Solution: Set 2

SY. B.Tech IT Fundamentals of Data Communication

Total No. of Questions – [08] Total No. of Printed Pages 02

G.R. No.	

DECEMBER 2018/ENDSEM solution

S. Y. B. TECH. (IT) (SEMESTER - I)

COURSE NAME:FUNDAMENTALS OF DATA COMMUNICATION

COURSE CODE: ITUA21173

(PATTERN 2017)

Time: [**2 Hours**] [Max. Marks: **50**]

(*) Instructions to candidates:

1) **Answer Q.1, Q.2, Q.3, Q.4, Q.5 OR Q.6, Q.7 OR Q.8**
2) **Figures to the right indicate full marks.**
3) **Use of scientific calculator is allowed**
4) **Use suitable data whereever required**

Q.1) a) Define the transmission impairments and discuss it with help of signal representation. [6M]

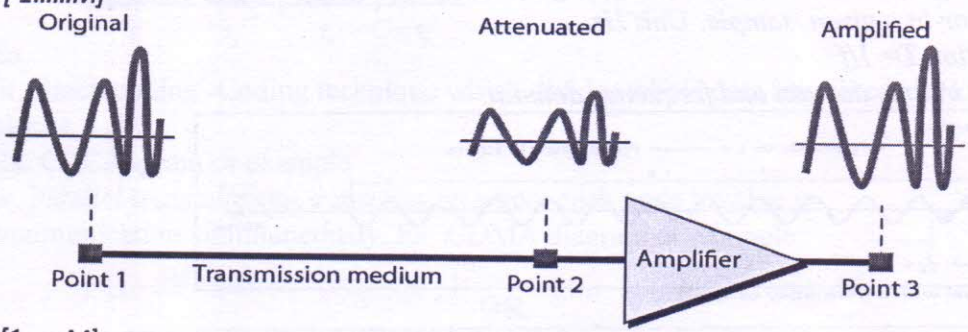
Ans.

- *Attenuation*

the reduction of the amplitude of a signal, electric current, or other oscillation.

attenuation is a general term that refers to any reduction in the strength of a signal.

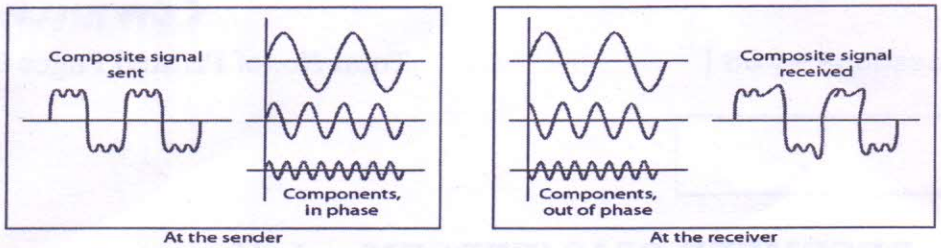
[1.....M]



[1.....M]

- *Distortion*

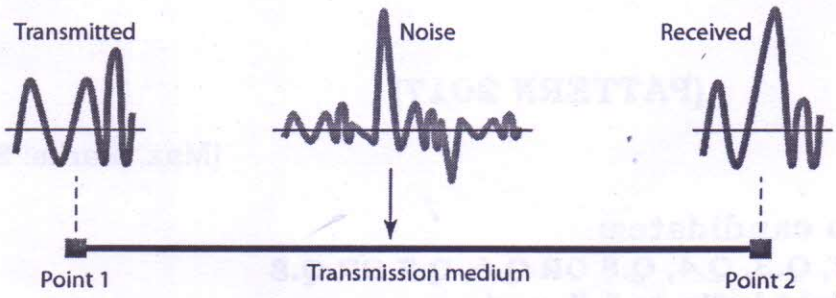
distortion refers to any kind of deformation of an output waveform compared to its input, usually clipping, harmonic distortion. [1.....M]



[1.....M]

- *Noise*

unwanted (and, in general, unknown) modifications that a signal may suffer during capture, storage, transmission, processing, or conversion. [1.....M]



[1.....M]

OR

b) Describe the terms Time and Frequency and co-relate them, assuming both features are belongs to same signal. Represent two signals in time domain and two signals in frequency domain with distinct features. [6M]

Ans. Definition time [1/2....M]

Definition Frequency [1/2....M]

Units +Corelation T= 1/f.....[1.....M]

Four distinct signals 2 in time domain [2.....M]

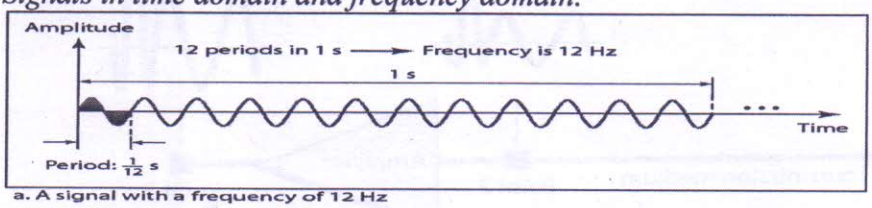
2 in time domain [2.....M]

