send pair of one PC to the receive pair of the other PC (and vice-a-versa). That means we need a crossover cable. If we used a straight through cable the both be listening on the one pair - and hearing nothing, and sending on the one pair - achieving nothing.

The most common cable is the straight through cable. In a home or small office network you might only have one crossover cable used - perhaps from the cable or DSL modem to the distribution hub.

### Color Codes

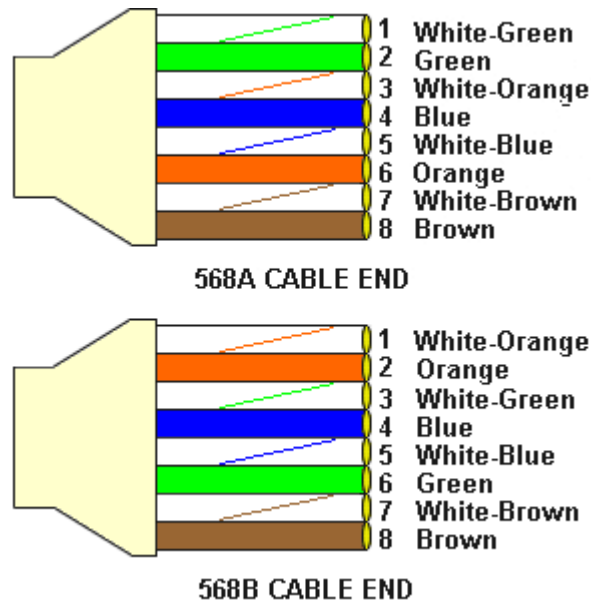
If a cable has 568A color wiring on both ends then it's a straight through cable.
If a cable has 568B color wiring on both ends then it's also a straight through cable.
If a cable has 568A color wiring on one end and 568B color coded wiring on the other end, then it's a crossover cable.

In fact, while the colors are standardized and usually followed, that's not the important part. What's more important is that one "pair" (wires that are twisted together inside the cable sheath) is used for the transmit side and another pair for the receive side. If pairs aren't used then it's likely your cable will not work. Pairs are identified by the colors. The orange wire and

---

the orange with white stripe (or sometimes white with orange stripe) wire are a pair. The brown wire and the brown with white stripe wire are a pair. Etc.

**DIAGRAM: -**



**RESULT: -** CAT types of cables are studied.

**Question/Answers:-**

Q1. What are the different Ethernet cables?

A1. Cat3, Cat4, Cat5, CAT5E, Cat 6, and Cat 7 Cables

Q2. What is the spectral band width of CAT 3 cable?

A2. Sixteen MHz

Q3. What is the spectral band width of CAT 4 cable?

A4. Twenty MHz

Q4. What is the spectral band width of CAT 5 cable?

A4. 100 MHz

Q5. What is the length of CAT 3 Cable?

A5. 100m

Q6. What is the length of CAT 4 Cable?

A6.100m

Q7.What is the length of CAT 5 Cable?

A7.100m

Q8.What is the bending radius of Cat 5 cable?

A8. Most Cat.5 cables can be bent at a radius approximately 4 times the diameter of the cable

Q9. What are solid core cables?

A9.Solid core cable is supposed to be used for long permanently installed runs. It is less flexible than stranded and more prone to failure if repeatedly flexed.

Q10.What is Stranded Cable?

A10.Stranded cable is used for fly leads at patch panel and for connections from wall-ports to end Devices, as it resists cracking of the conductors. Stranded core is generally more expensive than Solid core.

## EXPERIMENT NO. 12

**AIM:-To Study Fiber Optic Communication.**

**APPARATUS REQUIRED:** ST5001, TRAINER kit, ST5001 Software, 2Patch (2mm), Fiber cable (0.5m), Cords (2mm), 2serial Port Cables, and Main Power Cord

**THEORY:-**

The Fiber Optic Data Communications Link, End-to-End

We consider the simple fiber optic data link given below. This is the basic building block for a fiber optic based network. A model of this simple link is shown in Fig.



The illustration indicates the Source-User pair, Transmitter and Receiver. It also clearly shows the fiber optic cable constituting the Transmission Medium as well as the connectors that provide the interface of the Transmitter to the Transmission Medium and the Transmission Medium to the Receiver.

