_____

WINTER – 2022 EXAMINATION

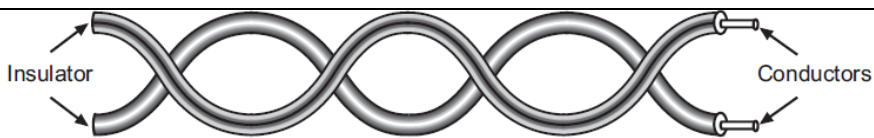**Subject Name: Data Communication**   **Model Answer**   **Subject Code:** | 22322
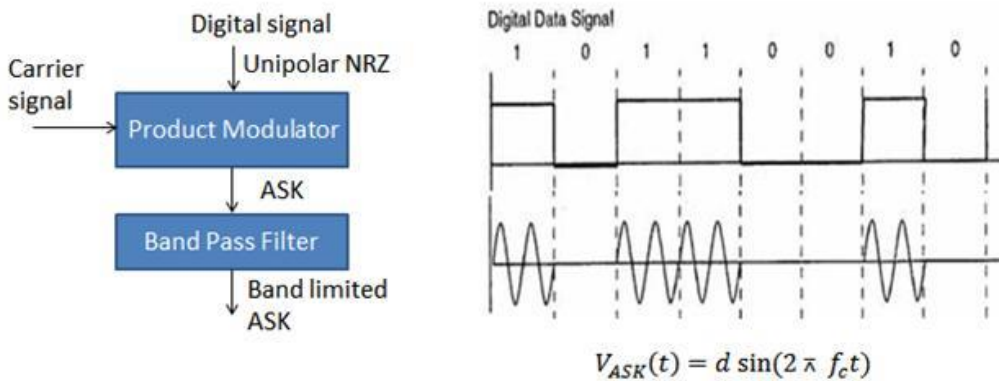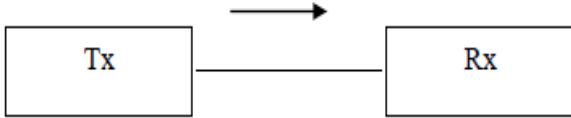
Important Instructions to examiners:

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.
8) As per the policy decision of Maharashtra State Government, teaching in English/Marathi and Bilingual (English + Marathi) medium is introduced at first year of AICTE diploma Programme from academic year 2021-2022. Hence if the students in first year (first and second semesters) write answers in Marathi or bilingual language (English +Marathi), the Examiner shall consider the same and assess the answer based on matching of concepts with model answer.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Attempt any <u>FIVE</u> of the following:**	**10 M**
	a)	**Define Protocol.**	**2 M**
	Ans	A protocol is defined as "a set of rules that governs the communication between computers on a network".	2 M for correct definition
	b)	**Draw a labelled diagram of twisted pair cable.**	**2 M**
	Ans	**Fig.: Twisted Pair (TP) Cable**	2 M for correct diagram
	c)	**Define Infrared Communication.**	**2 M**
	Ans	Electromagnetic waves having frequencies from 300 GHz to 400 THz are called IR waves or Infrared waves. Infrared communication (IR) is a wireless mobile technology used for device communication over short ranges. It use line-of-sight propagation. Unguided infrared and millimeter waves are widely used for short-range	2 M for correct definition

		communication.	
d)		**State advantages of spread spectrum.**	**2 M**
	Ans	**Advantages:** 1.Low power density 2.Redundancy 3.Anti-jamming 4.Anti-interferance 5.Low probability of intercept 6.message privacy 7.High resolution raging and timing	Any 4 correct Advantages ½ M each
e)		**State advantages of frequency-division multiplexing.**	**2 M**
	Ans	Advantages of FDM: 1. A large number of signal (channel) can be transmitted simultaneously. 2. FDM does not need synchronization between its transmitter and receiver for proper operation. 3. DDemodulation of FDM is easy. 4.Due to slow narrow band fading only a single channel gets affected.	Any 4 correct Advantages ½ M each
f)		**Define single bit error and burst error.**	**2 M**
	Ans	**Single bit error:** Single-bit error occurs when only one bit of a given data string is in error (changed from 0 to 1 or from1 to 0). **Burst error:** A burst error or multiple-bit error occurs when two or more bits within a given data string are in error	1 M each for correct definition
g)		**Enlist features of VOLTE.**	**2 M**
	Ans	1.Set up of the transmission path between the terminal and IMS 2.Security features for user authentication providing 3.Providing the core functionality for the establishment and termination of the call. 4.Support to call forwarding, caller ID presentation and restriction,call waiting and multiparty conference.	Any 4 correct features ½ M each

