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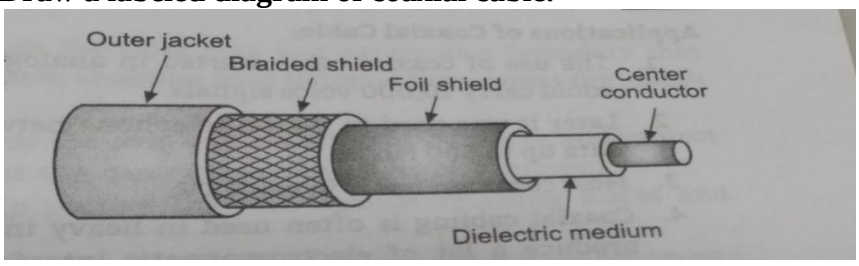
WINTER – 2018 EXAMINATION
MODEL ANSWER

Subject: Data Communication **Subject Code:** 22322

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q.N.	Answer	Marking Scheme
1.	**a) Ans.**	**Attempt any five of the following:** **Enlist four standard organizations.** **List of standard organizations:** 1) American National Standards Institute(ANSI) 2) Electronic Industries Association(EIA) 3) International Telecommunications Union-Telecommunications Standards Sector(ITU-T) 4) Institute of Electrical and Electronics Engineers(IEEE) 5) International Standards Organization(ISO)	**10** **2M** ***Any four 2M***
	b) Ans.	**Draw a labeled diagram of coaxial cable.**  **Diagram of coaxial cable**	**2M** ***Labeled Diagram 2M***

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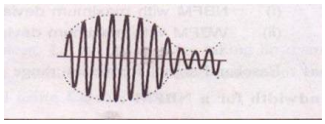
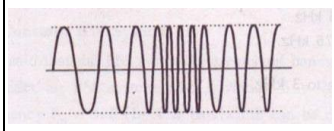
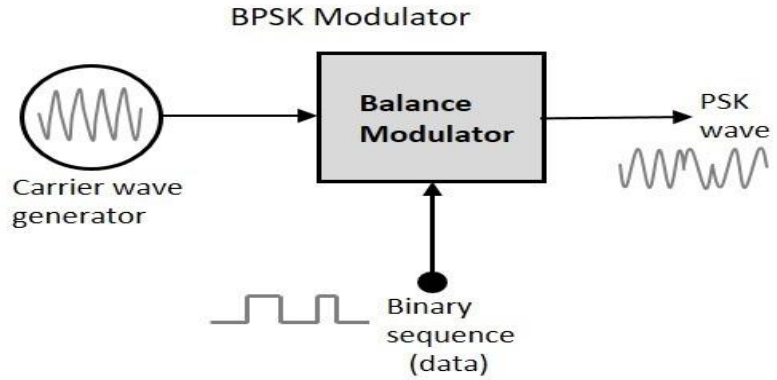
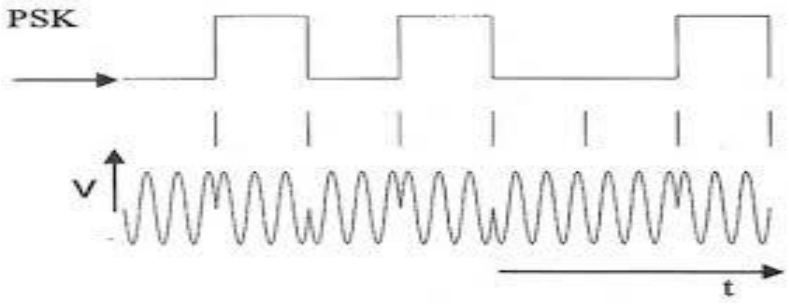
	c) Ans.	**Define line of sight propagation.** **Definition line of sight propagation:** Line of sight propagation is a characteristic of electromagnetic radiation or acoustic wave propagation which means waves travel in a direct path from the source to the receiver. Electromagnetic transmission includes light emissions travelling in a straight line. The rays or waves may be diffracted, refracted, reflected or absorbed by atmosphere and obstructions with material and generally cannot travel over the horizon or behind obstacles.	**2M** ***Correct definition 2M***
	d) Ans.	**State advantages of multiplexing.** **Advantages of multiplexing:** 1.Simple and easy 2.Large capacities and scalable. 3.Signals from different sources can be sent together through a single common channel. 4.Signals may have varying speed.	**2M** ***Any two advantages 1M each***
	e) Ans.	**State advantages of packet switching.** **Advantages of packet switching:** 1.Line efficiency is high since the link can be dynamically shared. 2.Stations can perform data rate conversions. 3.Packets can be stored and forwarded. 4.It has ability to prioritize the packets.	**2M** ***Any two advantages 1M each***
	f) Ans.	**State any two drawbacks of parity checking for error detection.** **Drawbacks of parity checking for error detection:** 1. Can be used to detect single bit errors 2.Cannot detect location of errors. 3.Overheads are more.	**2M** ***Any two drawbacks 1M each***
	g) Ans.	**Enlist generations of mobile telephone system.** **Generations of mobile telephone system:** • First Generation • Second Generation:2.5G, 2.75G • Third Generation:3.5, 3.75G • Fourth Generation • Fifth Generation	**2M** ***Generations 2M***
2.	**a) Ans.**	**Attempt any three of the following:** **Compare amplitude modulation and frequency modulation (4 points).**	**12** **4M**