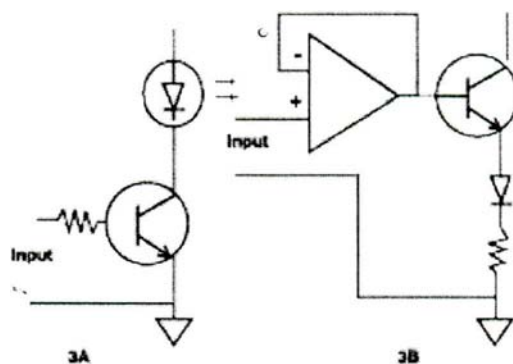
All of these are components of the simple fiber optic data line

**TRANSMITTER:-**

The Transmitter component serves two functions. First, it must be a source of the light coupled into the fiber optic cable. Secondly, it must modulate this light so as to represent the binary data that it is receiving from the Source.

The Source provides the data to the Transmitter as some digital electrical signal. The Transmitter can then be thought of as Electro-optical (EO) transducer.

Within the context of a fiber optic data link the modulating signal, the Information, assumes only the values of '0' and '1.' The demodulation function in the Receiver will just be looking for the presence or absence of energy during a bit time interval.



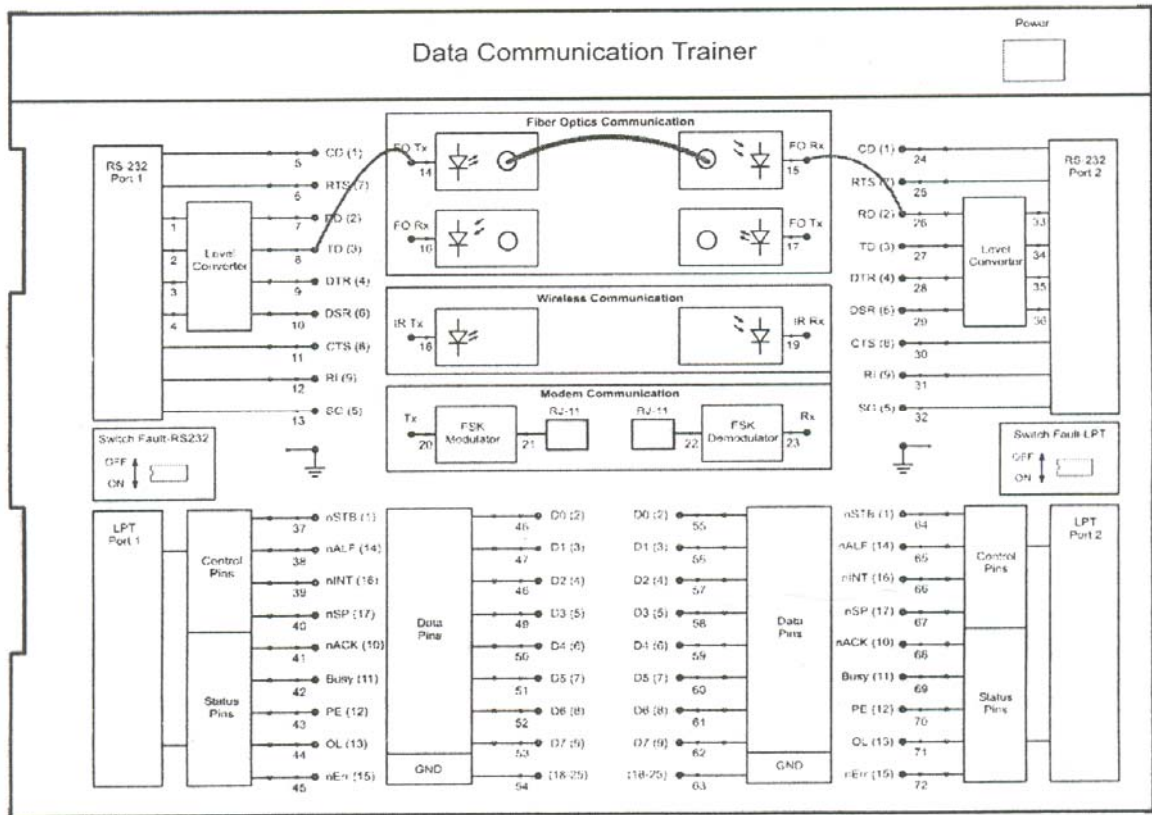
**RECEIVER:**

The Receiver component serves two functions. First, it must sense or detect the light coupled out of the fiber optic cable then convert the light into an electrical signal. Secondly, it must demodulate this light to determine the identity of the binary data that it represents. In total, it must detect light and then measure the relevant Information bearing light wave parameters in the premises fiber optic data link context intensity in order to retrieve the Source's binary data.

Receiver senses the light output of the fiber optic cable. Light is detected and then converted to an electrical signal. The demodulation process is carried out on the resulting electrical signal. The light detection is carried out by a photodiode. This senses light and converts it into an electrical current.

