

CSC423 EXAM PREPARATORY QUESTIONS

1. What is Radio Wave?

A radio wave is a type of electromagnetic signal designed to carry information through the air over relatively long distances. Sometimes radio waves are referred to as radio frequency (RF) signals. These signals oscillate at a very high frequency.

2. List and briefly explain the properties of a radio wave.

- Amplitude
- Frequency
- Phase Elements

Amplitude:

The amplitude of a radio wave indicates its strength. The measure for amplitude is generally power. Power in terms of electromagnetic signals represents the amount of energy necessary to push the signal over a particular distance. As the power increases, so does the range. Radio waves have amplitudes with units of watts, which represent the amount of power in the signal.

Frequency:

The frequency of a radio wave is the number of times per second that the signal repeats itself. The unit for frequency is Hertz (Hz), which is actually the number of cycles occurring each second. An old convention for the unit for frequency is cycles per second (cps). The frequency impacts the propagation of radio waves. Theoretically, higher-frequency signals propagate over a shorter range than lower-frequency signals. In practice,

however, the range of different frequency signals might be the same, or higher-frequency signals might propagate farther than lower-frequency signals.

Phase:

The phase of a radio wave corresponds to how far the signal is offset from a reference point (such as a particular time or another signal). By convention, each cycle of the signal spans 360 degrees. For example, a signal might have a phase shift of 90 degrees, which means that the offset amount is one-quarter ($90/360 = 1/4$) of the signal.

3. Stating the RF System Components, explain how radio signals is transferred from the source to the destination.

The RF System is composed of:

- The Transceiver
- Antennas and
- A Transmission Medium

A key component of a WLAN is the RF transceiver, which consists of a transmitter and a receiver. The transmitter transmits the radio wave on one end of the system (the “source”), and the receiver receives the radio wave on the other side (the “destination”) of the system. The transceiver is generally composed of hardware that is part of the wireless client radio device (sometimes referred to as a client card).

A process known as modulation converts electrical digital signals that represent information (data bits, 1s and 0s) inside a computer into radio waves at the desired frequency, which propagate through the air medium. The amplifier increases the amplitude of the radio wave signal to a desired transmit power prior to being fed to the antenna and

propagating through the transmission medium (consisting primarily of air in addition to obstacles, such as walls, ceilings, chairs, and so on).

At the destination, a receiver detects the relatively weak RF signal and demodulates it into data types applicable to the destination computer. The radio wave at the receiver must have amplitude that is above the receiver sensitivity of the receiver; otherwise, the receiver will not be able to “interpret” the signal, or decode it. The minimum receiver sensitivity depends on the data rate.

4. Write Short Note on the following:

➤ RF Modulation:

This is the process of converting the digital signal representing the data into an analog signal. In other words, RF modulation transforms digital data, such as binary 1s and 0s representing an e-mail message, from the network into an RF signal suitable for transmission through the air. As part of this process, modulation superimposes the digital data signal onto a carrier signal, which is a radio wave having a specific frequency. In effect, the data rides on top of the carrier.

➤ Quadrature Amplitude Modulation

Quadrature amplitude modulation (QAM) causes both the amplitude and phase of the carrier to change to represent patterns of data, often referred to as symbols. The advantage of QAM is the capability of representing large groups of bits as a single amplitude and phase combination. In fact, some QAM-based systems, for example, make use of 64 different phase and amplitude combinations, resulting in the representation of 6 data bits per symbol. Higher-order combinations of phase and

amplitude in QAM make it possible for standards such as 802.11n and 802.11ac to support higher data rates.

➤ **Orthogonal Frequency-Division Multiplexing**

Instead of using spread spectrum, higher-speed WLANs make use of orthogonal frequency division multiplexing (OFDM). OFDM divides a signal modulated with FSK, PSK, or QAM across multiple subcarriers occupying a specific channel. OFDM is extremely efficient, which enables it to provide the higher data rates and minimize multipath propagation problems. OFDM has also been around for a while, supporting the global standard for asymmetric digital subscriber line (ADSL), a high-speed wired telephone standard.