		<table><tr><th>Parameter</th><th>Amplitude modulation (AM)</th><th>Frequency modulation (FM)</th></tr><tr><td>Definition</td><td>Amplitude modulation (AM) is the process of changing the amplitude of a high frequency carrier signal in proportion with the instantaneous value of the modulating signal keeping frequency &Phase constant.</td><td>Frequency modulation (FM) is the process of changing the frequency of carrier signal in proportion with the instantaneous value of the modulating signal keeping Amplitude &Phase constant.</td></tr><tr><td>Waveform</td><td>AM wave:  </td><td>FM wave:  </td></tr><tr><td>Bandwidth</td><td>BW= $2f_m$(f_m -frequency of modulating signal)</td><td>Bandwidth =2 [$\delta + f_m$] (f_m - frequency of modulating signal)</td></tr><tr><td>Noise immunity</td><td>Less</td><td>More</td></tr><tr><td>Modulation index</td><td>$m_a = \frac{V_m}{V_c}$ V_m - Amplitude of modulating signal V_c- Amplitude of carrier signal</td><td>$m_f = \frac{\delta}{f_m}$ δ – frequency deviation f_m - frequency of modulating signal</td></tr><tr><td>Frequencies used for transmission</td><td>535 – 1700 KHz</td><td>88.1 – 108.1 MHz</td></tr></table>	***Any four points 1M each***
	b) Ans.	**Explain process of phase shift keying.** Phase-shift keying (PSK) is a digital to analog modulation scheme based on changing, or modulating, the initial phase of a carrier	**4M**

		signal. PSK is used to represent digital information, such as binary digits zero (0) and one (1).The modulation of PSK is done using a balance modulator, which multiplies the two signals applied at the input. For a zero binary input, the phase will be 180° and for a high input, the phase reversal is of 0°. Following is the diagrammatic representation of PSK Modulated output wave along with its given input.   The output sine wave of the modulator will be the direct input carrier or the inverted (180° phase shifted) input carrier, which is a function of the data signal. Amplitude and frequency of the original carrier signal is kept constant.	***Explanation 2M*** ***Diagram 2M***
	c) **Ans.**	**Draw a labeled diagram of fiber optic cable and state its advantages.** ***(Note: Any other relevant diagram can also be considered)***	**4M**

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		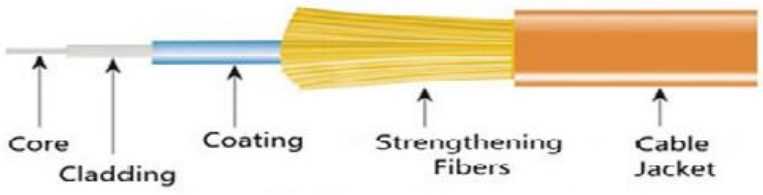 **Advantages of fiber optic cable:** 1.Higher data rate 2.Large Bandwidth 3.Less signal attenuation 4.Light weight. 5.More reliability 6.Long distance. 7.Higher security.	***Diagram 2M*** ***Any 2 Advantages 1M each***
	d) Ans.	**Differentiate between circuit switching and packet switching.** **Circuit switching** | **Packet switching** 1.Dedicated transmission path | 1.No dedicated path 2.Continuous transmission of data. | 2.Transmission of packets. 3.Messages are not stored. | 3.Packets may be stored until delivered. 4.Fixed bandwidth | 4.Dynamic bandwidth 5.After call setup, no overhead bits. | 5.Overhead bits in each packet.	**4M** ***Any four points 1M each***
3.	**a) Ans.**	**Attempt any three of the following:** **Draw a BFSK waveform to represent the following bit stream 0 1 1 0 1 0.**	**12** **4M**