**BLOCK DIAGRAM:-**

**Half duplex**



**PROCEDURE:-**

1. Connect patch cords as shown in above figure.
2. Connect mains power cord to the trainer and switch ON the trainer.
3. Connect the serial port cables between one PC to Port 1 & another PC to Port2.
4. To open the window as shown in fig. 10, follow the steps.
5. Run ST5001 software on both PCs
6. Click "Fiber Optics Communication" image/press "Ctrl + F"/click "Options" on menu bar. .
7. The software will open with default settings. Set the same parameters on both the PCs. Baud rate can be varied from 2400bps to 1 15200bps. Select the desired baud rate. Select the desired port settings.
8. After the port settings are done, open the port by clicking "Open Port" button.
9. To send data to other node enter the text in the window titled as "Enter Data to Transmit". Click on "Send" button to transmit.
10. Transmitted data will be displayed in the "Received Data" window and the ASCII codes of each byte received is displayed in "Received Data in ASCII" window.
11. A small window at sender side is given for transmission of ASCII code. Enter an ASCII code in the window and then click "Send" button.
12. "Clear" buttons are given to clear all windows.
13. Before changing the port settings close the port by clicking "Close Port" button and after changing the parameters click "Open Port" button to reopen the port.

**RESULT:** - The fiber optics communication has been studied

**QUESTIONS/ANSWERS**

Q1. In selecting optical fibre, how does each of the following affect maximum distance?  
Span of a fibre run between switches?

- a) Fibre Quality b) Wavelength.  
A1. a) Fibre Quality

Q2. In optical fiber refractive index of cladding is less than core. Why?

A2. It helps to undergo multiple total internal reflections through the optical fiber.

Q3. Define Acceptance angle?

A3. Is the maximum angle to the axis at which light may enter the fiber in order to propagate?

Q4. Define Skew rays?

A4. Rays, which greatly outnumber the meridional rays, follow a helical path through the fibre.

Q5. Write advantages of optical fibre communication.

A5. Electrical isolation, Immunity to interference and crosstalk, Signal security, System reliability.

Q6. Define cladding?



A6. The cladding surrounds the core and supports the waveguide structure whilst, substantially reducing the radiation loss into the surrounding air.

Q7. Define Numerical aperture?

A7. The relationship between the acceptance angle and the refractive indices of the three media involved namely, core, cladding and air.

$$NA = n_0 \sin \theta_a$$

Q8. Define mode?

A8. The stable field distribution in the x direction with only periodic z dependence is known as a mode.

Q9. Disadvantage of fiber optics?

A9. High initial cost, difficult to install.

Q10. Define reflective index?

A10. ratio of the velocity of light in vacuum to the velocity of light in the medium