5. What is Analog Modulation?

Modulation is the process of impressing a low-frequency information signal (baseband signal) onto a higher frequency carrier signal. This is done to bring information signals up to the Radio Frequency (or higher) signal.

6. List and explain three (3) types of Analog Modulation.

The types of analog modulation are:

➤ **Amplitude Modulation**

Amplitude modulation is the process of varying the amplitude of a carrier wave in proportion to the frequency of a baseband signal. The frequency of the carrier remains constant.

➤ **Frequency Modulation**

Frequency modulation is the process of varying the frequency of a carrier wave in proportion to the amplitude of a baseband signal. The amplitude of the carrier remains constant.

➤ **Phase Modulation**

When the phase of a high-frequency carrier wave changes or varies due to the change of the phase of the signal modulation while the amplitude and frequency are at a constant state, we term it as Phase modulation.

7. List and explain the functions of the basic components of an Analog System.

➤ **Input Transducer:**

The device that converts a physical signal from source to an electrical, mechanical or electromagnetic signal more suitable for communicating.

➤ **Transmitter:**

The device that sends the transduced signal.

➤ **Transmission Channel:**

The physical medium on which the signal is carried.

➤ **Receiver:**

The device that recovers the transmitted signal from the channel

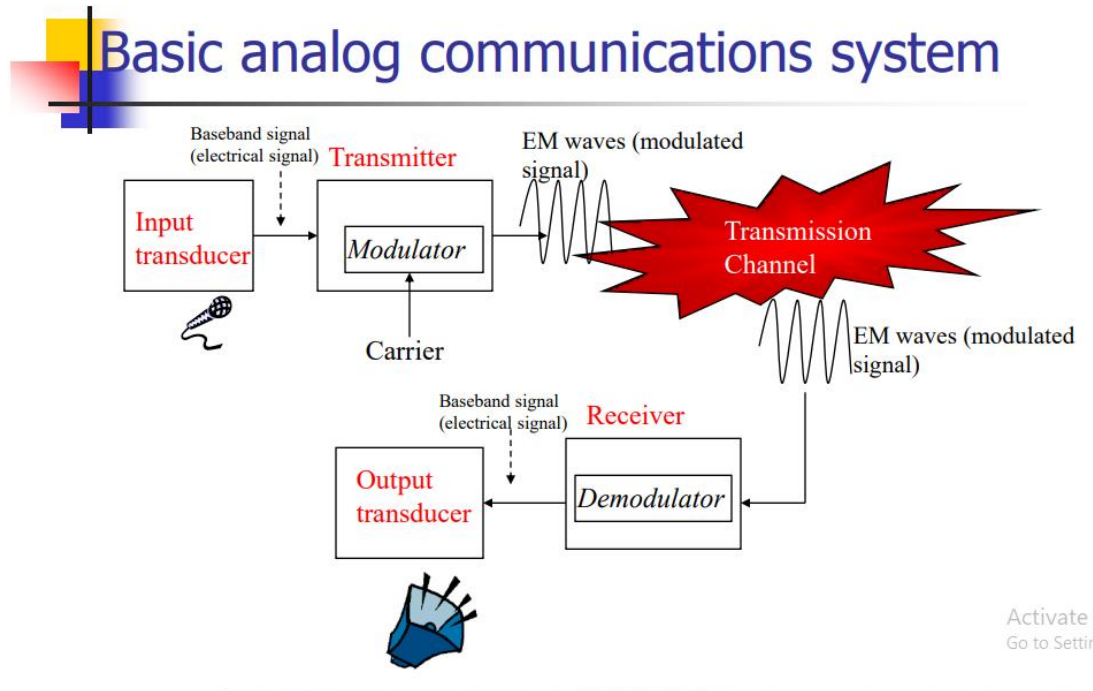
➤ **Output Transducer:**

The device that converts the received signal back into a useful quantity

8. Compare and Contrast between AM and FM

AM	FM
➤ Stands for Amplitude Modulation	Stands for Frequency Modulation
➤ Poor sound quality due to lower bandwidth	Better sound quality due to higher bandwidth.
➤ Cheaper and can be transmitted over long distances.	FM signals are impacted by physical barriers.
➤ The process of varying the amplitude of a carrier wave in proportion to the frequency of a baseband signal. The frequency of the carrier remains constant.	The process of varying the frequency of a carrier wave in proportion to the amplitude of a baseband signal. The amplitude of the carrier remains constant.
➤ AM radio ranges from 535 to 1705 KHz (OR) Up to 1200 bits per second.	FM radio ranges in a higher spectrum from 88 to 108 MHz. (OR) 1200 to 2400 bits per second.