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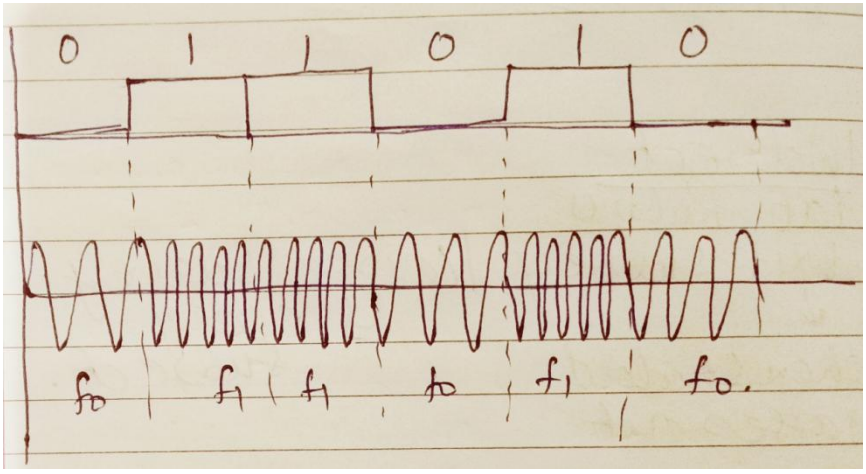
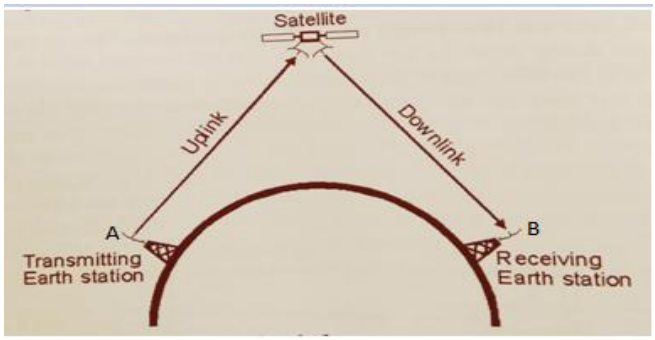
			***4M for proper waveform***
	b) **Ans.**	**Draw and explain block diagram of satellite communication.** ***(Note: Any other relevant block diagram may also be considered).*** Satellites are the bodies that revolve around the earth just in same way moon revolves around the earth. Satellite communication is similar to terrestrial microwave communication except that satellite acts as one of the station. Satellite performs the functions of an antenna and the repeater together. Ground station A sends information to ground station B via the satellite.  Two frequency bands are used for signals from earth to satellite (uplink) and from satellite to earth (downlink). Satellite takes uplink signal coming from sender, processes it and converts to downlink frequency and transmit it towards earth. The coverage area over which the signal of satellite is available is called as footprint of satellite.	**4M** ***Diagram 2M*** ***Explanation 2M***

c) Ans. **Compare DSSS with FHSS.** **4M**

Compare	DSSS	FHSS
Definition	PN sequence of large bandwidth is multiplied with narrow band data signal.	Data bits are transmitted in different frequency slots which are changed by PN sequence.
Modulation method	M-ary FSK	BPSK
Acquisition time	Short	Long
Effect of distance	More	Less

1M for each point

d) Ans. **Explain the process of CRC with respect to following example. If G (X) = 110010 and M (X) = 101 then calculate CRC for above stream.** **4M**

Procedure:- data bits= G(X)=110010 divisor=M(X)=101

Here divisor is 3 bits so we need to append 2 zeroes (2 bit) to the data bits for division.

Division carried is the normal binary division.

Result is calculated by the following condition:

1. If the remainder after division process is zero , it indicates that the data bits has no errors and the data bit is acceptable
2. If the remainder after division is non-zero , it indicates that the data bits has errors and we have to append the remainder bits to the original data bits and then send the data again. This remainder bits are called as the CRC. So the data bits transmitted will be DATA + CRC

DATA BITS	CRC

Consider the given example, lets perform division process for CRC. Here the divisor is 3 bits hence we append 2 zeroes to the data bits, so the data bits will be 11001000 this will be divided by 101