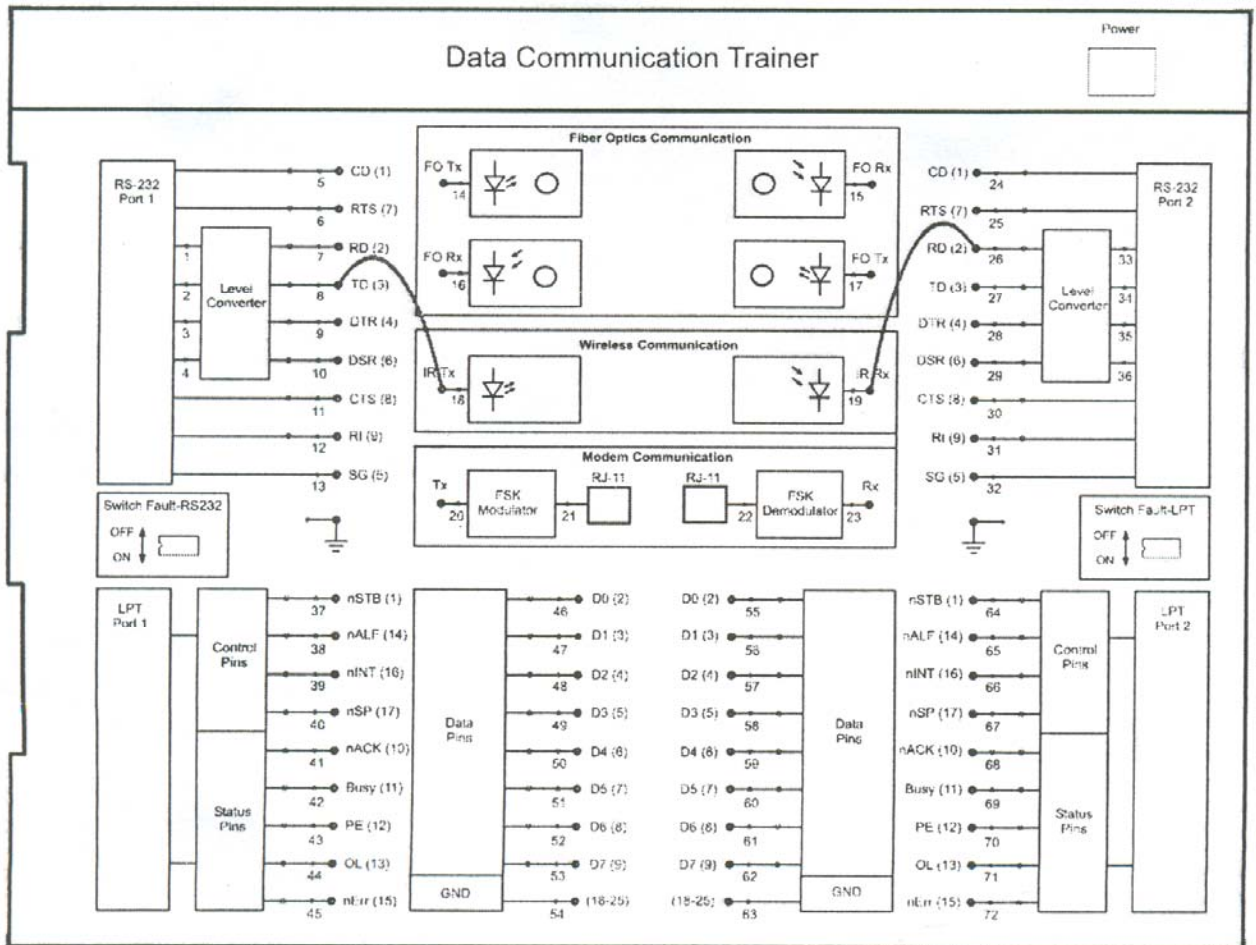
## EXPERIMENT NO – 13

**AIM: - To Study Wireless Communication.**

**APPARATUS REQUIRED:-**

ST 5001 Trainer Kit, ST5001 Software, 2 Patch Cords (2mm), 2 Serial Port Cables, Mains Power Cord.

**THEORY:** In wireless communication we are using Infrared signals. Infrared signals with frequencies from 300 GHz to 400 GHz can be used for short range communication. Infrared signals having high frequencies cannot penetrate walls. When we use our infrared remote control, we do not interfere with the use of the remote by our neighbours. This advantageous characteristic prevents interference between one system and another; a short range communication system in one room cannot be affected by another system in the next room.



**PROCEDURE:**

1. Connect patch cords as shown in fig. 1
2. Connect mains power cord to the trainer and switch ON the trainer.
3. Connect the serial port cables between one PC to Port 1 & another PC to Port2.
4. To open the window as shown in fig. 12, follow the steps.
5. Run ST5001 software on both PCs
6. Click "Wireless Communication" image/press "Ctr + W"/click "Options" on menu bar.
7. The software will open with default settings. Set the same parameters on both the PCs. Baud rate can be varied from 300bps to 2400bps. Select the desired baud rate. Select the desired port settings.
8. After the port settings are done, open the port by clicking "Open Port" button.
9. To send data to other node enter the text in the window titled as "Enter Data to Transmit". Click on "Send" button to transmit.
10. Transmitted data will be displayed in the "Received Data" window and the ASCII codes of each byte received is displayed in "Received Data in ASCII" window.
11. A small window at sender side is given for transmission of ASCII code. Enter an ASCII code in the window and then click "Send" button.
12. "Clear" buttons are given to clear all windows.
13. Before changing the port settings close the port by clicking "Close Port" button and after changing the parameters click "Open Port" button to reopen the port.

**RESULT:** - The wireless communication has been studied.

**QUESTIONS/ANSWERS:-**

- Q1. What are the two types of communication systems?  
A1. The two types are wired and wireless communication.
- Q2. Which are different types of wireless communication?  
A2. Radio frequency, satellite communication, microwave etc.
- Q3. What is the range microwave?  
A3. 1GHz to 300GHz.
- Q4. What is the range of satellite communication?  
A4. 4GHz to 6GHz (uplink) and 6GHz to 10GHz (downlink)
- Q5. State two applications of wireless communication.  
A5. Remote control devices, mobile communication.
- Q6. What are the advantages of wireless communication?

A6. Increases capacity of system, Higher mobility of device.

Q7. What is disadvantage of wireless?

A7. Dependence on weather condition, Spectrum allocation is fixed.

Q8. What are the different generations in wireless communication?

A8. 2G, 2.5G, 3G

Q9. Which are different standards in wireless Communication?