| 2.		**Attempt any <u>THREE</u> of the following:**	**12 M**
	a)	**Explain the process of amplitude shift keying.**	**4 M**
	Ans	Amplitude Shift Keying (ASK) is the digital modulation technique in which the amplitude of the sinusoidal carrier will take one of the two predetermined values in response to 0 or 1 value of the digital input modulating message signal $$V_{ASK}(t) = d \sin(2\pi f_c t)$$ Amplitude shift keying is the simplest form of digital modulation. Here the carrier is a sin wave of frequency. The digital signal from the information source is a unipolar NRZ signal which acts as the modulating signal. The ASK modulator is nothing but a multiplier followed by a band pass filter as shown in above figure. Due to multiplication, the ASK output will be present only when a binary "1" is to be transmitted and when the digital input is "0" then we get zero output as shown in the waveform above. From the waveform analysis we can conclude that when a binary "1" is to be sent the carrier is transmitted and when binary "0" is to be sent then the carrier is not transmitted	2 M Diagram & 2 M Explanation
	b)	**Explain the modes of communication with examples.**	**4 M**
	Ans	**Simplex:** **Definition:** One-way communication, in which the information is communicated is only one direction. **Sketch:** 	3M for modes of communication- Definition with Sketch 1M for examples

Applications or Examples:
TV broadcasting,Radio broadcasting,Telemetry,Remote control

Half Duplex:
Definition: Two-way communication,which can transmits as well as receives information but not simultaneously
Sketch:

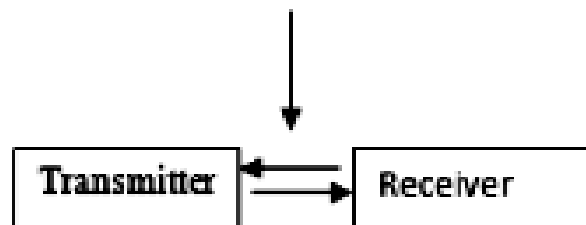
Half duplex
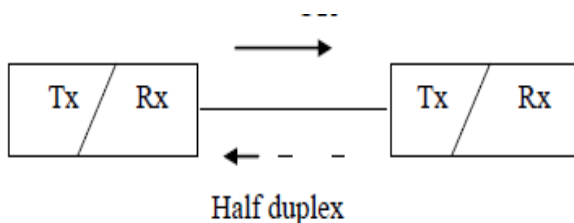
Applications or Examples:
Walky Talky,Ameature Radio,Citizen Radio,Fax,Pager

Full Duplex:
Definition: Two-way communication.which can transmits as well as receives information simultaneously
Sketch:

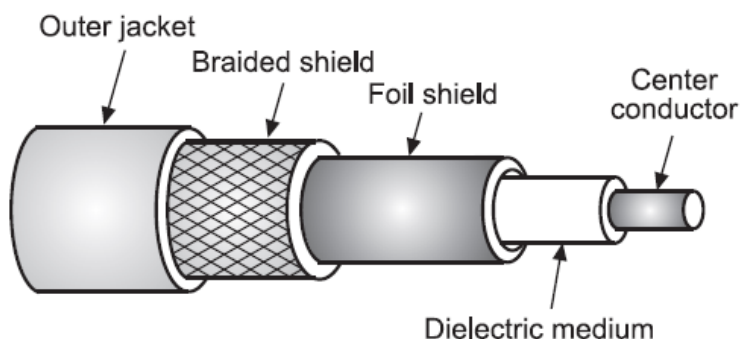**Applications or Examples:**
Telephone,Mobile Phones,RADAR

	c)	**Draw a labelled diagram of Coaxial cable and state its advantages.**	**4 M**
	Ans		2 M Diagram 2 M Advantages