Time- period for which a signal complete a cycle. Uint- Sec

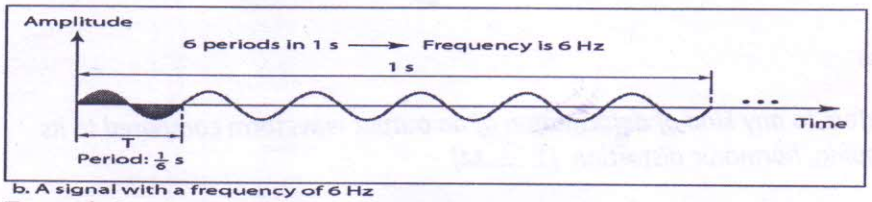
Frequency: the rate at which something occurs over a particular period of time or in a given sample. Unit Hz

Corelation T= 1/f

Signals in time domain and frequency domain:

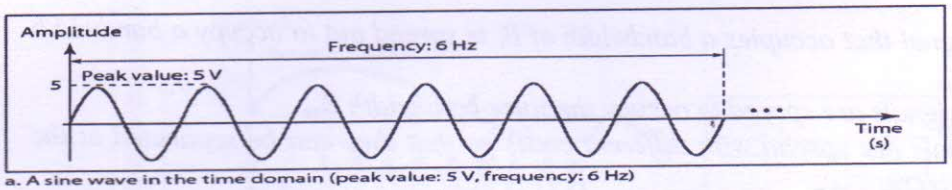


a. A signal with a frequency of 12 Hz

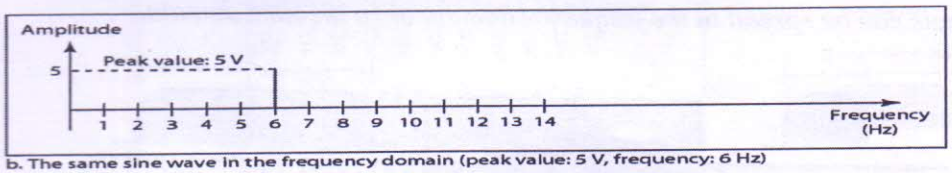


b. A signal with a frequency of 6 Hz

Example1



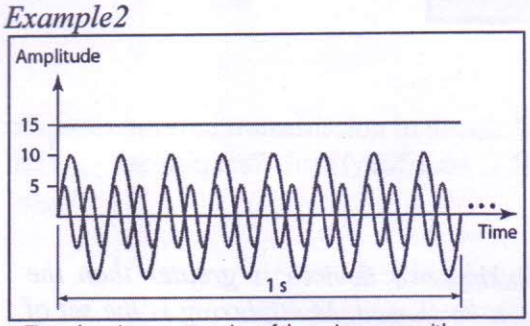
a. A sine wave in the time domain (peak value: 5 V, frequency: 6 Hz)



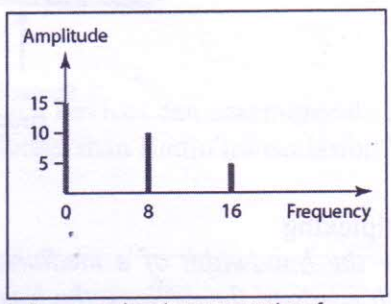
b. The same sine wave in the frequency domain (peak value: 5 V, frequency: 6 Hz)

..... *2M*

Example2



a. Time-domain representation of three sine waves with frequencies 0, 8, and 16



b. Frequency-domain representation of the same three signals

..... 2M

Q.2) a) Define fallowing terms with example. [6M]

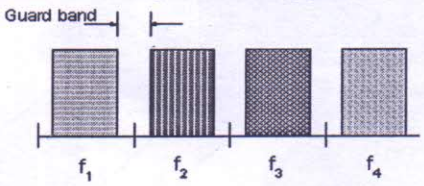
i. Band pass signal ii. Guard Band iii. Block coding iv. Parallel transmission

Ans.

*i. A **band pass signal-** is a **signal** which is having a **band** of frequencies ranging from some non zero value to another non zero value.*

Ex. radio , FM diagram

ii. *Guard Band* - A frequency Band which separate out other two frequency bands to avoid signal overlapping.



Ex.

iii. Block coding -Coding technique which divides whole data into fixed size blocks.

Ex. CRCdiagram or example

iv. Parallel transmission- transmission where each node involve in communication simultaneously. Ex. CDMA diagram or example

OR

b) Discuss the Functionality of fallowing in brief. [6M]

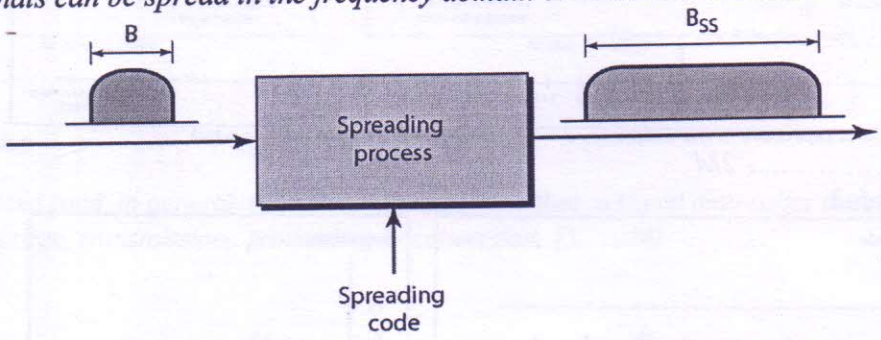
i) Spread spectrum, ii) Multiplexing iii) Modulation

i) Spread spectrum -

In spread spectrum (SS), we combine signals from different sources to fit into a larger bandwidth, but our goals are to prevent eavesdropping and jamming. To achieve these goals, spread spectrum techniques add redundancy.