➤ Equidistant Zero crossing in modulated signal	Not Equidistant zero crossing in modulated signal
➤ Transmitter and receiver are simple	Transmitter and receiver are more complex as variation of modulating signal has to be converted and detected from corresponding variation in frequencies.
➤ AM is more susceptible to noise because noise affects amplitude, which is where information is "stored" in an AM signal.	FM is less susceptible to noise because information in an FM signal is transmitted through varying the frequency, and not the amplitude.

9. Draw a diagram showing the basic analog communication system



10. Write short notes on the following communication modulation techniques:

I. Amplitude Shift Keying

One of the simplest forms of modulation is amplitude modulation (sometimes referred to as amplitude-shift keying), which varies the amplitude of a signal to represent data. Amplitude modulation alone does not work very well with RF systems because there are signals (noise) present inside buildings and outdoors that alter the amplitude of the radio wave, which causes the receiver to demodulate the signal incorrectly. These noise signals can cause the signal amplitude to be artificially high for a period of time.

II. Frequency Shift Keying:

FSK makes slight changes to the frequency of the carrier signal to represent data in a manner that's suitable for propagation through the air at low to moderate data rates. For example, modulation can represent a 1 or 0 data bit with either a positive or negative shift in frequency of the carrier. If the shift in frequency is negative—that is, a shift of the carrier to a lower frequency—the result is a logic 0. The receiver can detect this shift in frequency and demodulate the results as a 0 data bit. As a result, FSK avoids the impacts of common noise that exhibits shifts in amplitude.

III. Phase Shift Keying

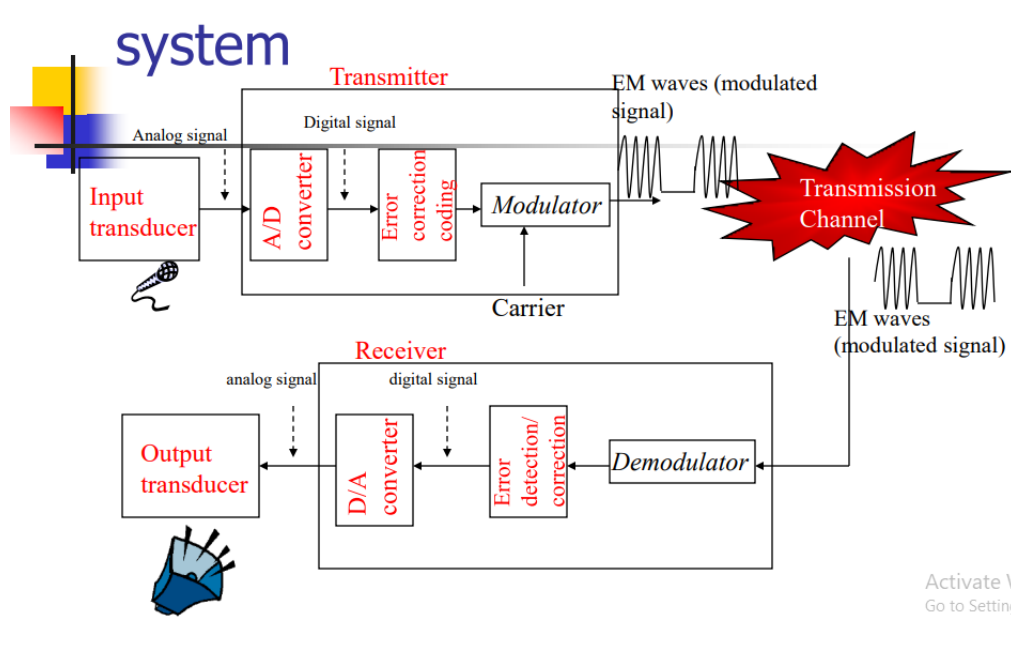
Some systems use phase-shift keying (PSK), which is similar to FSK, for modulation purposes for low to moderate data rates. With PSK, data causes changes in the signal's phase, while the frequency remains constant. The phase shift can correspond to a specific positive or negative amount relative to a reference. A receiver can detect these phase shifts and realize the corresponding data bits. As with FSK, PSK is mostly immune to common noise that is based on shifts in amplitude.