		Advantages of Coaxial Cable: 1. Low cost due to less total footage of cable, hubs not needed. 2. Lower attenuation than twisted pair. 3. Good immunity to EMI/RFI and Highly insensitive to EMI. 4. Supports high bandwidths. 5. Heavier types of coax are sturdy and can withstand harsh environments	
d)		**Differentiate between circuit switching and packet switching.**	**4 M**
	Ans		Any 4 correct comparison points 1 M each
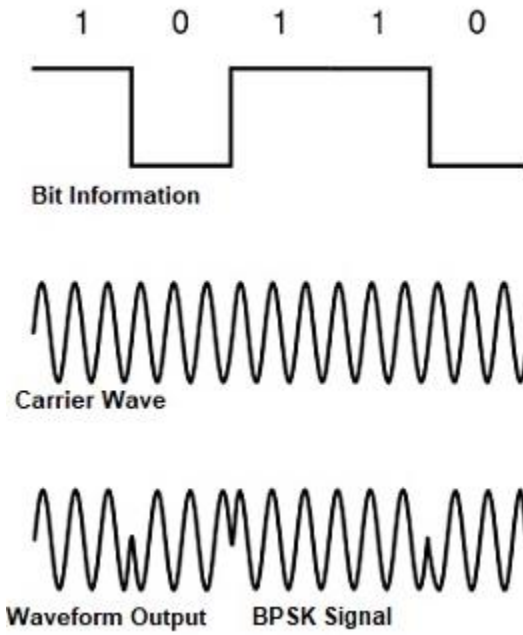
Sr No.	Parameter	circuit switching	packet switching
1	Concept	When you or your computer places a telephone call, the switching equipment within the telephone system seeks out a physical path all the way from your telephone to the receiver's telephone. This technique is called circuit switching.	With this technology, packets are sent as soon as they are available.
2	Store and forward transmission	No.	Yes.
3	Addressing	Hierarchical numbering plan.	Hierarchical address space.
4	Routing	Route selected during call setup.	Each packet routed independently.
5	Multiplexing	Circuit multiplexing	Packet multiplexing shared media across networks.
6	Call setup	Required.	Not needed
7	Dedicated physical path	Yes.	No.
8	Bandwidth available	Fixed.	Dynamic.
9	Application	Telephone network for bidirectional, real time transfer of voice	Internet for datagram and reliable stream service between

			signals.	computers.	
	10	End Terminal	Telephone, modem.	Computer.	
	11	Information Type	Analog voice or PCM digital voice.	Binary Information	
	12	Transmission system	Analog and Digital data over different transmission media.	Digital data over differential transmission media.	

3.		**Attempt any <u>THREE</u> of the following:**	**12 M**
	a)	**Draw a BPSK waveform to represent the following bit stream 10110.**	**4 M**
	Ans		Correct Diagram 4 M

	b)	**Compare Radio wave and Microwave Communication (any 4 points).**	**4 M**
	Ans		