Stepwise procedure 2M

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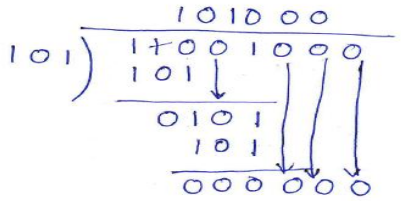
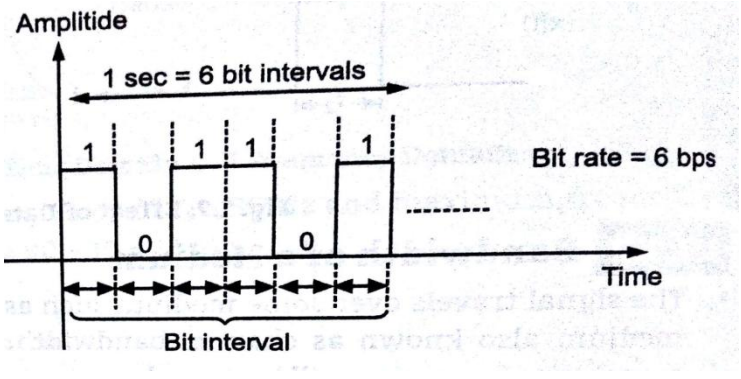
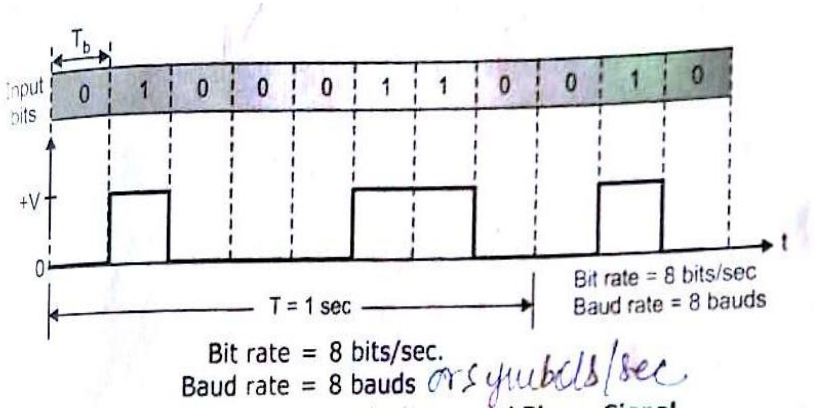
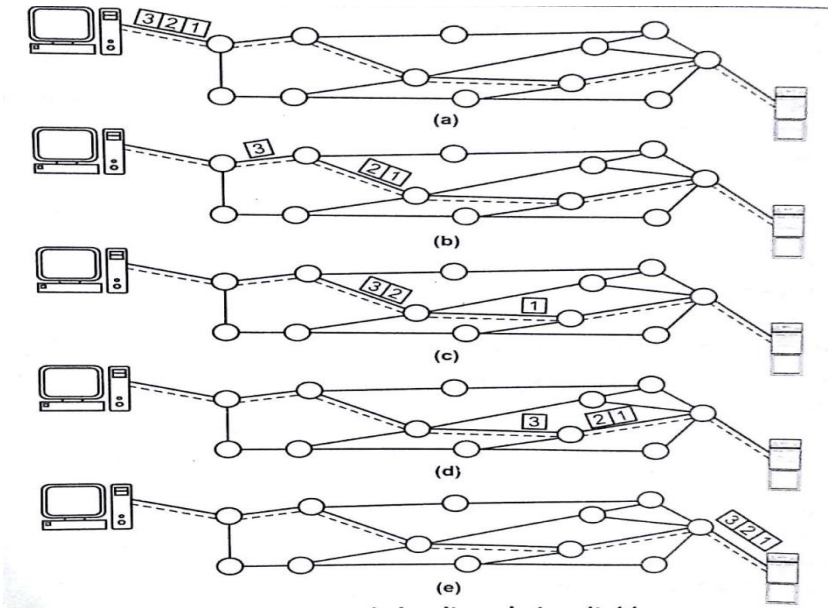
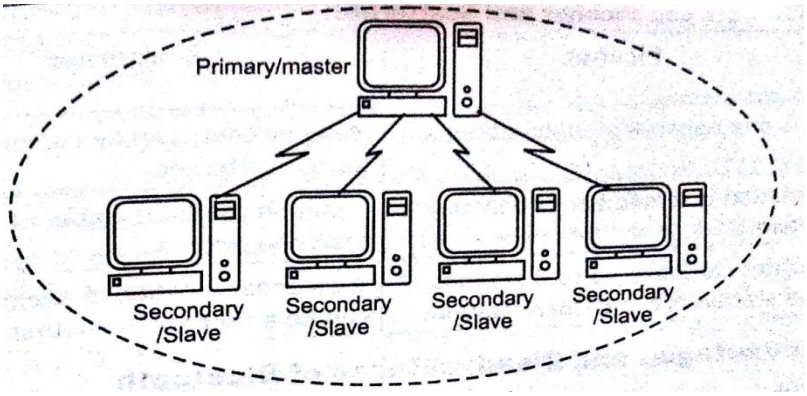
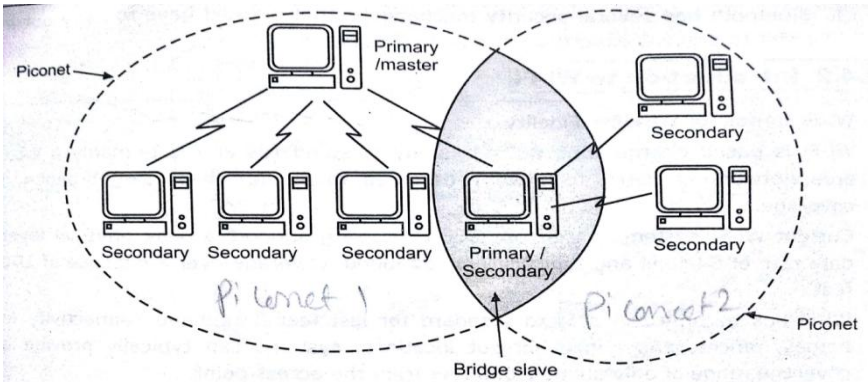
		 Reminder is 00 = CRC ∴ Data + CRC = 11 0010 + 00 = 1100 1000 Since remainder is 0 there is no error in the data.	***CRC 2M***
4.	**a)** **Ans.**	**Attempt any three of the following:** **Explain the following concept with neat diagram:** **i) Bit Rate ii) Baud Rate** **i) Bit Rate:** Bit rate is the number of bits transmitted in one second. It is represented as bits per second(bps).  **Bit Rate** **ii) Baud Rate:** Baud rate is defined as the number of signal units per second. It is always less than or equal to bit rate. It is represented as bauds or symbols/second.	**12** **4M** ***Definition of each term 1M*** ***Waveform of each term 1M***