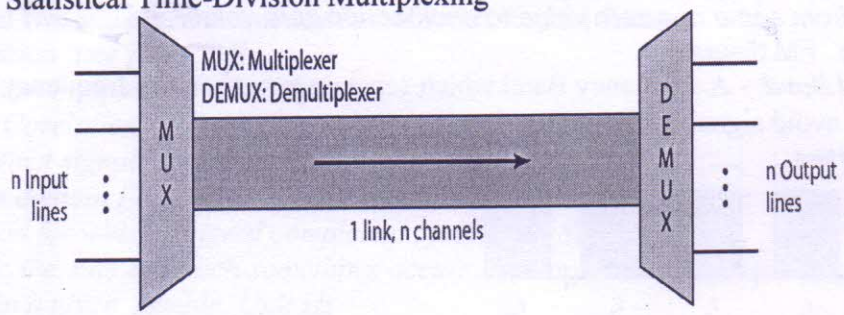
- *Types-Frequency Hopping Spread Spectrum (FHSS)*
- *Direct Sequence Spread Spectrum (DSSS)*

A signal that occupies a bandwidth of B, is spread out to occupy a bandwidth of B_{ss}
All signals are spread to occupy the same bandwidth B_{ss}
Signals are spread with different codes so that they can be separated at the receivers.
Signals can be spread in the frequency domain or in the time domain.



, ii) Multiplexing
Whenever the bandwidth of a medium linking two devices is greater than the bandwidth needs of the devices, the link can be shared. Multiplexing is the set of techniques that allows the (simultaneous) transmission of multiple signals across a single data link. As data and telecommunications use increases, so does traffic.
Types:

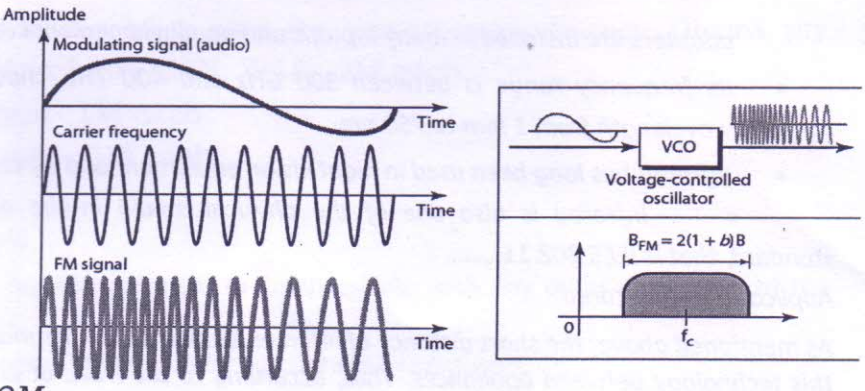
- Frequency-Division Multiplexing
- Wavelength-Division Multiplexing
- Synchronous Time-Division Multiplexing
- Statistical Time-Division Multiplexing



iii) Modulation
Modifying carrier signal according to information signal is called as modulation.
Types:
Depends on which parameter of information signal is considered.
Ex. Frequency modulation

- *The modulating signal changes the freq. f_c of the carrier sig according to amplitude of original information signal.*
- *The bandwidth for FM is high*
- *It is approx. 10x the signal frequency*
- *Brief about components used like Information source, Carrier oscillator, modulator and Process of modulation*

..... 2M

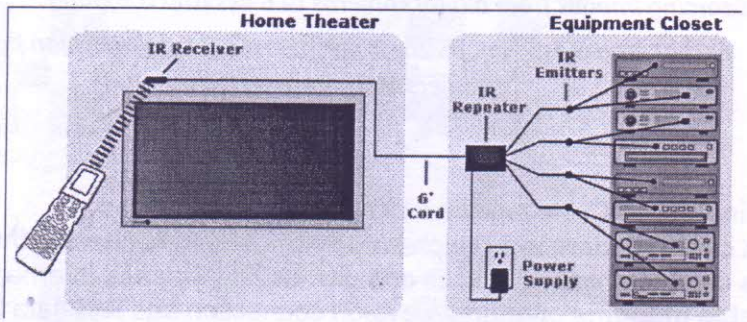


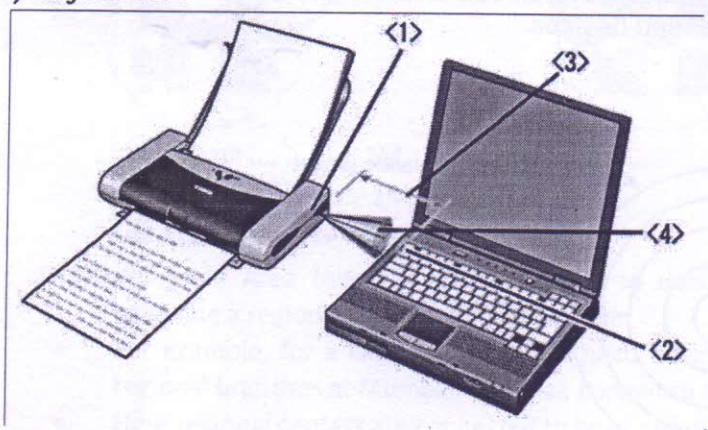
2M

Q.3) a) Explain Infrared transmission in detail. Which devices can communicate using this techniques? Justify infrared is different than Radio transmission? [6M]