IV. Spread Spectrum

After modulating the digital signal into an analog carrier signal using FSK, PSK, or QAM, some WLAN transceivers spread the modulated carrier over a wider spectrum to comply with regulatory rules. This process, called spread spectrum,

significantly reduces the possibility of outward and inward interference. As a result, regulatory bodies generally do not require users of spread spectrum systems to obtain licenses. Spread spectrum, developed originally by the military, spreads a signal's power over a wide band of frequencies. Spread spectrum radio components use either direct sequence or frequency hopping for spreading the signal.

11. Draw a diagram showing the basic digital communication system



12. What is modem and write short notes on four (4) different kinds of modem.

Modem

Modems are devices used to enable the transfer of data over the public switched telephone network (PSTN). The name modem comes from the name MODulator-DEModulator which describes the function the modem performs to transfer digital information over an analog network. The goal is to produce a signal that can be transmitted easily and decoded to reproduce the original digital data. Primarily used

to communicate via telephone lines, modems can be used over any means of transmitting analog signals.

There are many kinds of modems available today:

a. Internal modem:

A modem card in your computer that is integrated within the system. Less expensive than external modems v Disadvantage is that you need to access inside the computer to replace the modem.

b. External modem:

A device that connects externally to your computer through a serial port. External power supply does not drain power from the computer. Modem activity can easily be observed. More expensive than an internal modem.

c. Digital Subscriber Line (DSL)

A high-speed data service that works over conventional telephone lines and is typically offered by telephone companies. It does not occupy the phone line-you can still talk on the phone. Speed is much higher than regular modem.

d. Cable Modem

A device that connects to the existing cable feed and to an Ethernet network card in the PC (also called a NIC for Network Interface Card). Is different than a common dial up modem. Supports higher speeds; typically offered by cable companies.

13. State three (3) Telecommunication problems and their corresponding solutions that Modulation helps to solve.

❖ Problem:

Certain types of data such as voice, video, and bit streams from computers have lower frequency bands and therefore they cannot travel very far wirelessly because they cannot propagate through space.

Solution:

When using modulation, the carrier wave (which has a much higher frequency) is used to carry the signal, meaning it can travel further and more quickly through space.

❖ Problem:

Antenna length would be impractical for voice, video and bit streams without modulation.

Solution:

By using the high frequency carrier waves, the necessary antenna size is greatly reduced.

❖ Problem:

Without modulation, transmission of video, voice or data bit streams being sent on the same frequency range would cause overlapping of channels (resulting in interference).

Solution:

Carrier radio waves have a wide range of frequencies which allow you to select individual non-overlapping channels to carry the information.

14. What is a computer network and state its advantages and disadvantages.

A network is a set of interconnected computer and communication devices. The advantages of computer network includes:

- a. **Resource Sharing.** The aim is to make all programs, data and peripherals available to anyone on the network irrespective of the physical location of the resources and the user.
- b. **Reliability.** A file can have copies on two or three different machines, so if one of them is unavailable (hardware crash), the other copies could be used. For military, banking, air reservation and many other applications it is of great importance.
- c. **Cost Factor.** Personal computers have better price/performance ratio than microcomputers. So it is better to have PC's, one per user, with data stored on one shared file server machine.
- d. **Communication Medium.** Using a network, it is possible for managers, working far apart, to prepare financial report of the company. The changes at one end can be immediately noticed at another and hence it speeds up co-operation among them.
- e. **Central Storage of Data.** Files can be stored on a central node (the file server) that can be shared and made available to each and every user in an organization.
- f. **Faster Problem solving.** Since an extensive procedure is disintegrated into a few little procedures and each is taken care of by all the associated gadgets, an explicit issue can be settled in lesser time.
- g. **Security through Authorization.** Security and protection of information is additionally settled through system. As just the system clients are approved to get to specific records or applications, no other individual can crack the protection or security of information.