		 **Baud Rate**	
	b) **Ans.**	**"In satellite communication different frequency bands are used for uplink and downlink". Explain.** Uplink frequency is used for transmission of signals from earth station transmitter to satellite. Downlink frequency is used for transmission of signals from satellite to earth station receiver. Both the frequencies are different because: 1. The satellite transmitter generates a signal that would jam its own receiver if both uplink and downlink shared same frequency. 2. Trying to receive and transmit an amplified version of the same uplink waveform at same satellite will cause unwanted feedback or ring around from downlink antenna back to the receiver. 3. Frequency band separation allows the same antenna to be used for both receiving and transmitting simplifying satellite hardware.	**4M** ***Definition of uplink and downlink 1M and any three reasons why to use the frequency 3M***
	c) **Ans.**	**Explain virtual circuit approach of switching used in computer networks.** In virtual circuit approach a logical connection is established between sending and receiving devices called virtual circuits. This connection remains the same and is retained unless and until the complete communication takes place. During the entire communication, data is transmitted through the same connection and once the communication is finished the logical connection is dissolved or terminated or disconnected. It is then ready for creating 3 2 1 new	**4M** ***Explanation 2M***

		connection for communication of some different nodes. In this type of approach packets are forwarded more quickly. *E.g.*consider a network in which sender wants to sendthe data .this can be diagramatically represented as follows:  **Virtual circuit approach**	***Diagrammatic representation of flow of packets 2M***
	d) **Ans.**	**Assuming even parity technique find the parity bit for following frames:** **i) 0000010** **ii) 1111000** **iii) 1010101** **iv) 1011011** **Sr. No** | **Data** | **Parity bit** 1 | 0000010 | 1 2 | 1111000 | 0 3 | 1010101 | 0 4 | 1011011 | 1	**4M** ***Each correct parity bit 1M***

	e) **Ans.**	**Explain the concept of pico net and scatter net of Bluetooth.** **Piconet:-** It is a Bluetooth network that consists of one primary (master) node and seven active secondary (slave)nodes. It can have 8 active nodes within the distance of 10 meter. Communication between primary and secondary can be one-to-one or one-to-many. All communication is between master and slave. There can be only one primary or master station in each piconet.  **PICONET** **Scatternet**:- Scatternet is formed by combining various piconets. Slave in one piconet acts as a master or primary in other piconet. A node can receive messages from master in first piconet and deliver the messages to its slave I other piconet where it is acting as master. This node is called bridge slave. This node cannot be the master of two piconets.  **Scatternet**	**4M** ***Piconet explanation with diagram 2M*** ***Scatternet explanation with diagram 2M***

5. **a)** **Attempt any two of the following:** **12**
Differentiate between twisted pair coaxial cable and fiber optic cable (any 4 points). **6M**

Ans.