Ans.

i) Infrared:





..... 2M

Computer Communication uses Infrared

technology allows computing devices to communicate via short-range wireless signals. With infrared, computers can transfer files and other digital data bidirectionally. The infrared transmission technology used in computers is similar to that used in consumer product (television and VCRs) remote control units.

- *Used for very short line of sight transmission, remote car locking systems, wireless security alarms.*
- ***Infrared** light is part of electromagnetic spectrum that is shorter than radio waves but longer than visible light. Computer infrared network adapters both transmit and receive data through ports on the rear or side of a device. Infrared*

adapters are installed in many laptops and handheld personal devices.

- *Its frequency range is between 300 GHz and 400 THz, that correspond to wavelength from 1 mm to 750 nm.*
- *Infrared has long been used in night vision equipment and TV remote control.*
- *Infrared is also one of the physical media in the original wireless standard, that is IEEE 802.11.....*

Applications of Infrared

As mentioned above, the short distance of interconnection drives the main application of this technology between appliances. Thus, according to the IrDA, at present, the main benefits and applications are :

- *Sending a document from your notebook computer to a printer.*
- *Co-ordinating schedules and telephone books between desktop and hand-held (notebook) computers.*
- *Sending faxes from a hand-held computer, via a public telephone, to a distant fax machine.*
- *Beaming images from digital cameras to a desktop computer.*
- *Exchanging messages, business cards, and other information between hand-held personal computers.....*

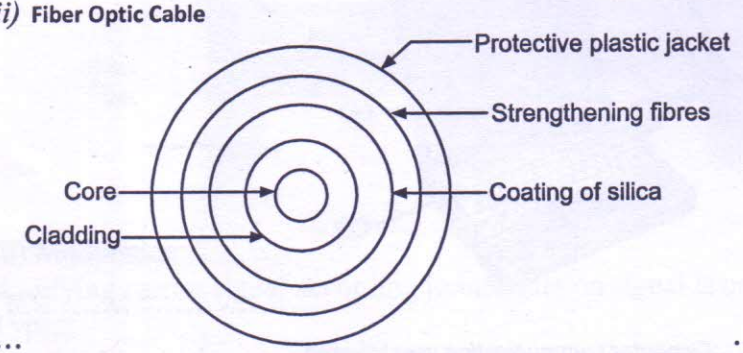
OR

b) Discuss in detail i) Cable modem ii) Fiber-Optic cable [6M]

Ans. i) A **cable modem** is a peripheral device used to connect to the Internet. It operates over coax **cable**TV lines and provides high-speed Internet access. Since **cable modems** offer an always-on connection and fast data transfer rates, they are considered broadband devices.

Diagram.....2M

ii) **Fiber Optic Cable**



... . 2 M

- Data transmission over optical fiber has greatly increased over the last few years, although fiber to the desktop has not really caught on as expected.
- However, fiber optic plays an important role in many networks.
- In addition, it has some outstanding advantages over copper cabling for certain applications.
- There are a number of network topologies and standards based on fiber optic, such as 10 BASE FL and FDDI, which apply mainly to the backbone cabling of very large facilities and campus environments.

Q.4) a) Classify Networks depending upon the inter-processor distance. Discuss any categories. [4M]

Ans:LAN, MAN, WAN- 2M each

Diagram- 1M each

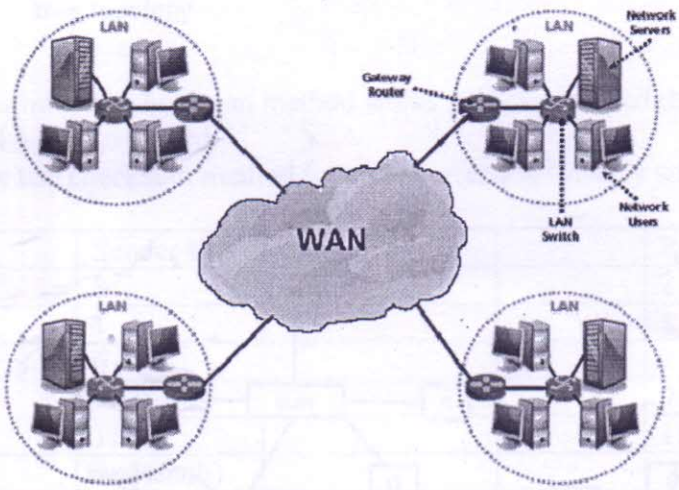
Example - 1M each

local area network:

Every computer has the potential to communicate with any other computers of the network.