The disadvantages of a computer network includes:

- a. It lacks robustness
- b. It lacks independence
- c. Virus and malware can affect devices connected to the network.

15. Write short note on the following:

- a. **Nodes:** These are the computers that are attached to a network and are seeking to share the resources of the network. Of course, if there were no nodes (also called workstations), there would be no network at all.
- b. **Server:** A computer that facilitates the sharing of data software and hardware - resources e.g. printers, modems etc., on the network. Servers can be either Dedicated or Non- Dedicated.
- c. **Differentiate between Dedicated and Non-Dedicated Servers**

Dedicated Servers:

On bigger network installations, there is a computer reserved for server's job and its only job is to help workstations access data, software and hardware resources. It does not double-up as a workstation and such a server is known as dedicated server. The networks using such a server are known as master-slave networks.

Non-Dedicated Servers:

On small networks, a workstation that can double up as a server, is known as non-dedicated server since it is not completely dedicated to the cause of serving. Such servers can facilitate the resource-sharing among workstations on a proportionately smaller scale. Since one computer works as a workstation as well as a server, it is

.slower and requires more memory. The (small) networks using such a server are known as peer-to-peer networks.

- d. **Network Interface Unit:** This is an interpreter that helps to establish communication between the server and workstations. The network-interface-unit is a device that is attached to each of the workstations and the server, and helps the workstation to establish the all-important connection with the network. Each network-interface-unit that is attached to a workstation has a unique number identifying it which is known as the node address. The NIU is also called Terminal Access Point (TAP).

16. Applications and Uses of Computer Networks

❖ Marketing and sales.

Computer networks are used extensively in both marketing and sales organizations. Marketing professionals use them to collect, exchange, and analyze data relating to customer needs and product MCA-301 8 development cycles. Sales applications include teleshopping, which uses order entry computers or telephones connected to an order-processing network, and on-line reservation services for hotels, airlines, and so on.

❖ Financial services.

Today's financial services are totally dependent on computer networks. Applications include credit history searches, foreign exchange and investment services, and electronic funds transfer (EFT), which allows a user, to transfer money without going into a bank (an automated teller machine is a kind of electronic funds transfer; automatic paycheck deposit is another).

❖ Manufacturing.

Computer networks are used today in, many aspects of manufacturing, including the manufacturing process itself. Two applications that use networks to provide essential services are computer-assisted design (CAD) and computer-assisted manufacturing (CAM), both of which allow multiple users to work on a project simultaneously.

❖ • Electronic messaging:

Probably the most widely used network application is electronic mail (e-mail).

❖ Directory services:

Directory services allow lists of files to be stored in a central location to speed worldwide search operations.

❖ Information services:

Network information services include bulletin boards and data banks. A World Wide Web site offering the technical specifications for a new product is an information service.

❖ Electronic data interchange (EDI):

EDI allows business information (including documents such as purchase orders and invoices) to be transferred without using paper.

❖ Teleconferencing:

Teleconferencing allows conferences to occur MCA-301 9 without the participants being in the same place. Applications include simple text conferencing (where participants communicate through their keyboards and computer monitors). Voice conferencing (where participants at a number of locations communicate simultaneously over the phone) and video conferencing (where participants can see as well as talk to one another).

❖ Cellular telephone:

In the past two parties wishing to use the services of the telephone company had to be linked by a fixed physical connection. Today's cellular networks make it possible to maintain wireless phone connections even while traveling over large distances.

❖ Cable television:

Future services provided by cable television networks may include video on request, as well as the same information, financial, and communications services currently provided by the telephone companies and computer networks.

17. What is network topology and what are the factors to consider when selecting a particular topology?

Network topology refers to the pattern of interconnection of nodes in a network.