A9. EDGE, HPSCD, CDMA, TDMA

Q10. State any two wireless devices.

A10. TV, Mobile.

## EXPERIMENT NO – 14

**AIM: To Study PC-PC Communication Using LAN**

**APPARATUS:** LAN Trainer Kit

**THEORY:**

The physical topology of a network refers to the configuration of cables, computers, and other peripherals. Physical topology should not be confused with logical topology which is the method used to pass information between workstations.

**Tree Topology**

Tree topologies integrate multiple star topologies together onto a bus. In its simplest form, only hub devices connect directly to the tree bus, and each hub functions as the "root" of a tree of devices. This bus/star hybrid approach supports future expandability of the network much better than a bus (limited in the number of devices due to the broadcast traffic it generates) or a star (limited by the number of hub connection points) alone.

**Advantages of a Tree Topology**

- Point-to-point wiring for individual segments.
- Supported by several hardware and software vendors.

**Disadvantages of a Tree Topology**

- Overall length of each segment is limited by the type of cabling used.
- If the backbone line breaks, the entire segment goes down.

More difficult to configure and wire than other topologies

**Bus Topology**

Ethernet bus topologies are relatively easy to install and don't require much cabling compared to the alternatives. 10Base-2 ("ThinNet") and 10Base-5 ("ThickNet") both were popular Ethernet cabling options many years ago for bus topologies. However, bus networks work best with a limited number of devices. If more than a few dozen computers are added to a network

**Advantages of a Linear Bus Topology**

- Easy to connect a computer or peripheral to a linear bus.
- Requires less cable length than a star topology.

**Disadvantages of a Linear Bus Topology**

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- Entire network shuts down if there is a break in the main cable.
- Terminators are required at both ends of the backbone cable.
- Difficult to identify the problem if the entire network shuts down.
- Not meant to be used as a stand-alone solution in a large building

### **Star Topology**

Many home networks use the star topology. A star network features a central connection point called a "hub" that may be a hub, switch or router. Devices typically connect to the hub with Unshielded Twisted Pair (UTP) Ethernet.

Compared to the bus topology, a star network generally requires more cable, but a failure in any star network cable will only take down one computer's network access and not the entire LAN. (If the hub fails, however, the entire network also fails.

### **Advantages of a Star Topology**

- Easy to install and wire.
- No disruptions to the network then connecting or removing devices.
- Easy to detect faults and to remove parts.

### **Disadvantages of a Star Topology**

- Requires more cable length than a linear topology.
- If the hub or concentrator fails, nodes attached are disabled.
- More expensive than linear bus topologies because of the cost of the concentrators.

The protocols used with star configurations are usually Ethernet or Local Talk. Token Ring uses a similar topology, called the star-wired ring.

### **PROCEDURE:**

1. Implement Star topology with the help of ST5002 trainer kit.
2. Install the ST5002 Software on each node or system connected on trainer kit as per the given steps in 'installation procedure' in case it is not installed
3. Run ST5002 software on each node connected to the trainer
4. Click on 'Star Topology'
5. Enter remote nodes IP address or computer name in the 'Destination IP / Name text window.
6. Select the flow control 'Stop-N-Wait'
7. Select all other settings like; packet size, inter packet delay, & transmission error
8. Save all parameters by clicking on 'Save Parameters' button
9. Browse a file to transmit by clicking on 'Open' button

10. Click "Send" button to transmit the file.
11. To see the live packet details press 'Packet details'
12. Analyze the network statistics for the file transmission by clicking 'Statistics' button

**RESULT:** PC-PC communication using LAN has been studied

### **QUESTIONS/ANSWERS**

Q1.Using internet, how can you transfer a file or software from one computer to another. Explain.

A1.File Transfer Protocol (FTP)

Q2. Give two examples of hybrid topology

A2.Star and ring are the two examples of hybrid topology

Q3. What are the four basic type of topology?

A3. Four basic type of topology are star, bus, ring, and mesh

Q4. Give one advantage of tree topology?

A4. Point-to-point wiring for individual segments.

Q5 Give one disadvantage of tree topology?

A5. Overall length of each segment is limited by the type of cabling used

Q6 Define topology?

A6.Physical composition of the network is defined as topology

Q7. What is poll?

A7. Primary message inquiring if secondary has any traffic to send

Q8. What does the term “selection process” signify in bus topology?

A8. Primary message inquiring if secondary is ready to receive traffic

Q9.What are the advantage of bus topology?

A9. Easy to connect, requires less cable.

Q10.What are the disadvantages of bus topology?

A10.Entire network shuts down if there is a break in the main cable.