- High degree of interconnection between computers.
- Easy physical connection of computers in a network.
- Inexpensive medium of data transmission.
- High data transmission rate.
- Components: Workstations, Servers, Clients, Nodes, Network Interface Ca connectors, Network Operating Sys

..... 1 M



LAN diagram..... 1M

WAN Diagram..... 1M

Wide Area Network:

The term Wide Area Network (WAN) is used to describe a computer network spanning a regional, national or global area.

- For example, for a large company the head quarters might be at Delhi and regional branches at Mumbai, Chennai, Bangaluru and Kolkata.
- Here regional centers are connected to head quarters through WAN.
- The distance between computers connected to WAN is larger. Therefore the transmission medium used are normally telephone lines, microwaves and satellite links.
- Components: Workstations, Servers, Clients, Nodes, Network Interface Ca connectors, Network Operating System
- characteristics of WAN.

1. Communication Facility
2. Remote Data Entry
3. Centralized Information..... 1M

A Metropolitan Area Network:

..... 1M

(MAN) is a bigger version of a Local Area Network (LAN) and usually uses similar technology.

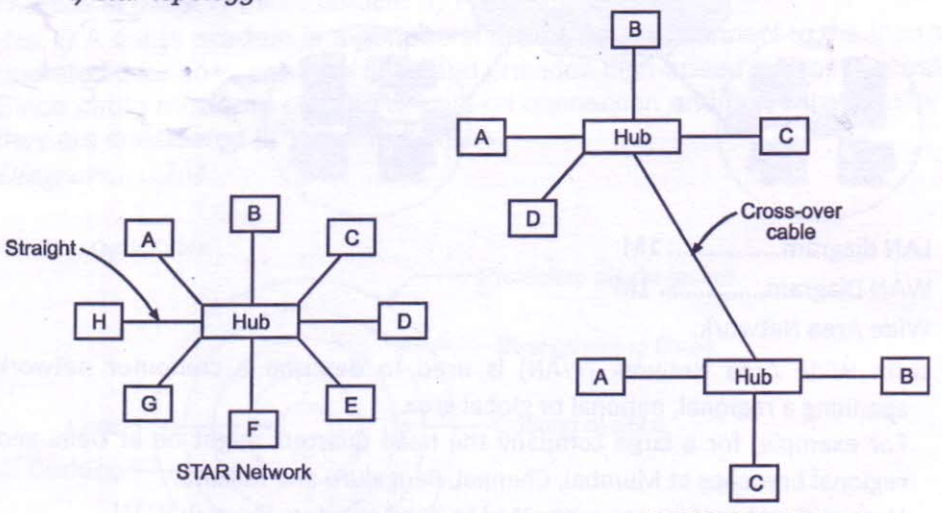
- A MAN can cover a group of corporate offices or a town or city, and can be either privately or publicly owned. A MAN can support both data and voice, and may be related to the local cable television network (CATV).
- A MAN employs one or two cables, and does not contain switching elements, which simplifies the design.
- A standard has been adopted for MANs called *Distributed Queue Dual Bus* (DQDB) and is defined by IEEE 802.6.

OR

b) List out the ways in which multiple nodes can be connected within same network. What is the criteria for choosing the best layout for any particular application. Represent any two layouts diagrammatically. [4M]

Ans.1. Bus topology
2. ring topology
3. Star topology
4. Hybrid topology

i) Star topology:



1M

Star networks are used in concentrated networks, where the end-points are directly reachable from a central location. When network expansion is expected and when the greater reliability is needed, Hub may be used.

Advantages :

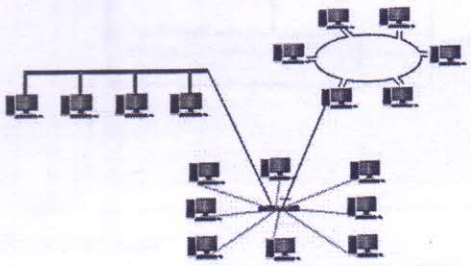
- It is very easy to modify and add new network without disturbing the rest of the network.
- Center of a star network is good place to diagnose network faults.
- Single computer failure do not bring down the whole network.
- With hub, you can use several cable types - UTP, STP, coaxial, fiber, etc.

Disadvantages :

- If central hub fails, the whole network fails to operate.

- Cost is more than bus network because network cables must be pulled to one central point. Thus cable requirement increases. .....

ii) Hybrid topology:



A hybrid topology is a type of network topologythat uses two or more differing network topologies. These topologies include a mix of bus topology, mesh topology, ring topology, star topology, and tree topology
tree topology

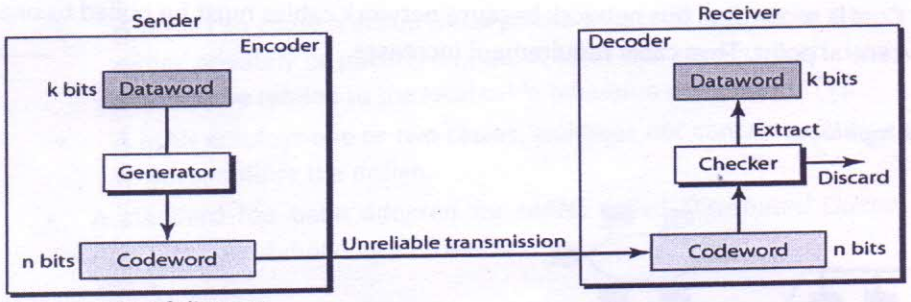
Q.5) a) Discuss how the checksum method works stepwise to send the data 8,1,6,9,11 using 4-bit binary word. [6M]
Can we use checksum method for error correction? Justify with example.