Factors to be considered when selecting a particular topology includes:

a. Cost:

For a network to be cost effective, one would try to minimize installation cost. This may be achieved by using well understood media and also, to a lesser extent, by minimizing the distances involved.

b. Flexibility:

Because the arrangement of furniture, internal walls etc. in offices is often subject to change, the topology should allow for easy reconfiguration of the network. This involves moving existing nodes and adding new ones.

c. Reliability:

Failure in a network can take two forms. Firstly, an individual node can malfunction. This is not nearly as serious as the second type default where the network itself fails to operate. The topology chosen for the network can help by allowing the location of the fault to be detected and to provide some means of isolating it.

18. Write short note on Star Topology stating its advantages and disadvantages.

Star Topology consists of a central node to which all other nodes are connected by a single path. Example of star topology is the connection of laptops, smartphones, smart watches etc. to a wireless modem for the purpose of sharing internet connection.

Advantages of Star Topology

1. Ease of service:

The star topology has a number of concentration points (where connections are joined). These provide easy access for service or reconfiguration of the network.

2. One device per connection:

Connection points in any network are inherently prone to failure in the star topology, failure of a single connection typically involves disconnecting one node from an otherwise fully functional network.

3. Centralized control/problem diagnosis:

The fact that the 'central node is connected directly to every other node in the network means that faults are easily detected and isolated. It is a simple matter to disconnect failing nodes from the system.

4. Simple access protocols:

Any given connection in a star network involves only the central node. In this situation, contention for who has control of the medium for the transmission purposes is easily solved. Thus in a star network, access protocols are very simple.

Disadvantages of Star Topology

1. Long cable length:

Because each node is directly connected to the center, the star topology necessitates a large quantity of cable as the cost of cable is often small, congestion in cable ducts and maintenance and installation problems can increase cost considerably.

2. Difficult to expand:

The addition of a new node to a star network involves a connection all the way to the central node.

3. Central node dependency:

If the central node in a star network fails, the entire network is rendered inoperable. This introduces heavy reliability and redundancy constraints on this node. The star topology has found extensive application in areas where intelligence in the network is concentrated at the central node.

19. Write short note on Bus Topology, stating its advantages and disadvantages.

This consists of a single length of the transmission medium (normally coaxial cable) onto which the various nodes are attached. The topology is used in traditional data

communication network where the host at one end of the bus communicates with several terminals attached along its length. Data is transmitted in small blocks, known as packets. Each packet has some data bits, plus a header containing its destination address. A station wanting to transmit some data sends it in packets along the bus. The destination device, on identifying the address on the packets, copies the data onto its disk. Example of Bus Topology is Ethernet.

Advantages of Bus Topology

- a. Easy to connect a computer or peripheral to a linear bus.
- b. Requires less cable length than a star topology.
- c. Easy to extend: Additional nodes can be connected to an existing bus network at any point along its length.
- d. Resilient Architecture: The LINEAR architecture has an inherent simplicity that makes it very reliable from a hardware point of view.

Disadvantages of Bus Topology

- a. Entire network shuts down if there is a break in the main cable.
- b. Terminators are required at both ends of the backbone cable.
- c. Difficult to identify the problem if the entire network shuts down.
- d. Not meant to be used as a stand-alone solution.
- e. Repeater configuration: When BUS type network has its backbone extended using repeaters, reconfiguration may be necessary.

20. Write short note on Ring or Circular Topology, stating its Advantages and Disadvantages.

In Ring or Circular topology, each node is connected to two and only two neighboring nodes. Data is accepted from one of the neighboring nodes and is transmitted onwards to another. Thus data travels in one direction only, from node to node around the ring. After passing through each node, it returns to the sending node, which removes it. Example of Ring topology is the IBM Token Ring.

Advantages of Ring or Circular Topology

- a. There is no need of network server to control the flow of data.
- b. Flow of data is in circular direction which minimizes the chance of packet collision.
- c. It can handle heavy traffic as compared to bus topology due to Token passing principal.
- d. Ring topology provides good communication over a long distance.
- e. The maintenance of ring network is much easier compared to the bus network.
- f. Troubleshooting in ring network is much easier because cable faults can be easily located.
- g. It has better performance than bus topology, even when the nodes are increased.
- h. The uni-directional ring topology provides very high speed.
- i. It is suitable for optical fibers.

Disadvantages of Ring or Circular Topology

- a. A single break in the cable can cause disturbance in the entire network
- b. In Uni-directional Ring, a data packet (token) must pass through all the nodes.