Sr. No.	Twisted pair cable	Coaxial cable	Fiber optic cable
1	Transmission of signals of takes place in the electrical form over the metallic conducting wires.	Transmission of signals takes place in the electrical form over the inner conductor of the cable.	Signal transmission takes place in an optical form over a glass fiber.
2	In this medium the noise immunity is low.	Coaxial having higher noise immunity than twisted pair cable.	Optical fiber has highest noise immunity as the light rays are unaffected by the electrical noise.
3	Twisted pair cable can be affected due to external magnetic field.	Coaxial cable is less affected due to external magnetic field.	Not affected by the external magnetic field.
4	Cheapest medium	Moderate Expensive	Expensive
5	Low Bandwidth	Moderately high bandwidth	Very high bandwidth
6	Attenuation is very high	Attenuation is low	Attenuation is very low
7	Installation is easy	Installation is fairly easy	Installation is difficult

Any four points - $1^{1/2}$M for each point

b) **Explain the following flow and error control techniques:** **6M**
i) Stop and wait
ii) Go back N ARQ.

Ans.

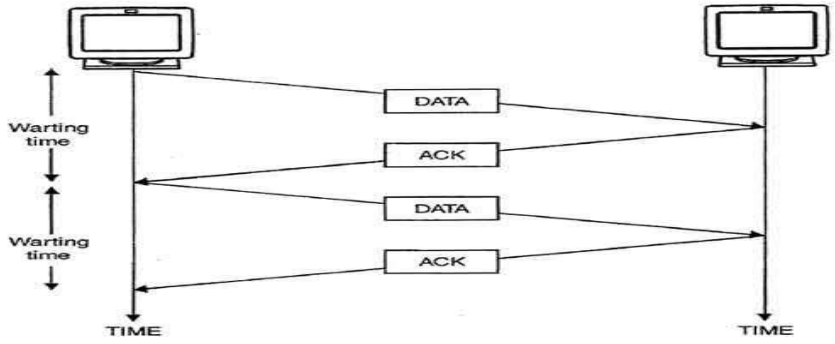
i) Stop and wait:

In this method of flow control, the sender sends a single frame to receiver & waits for an acknowledgment.

• The next frame is sent by sender only when acknowledgment of previous frame is received.

• This process of sending a frame & waiting for an acknowledgment continues as long as the sender has data to send.

• To end up the transmission sender transmits end of transmission (EOT) frame



Stop & Wait Method.

Each Technique with diagram 3M

ii) Go-Back-N ARQ:

In Go-Back-N ARQ method, both sender and receiver maintain a window.

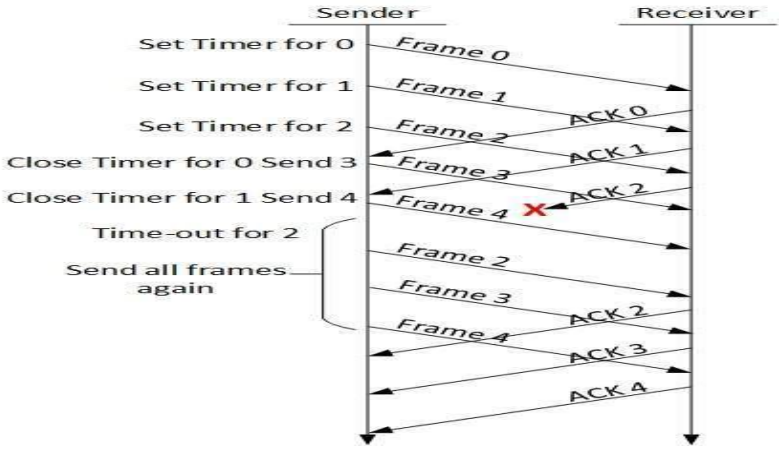


Fig: Go-Back-N ARQ

- The sending-window size enables the sender to send multiple frames without receiving the acknowledgement of the previous ones.
- The receiving-window enables the receiver to receive multiple frames and acknowledge them. The receiver keeps track of incoming frame's sequence number.
- When the sender sends all the frames in window, it checks up to what sequence number it has received positive acknowledgement.
- If all frames are positively acknowledged, the sender sends next set of frames.
- If sender finds that it has received NACK (negative acknowledgement)or has not receive any ACK for a particular frame, it retransmits all the frames after which it does not receive any positive ACK.

c) Ans. **Compare first, second, third and fourth generation mobile telephone systems (any 3 points).** **6M**

Technology	**1G**	**2G/2.5G**	**3G**	**4G**
Bandwidth	2Kbps	14-64kbps	2Mbps	200Mbps
Technology	Analog cellular	Digital cellular	Broadband width/CDMA/IP Technology	Unified IP and seamless combo of LAN/WAN/WLAN
Service	Mobile telephony	Digital voice, Short messaging	Integrated high quality audio, video and data	Dynamic information access, variable devices.
Multiplexing	FDMA	TDMA/CDMA	CDMA	CDMA
Switching	Circuit	Circuit/circuit for access network and air	Packet except for air interface	All packet