Ans.

	Sender side			Receiver side
	8			2
	1			1
	6			7
	9			9
	11			11
	0 (default)			10 (receivedsum)
sum	35		sum	45
100011	Binary sum		101101	Binary sum
0011 10 0101 1010 Dec 10	Wraped Bin 1's compliment		1101 10 1111 0000	Wrapped Bin One's compliment

b) How block coding schema works, explain with example. In the 4B/5B block coding schema, how many codewords are possible and assuming all possible combinations of datawords has been used, how many codewords will be correct and how many of them will be error pruned? [4M]

Ans: Block coding schema [3.....M]
In block coding, we divide our message into blocks, each of k bits, called datawords. We add r redundant bits to each block to make the length n = k + r. The resulting n-bit blocks are called codewords.



Explanation of diagram

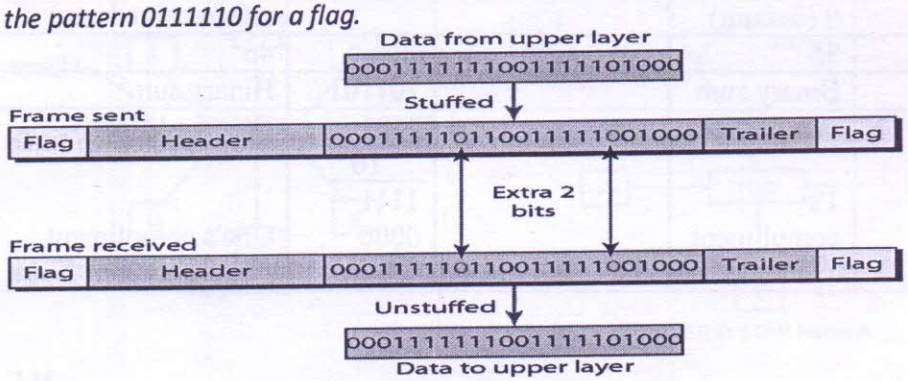
Fallowing Ans. [1.....M]
Total possible codewords : 2^5= 32
Correct codewords: 2^4= 16
Error pruned codewords: 32-16= 16

c) Brief about framing techniques. What is the role of Bit stuffing in framing, explain with example. [4M]

Ans. The data link layer needs to pack bits into frames, so that each frame is distinguishable from another. Our postal system practices a type of framing. The simple act of inserting a letter into an envelope separates one piece of information from another; the envelope serves as the delimiter.
Types: 1.Fixed-Size Framing
2. Variable-Size Framing

Byte stuffing is the process of adding 1 extra byte whenever there is a flag or escape character in the text.

Bit stuffing is the process of adding one extra 0 whenever five consecutive 1s follow a 0 in the data, so that the receiver does not mistake the pattern 0111110 for a flag.



OR

Q.6) a) List-out four error detection /correction techniques. State the truth of the statement and justify with two different example (different in length of the dataword) "To guarantee correction of up to t errors in all cases, the minimum Hamming distance in a block code must be $d_{min} = 2t + 1$." [6M]

Ans.1. Parity check
2. Hamming code
3. CRC
4. Checksum
Any hamming distance example with assumption of values for t and d_{min}.

b Explain any one flow control techniques for noiseless channel in brief with help [4M]

) of algorithm/ pseudo code.

Ans.

Simplest Protocol or Stop-and-Wait Protocol in brief [2.....M]

Simplest Protocol pseudo code:*Sender side [2....M]*

```
1  while(true)                          // Repeat forever
2  {
3    WaitForEvent();                    // Sleep until an event occurs
4    if(Event(RequestToSend))           //There is a packet to send
5    {
6       GetData();
7       MakeFrame();
8       SendFrame();                    //Send the frame
9    }
10 }
```

Receiver side:

```
1  while(true)                          // Repeat forever
2  {
3    WaitForEvent();                    // Sleep until an event occurs
4    if(Event(ArrivalNotification))     //Data frame arrived
5    {
6       ReceiveFrame();
7       ExtractData();
8       DeliverData();                  //Deliver data to network layer
9    }
10 }
```