- c. Addition and removal of any node in a network is difficult and can cause issue in network activity.
- d. Network reconfiguration is difficult. It is not possible to shut down a small section of the ring while keeping the majority of it working normally.
- e. Node failure causes network failure. The transmission of data on a ring goes through every connected node on the ring before returning to the sender. If one node fails to pass data through itself, the entire network has failed and, no traffic can flow until the defective node has been removed from the ring.

21. Write short note on Tree Topology stating its Advantages and Disadvantages.

Tree topology can be derived from the star topology. Tree has a hierarchy of various hubs, like you have branches in a tree; hence the name. The central hub contains a repeater, which looks at the incoming bits and regenerates them afresh as the full blown signals for 0 or 1 as required. This allows the digital signals to traverse over longer distances. Therefore, the central hub is also called active hubs. The tree topology also contains many secondary hubs, which may be active hubs or passive hubs.

Advantages of Tree Topology

- a. This topology is the combination of bus and star topology.
- b. This topology provides a hierarchical as well as central data arrangement of the nodes.
- c. As the leaf nodes can add one or more nodes in the hierarchical chain, this topology provides high scalability.

- d. The other nodes in a network are not affected, if one of their nodes get damaged or not working.
- e. Tree topology provides easy maintenance and easy fault identification can be done.

Disadvantages of Tree Topology

- a. This network is very difficult to configure as compared to the other network topologies.
- b. If the computer in first level is erroneous, next level computer will also go under problems.
- c. Requires large number of cables compared to star and ring topology.
- d. Due to the presence of large number of nodes, the network performance of tree topology becomes a bit slowly.
- e. If the bulk of nodes are added in this network, then the maintenance will become complicated.
- f. The establishment cost increases as well.

22. Write short note on Hybrid Topology, stating its Advantages and Disadvantages.

Hybrid topology is one that uses two or more of other topologies. The choice to use a hybrid topology over a standard topology depends on the needs of a business, school, or the users. The number of computers, their location, and desired network performance are all factors in the decision.

Advantages of Hybrid Topology

- a. This type of topology combines the benefits of different types of topologies in one topology.
- b. Can be modified as per requirement.
- c. It is extremely flexible.
- d. It is very reliable.
- e. It is easily scalable as Hybrid networks are built in a fashion which enables for easy integration of new hardware components.
- f. Error detecting and trouble shooting is easy.
- g. Handles large volume of traffic.
- h. It is used for create large network.

Disadvantages of Hybrid Topology

- a. It is a type of network that is expensive to establish and maintain.
- b. Design of a hybrid network is very complex.
- c. There is change hardware in order to connect topology with another topology.
- d. Usually hybrid architectures are usually larger in scales so they requires a lot of cables in installation process.
- e. Installation is a difficult process

23. Write short notes on the following:

- i. LANs (Local Area Networks)

Local Area Networks (LANs) are most often described as privately owned networks that offer reliable high speed communication channels optimized for connecting information processing equipment in a limited geographical area,

namely, an office building, complex of buildings, or campus. LANs interconnect computers and peripherals over a common medium in order that users might share access to host computers, databases, files, applications, and peripherals. It can also provide a connection to other networks either through a computer, which is attached to both networks, or through a dedicated device called a gateway. The main users of LANs include business organizations, research and development groups in science and engineering, industry, educational institution.

ii. MAN (Metropolitan Area Network)

A metropolitan area network (MAN) is designed to extend over an entire city. It may be a single network such as a cable television network, or it may be a means of connecting a number of LANs into a larger network so that resources may be shared LAN-to-LAN as well as device-to-device. It can be wholly owned and operated by a private company, or it may be a service provided by a public company, such as a local telephone company.

iii. Wide Area Network (WAN)

A wide area network (WAN) provides long-distance transmission of data, voice, image, and video information over large geographical areas that may comprise a country, a continent, or even the whole world. In contrast to LANs (which depend on their own hardware for transmission), WANs may utilize public, leased, or private communication devices, usually in combinations, and can therefore span an unlimited number of miles. A WAN that is wholly owned and used by a single company is often referred to as an enterprise network.