Any three points- 2M for each point

				interface		
		Core Network	PSTN	PSTN	Packet network	Internet

6.	**a)**	**Attempt any two of the following:** **Explain the following multiplexing techniques with block diagram:** **i) TDM ii) FDM**	**12** **6M**
	Ans.	**i) TDM (Time Division Multiplexing):** 1.TDM is the digital multiplexing technique. 2. In TDM, the channel/link is divided on the basis of on the basis of time. 3. Total time available in the channel is divided between several users. 4. Each user is allotted a particular time interval called time slot or time slice during which the data is transmitted by that user. 5. Thus each sending device takes control of entire bandwidth of the channel for fixed amount of time. 6. In TDM the data rate capacity of the transmission medium should be greater than the data rate required by sending or receiving devices. 7. In TDM all the signals to be transmitted are not transmitted simultaneously. Instead, they are transmitted one-by-one. 8. Thus each signal will be transmitted for a very short time. One cycle or frame is said to be complete when all the signals are transmitted once on the transmission channel. 9. The TDM system can be used to multiplex analog or digital signals, however it is more suitable for the digital signal multiplexing. 10. The TDM signal in the form of frames is transmitted on the common communication medium.	***Each technique with diagram 3M***

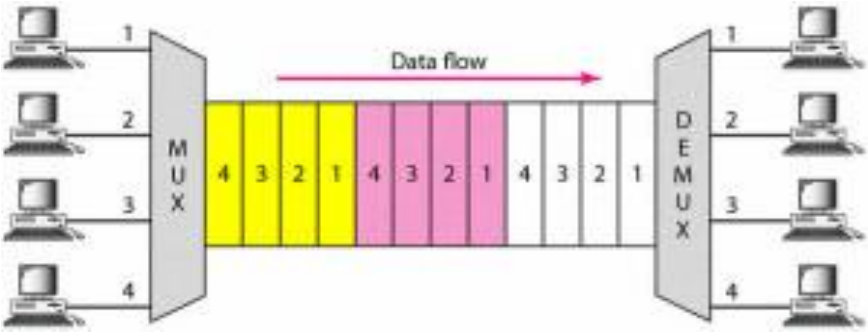


Fig. Time Division Multiplexing

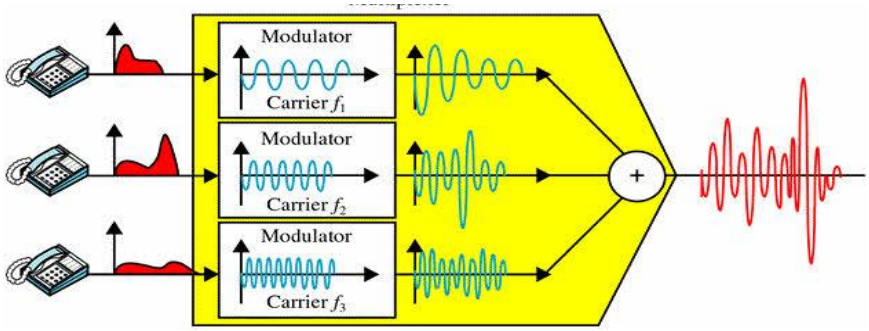
ii) FDM(Frequency-Division Multiplexing):

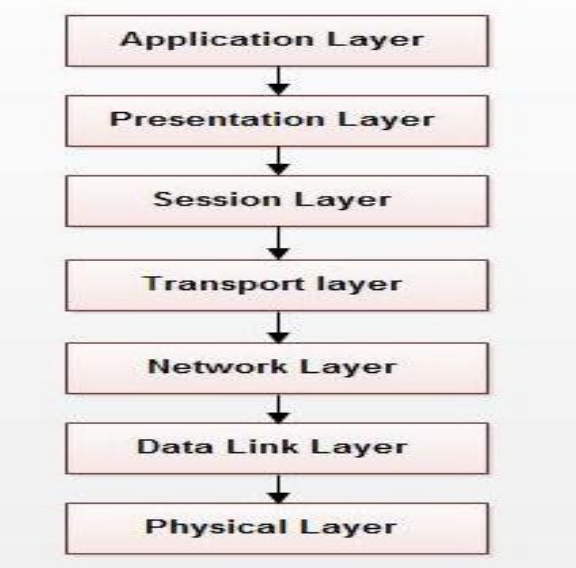
1.FDM is a scheme in which numerous signals are combined for transmission on a single communications line or channel.

2**.** It is analog multiplexing technique. Each signal is assigned a different frequency (sub channel) within the main channel. It requires channel synchronization.