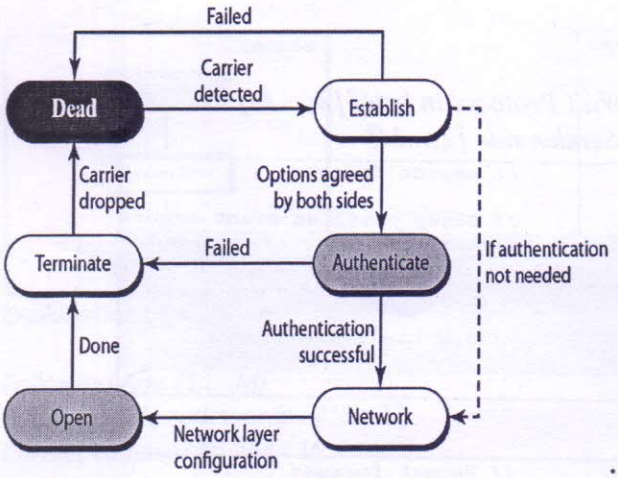
or Stop-and-Wait Protocol psudocode

```
1  while(true)                          //Repeat forever
2  canSend = true                       //Allow the first frame to go
3  {
4    WaitForEvent();                    // Sleep until an event occurs
5    if(Event(RequestToSend) AND canSend)
6    {
7       GetData();
8       MakeFrame();
9       SendFrame();                    //Send the data frame
10      canSend = false;                //Cannot send until ACK arrives
11   }
12   WaitForEvent();                    // Sleep until an event occurs
13   if(Event(ArrivalNotification)      // An ACK has arrived
14    {
15      ReceiveFrame();                 //Receive the ACK frame
16      canSend = true;
17    }
18 }
```

```
1  while(true)                          //Repeat forever
2  {
3    WaitForEvent();                    // Sleep until an event occurs
4    if(Event(ArrivalNotification))     //Data frame arrives
5    {
6       ReceiveFrame();
7       ExtractData();
8       Deliver(data);                  //Deliver data to network layer
9       SendFrame();                    //Send an ACK frame
10   }
11 }
```

c) Draw and explain state Transition phases of node willing to communicate. [4M]

Ans.



.... 2M

Explain diagram..... 2M

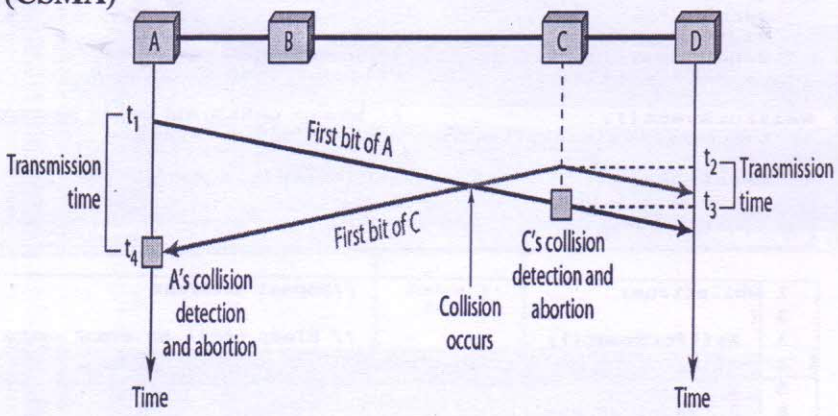
Q.7) a) Explain CSMA/CD methods in detail. How it is beneficial for multiple information source generator. Where it stands in state transition diagram of multiple node communication. [6M]

Ans.CSMA/CD:

- Simplified Algorithm
- When this **collision** condition is **detected,**

1. the station stops transmitting that frame,
2. station transmits a jam signal

- and then waits for a random time interval before trying to resend the frame(back-off time)
- **CSMA/CD** is a modification of pure carrier sense multiple access **(CSMA)**



b) Differentiate between token passing and reservation method. [4M]

Ans.

1. Reservation
Communication Channel is divided into uniform slots
Equal slots are allocated to each participated node
Every node is peer node
Channel slots are already reserved for each node.

3. Token passing
Token is like a pass for accessing channel
Every active node request for channel
If channel is free then token moves, node which get the token

will access the channel and then taken becomes busy. After done with data transmission, it makes the token free to move in channel.
Again same cycle continue.

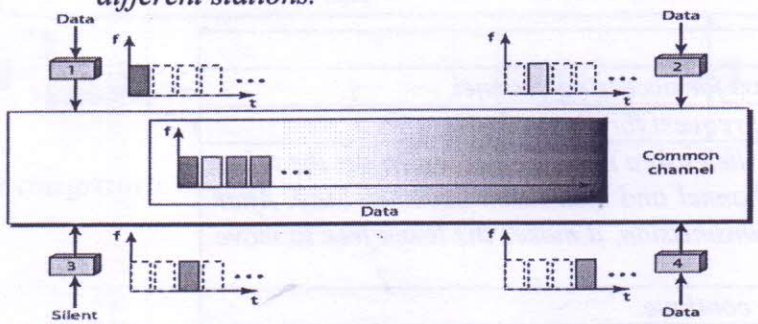
c) Which channelization methods are applicable for digital data. Discuss any one method out of it in detail with the help of diagram. [4M]

Ans.

For digital data:

1. *Time-Division Multiple Access (TDMA)*
2. *Code-Division Multiple Access (CDMA)*

- *In TDMA, the bandwidth is just one channel that is timeshared between different stations.*



Explain diagram.

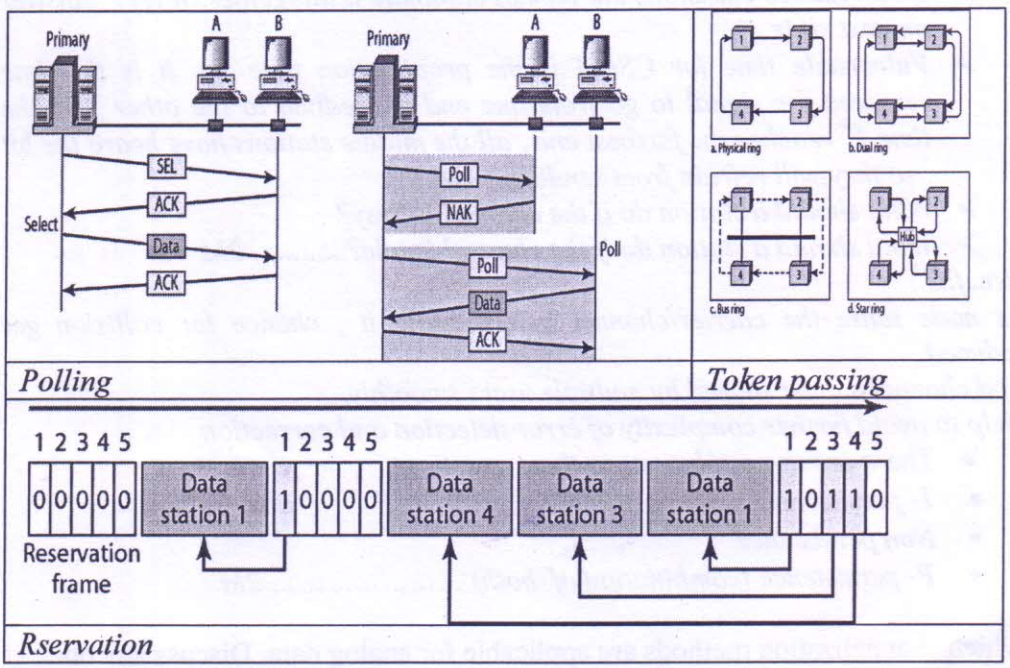
OR

Q.8) a) On what basis multiple access methods has been categorized broadly. Which category is more efficient, justify your answer. [6M]

Ans. On the basis of ways how channel is shared by multiple nodes, it is categorized further.

Any answer with justification acceptable.

Ex. Controlled multiple access methods. It has controlled mechanism so that no deadlock will occure.



1. Reservation
Communication Channel is divided into uniform slots
Equal slots are allocated to each participated node
Every node is peer node
Channel slots are already reserved for each node.

2. Polling
No need to divide channel
At a time only one node get a chance to use channel
Primary node decides channel is to be allocated to one node out of all participated nodes.
Channel allocation is done runtime.

3. Token passing
Token is like a pass for accessing channel
Every active node request for channel
If channel is free then token moves, node which get the token will access the channel and then taken becomes busy. After done with data transmission, it makes the token free to move in channel.
Again same cycle continue.

b) What is mean by carrier sense mechanism? How it is beneficial in channel access [4M]

Ans.

- *CSMA: It improves the efficiency further , by minimizing the chance of collision.*
- *In this the stations sense the medium (Carrier Sense) before sending data on it. i.e. listen before talk or Sense before transmit*
- *It can reduce collisions but cannot eliminate it altogether. WHY? Answer on next slide*
- *Vulnerable time for CSMA is the propagation time Tp. It is the time required for signal to go from one end of medium to the other . By the time 1st reaches the farthest end , all the middle stations have heard the bit , so they will refrain from sending.*
- *What should a station do if the channel is busy?*
- *What should a station do if the channel is idle?..... 2M*

Benefits :

As node sense the carrier/channel before using it , chance for collision get reduced.

And channel can be shared by multiple users smoothly.

Help to avoid further complexity of error detection and correction

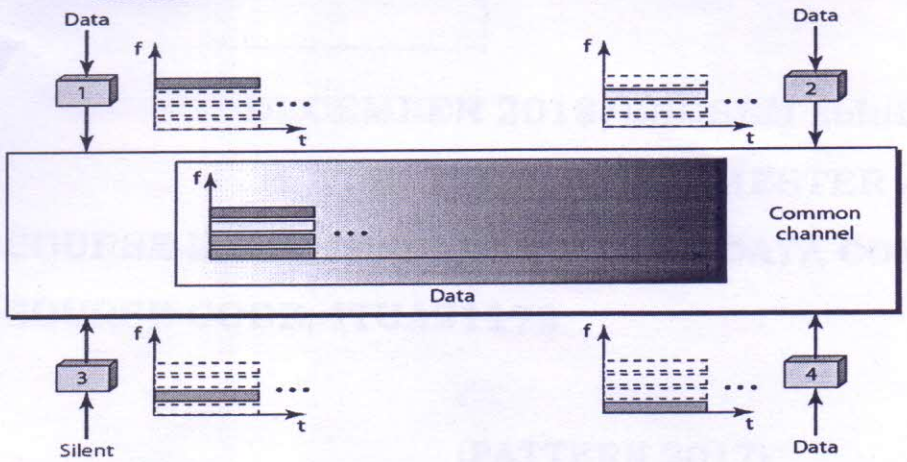
- *There are three solutions to these questions:*
  - *1- persistence*
  - *Non persistence*
  - *P- persistence (combination of both) 2M*

c) Which channelization methods are applicable for analog data. Discuss any one method out of it in detail with the help of diagram. [4M]

Ans.

FDMA

- In FDMA, the available bandwidth of the common *channel is divided into bands that are separated by guard bands.*



Explain diagram