3.FDM requires that the bandwidth of a link should be greater than the combined bandwidths of the various signals to be transmitted. Thus each signal having different frequency forms a particular logical channel on the link and follows this channel only. These channels are then separated by the strips of unused bandwidth called guard bands. These guard bands prevent the signals from overlapping as shown in Fig.

4.In FDM, signals to be transmitted must be analog signals**.** Thus digital signals need to be converted to analog form, if they are to use FDM.



	b)	**Explain the layered architecture of ISO-OSI model along with functions of each layer.**	**6M**
	Ans.	**Layered Architecture of ISO-OSI Model:** 1.The basic idea of a layered architecture is to divide the ISO-OSI model into small pieces. Each layer adds to the services provided by the lower layers in such a manner that the highest layer is provided a full set of services to manage communications and run the applications. 2. A basic principle is to ensure independence of layers by defining services provided by each layer to the next higher layer without defining how the services are to be performed. 3.In an n-layer architecture, layer n on one machine carries on conversation with the layer n on other machine. The rules and conventions used in this conversation are collectively known as the layer-n protocol.  **7 Layers of OSI reference Model** ISO-OSI model has 7 layered architecture. Functions of each layer are given below **Layer1 :Physical Layer** • It activates, maintains and deactivates the physical connection.	***Description of layered architecture 2M***

		• It is responsible for transmission and reception of the unstructured raw data over network. • Voltages and data rates needed for transmission is defined in the physical layer. • It converts the digital/analog bits into electrical signal or optical signals. • Data encoding is also done in this layer. **Layer2: Data Link Layer** 1. Data link layer synchronizes the information which is to be transmitted over the physical layer. 2. The main function of this layer is to make sure data transfer is error free from one node to another, over the physical layer. 3. Transmitting and receiving data frames sequentially is managed by this layer. 4. This layer sends and expects acknowledgements for frames received and sent respectively. Resending of non-acknowledgement received frames is also handled by this layer. **Layer3:The Network Layer** 1. Network Layer routes the signal through different channels from one node to other. 2. It acts as a network controller. It manages the Subnet traffic. 3. It decides by which route data should take. 4. It divides the outgoing messages into packets and assembles the incoming packets into messages for higher levels. **Layer 4: Transport Layer** 1. Transport Layer decides if data transmission should be on parallel path or single path. 2. Functions such as Multiplexing, Segmenting or Splitting on the data are done by this layer 3. It receives messages from the Session layer above it, convert the message into smaller units and passes it on to the Network layer. 4. Transport layer can be very complex, depending upon the network requirements. Transport layer breaks the message (data) into small units so that they are handled more efficiently by the network layer.	***Any one function of all the layers 4M***

		Layer 5: The Session Layer 1. Session Layer manages and synchronize the conversation between two different applications. 2. Transfer of data from source to destination session layer streams of data are marked and are resynchronized properly, so that the ends of the messages are not cut prematurely and data loss is avoided. **Layer 6: The Presentation Layer** 1. Presentation Layer takes care that the data is sent in such a way that the receiver will understand the information (data) and will be able to use the data. 2. While receiving the data, presentation layer transforms the data to be ready for the application layer. 3. Languages(syntax) can be different of the two communicating systems. Under this condition presentation layer plays a role of translator. 4. It performs Data compression, Data encryption, Data conversion etc. **Layer 7: Application Layer** 1. Application Layer is the topmost layer. 2. Transferring of files disturbing the results to the user is also done in this layer. Mail services, directory services, network resource etc are services provided by application layer. 3. This layer mainly holds application programs to act upon the received and to be sent data.	
	c) **Ans.**	**Two channels one with a bit rate of 100 Kbps and another with bit rate of 200 Kbps are to be multiplexed.** **Answer the following questions:** **i) Calculate size of frames in bits** **ii) Calculate the frame rate** **iii) Calculate the duration of frame** Channel 1 has a bit rate of 100Kbps. Channel 2 has a bit rate of 200Kbps Hence channel 2 is demultiplexed into 2 channels of 100Kbps each. Hence 3 channels of 100 Kbps are multiplexed effectively. Let us consider that one slot of the channel 1 is allocated and two	**6M**

		slots of the channel 2 is allocated in the frame . **i) Calculate size of frames in bits:** Thus **e**ach frame carries 3 bits. **ii) Calculate the frame rate:** The total bit rate of the multiplexed link is 300kbps. Each frame has 3 bits. The frame rate is100,000 frames per second (Any other assumption may also be considered). **iii) Calculate the duration of frame:** Thus the frame duration is 1/100,000s or 10μs.	***Each bit 2M***