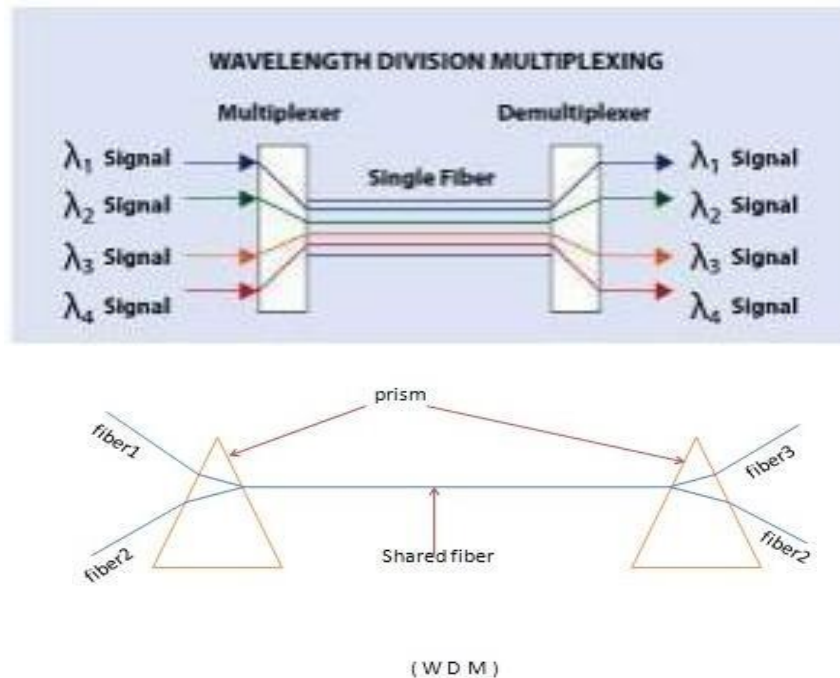| Parameters	Radio wave Communication	Microwave Communication	
			Any four points-1 M for each point
Frequency range	Frequency range: 3 KHz to 1GHz.	Frequency range: 1 GHz to 300 GHz.	
Direction	These are omni-directional in nature.	These are unidirectional in nature.	
Penetration	At low frequency, they can penetrate through solid objects and walls but	At low frequency, they can penetrate through solid objects and walls. at	

		high frequency they bounce off the obstacle.	high frequency, they cannot penetrate.	
	Security	These offers poor security.	These offers medium security.	
	Attenuation	Attenuation is high.	Attenuation is variable.	
	Usage Cost	Setup and usage cost is moderate.	Setup and usage cost is high.	

c)	**Draw and explain the WDM process diagram.**	**4 M**
Ans		2M for diagram,2M for explanation

WDM is an analog multiplexing technique to combine optical signals.
Principle: Very narrow bands of light from different sources are combined to make a wider band of lights & at the receiver, the signals are separated by demultiplexer. WDM is designed to use the high data rate capability of fiber optic cable. The optical fiber data rate is higher that the data rate of metallic transmission cable. Using a fiber optic cable for one single line wastes available bandwidth.
Multiplexing allows us to connect several lines into one.
WDM is conceptually same as FDM, except that the multiplexing & demultiplexing involve the optical signals transmitted through fiber optic cable. Very narrow band of lights of differential wavelengths are combined to make wide band of light. All wavelength travels through signal cable.
At receiver, the signals are separated by demultiplexer.
Combining & splitting of light sources are easily handled by prism.
Prism bends a beam of light based on angle of incidence & frequency.

|			
		Using this technique, multiplexer can be made to combine Several input beams of light, each containing narrow band of frequencies into one output beam of wider band of frequencies. Demultiplexer does reverse process.	
d)		**Explain the process of Cyclic Redundancy check with example**.	**4 M**
Ans		CRC Encoder:	Explanation 2 M , Example 2 M

CRC Encoder:

In the encoder, the dataword has k bits (4 here); the codeword has n bits (7 here). The size of the dataword is augmented by adding $n - k$ (3 here) 0s to the right-hand side of the word. The n-bit result is fed into the generator. The generator uses a divisor of size $n - k + 1$ (4 here), predefined and agreed upon. The generator divides the augmented data word by the divisor (modulo-2 division). The quotient of the division is discarded; the remainder $r2\ r1\ r0$ is appended to the dataword to create the codeword.

Example:

The encoder takes the data word and augments it with $n - k$ number of 0s. It then divides the augmented dataword by th divisor, as shown in Figure.
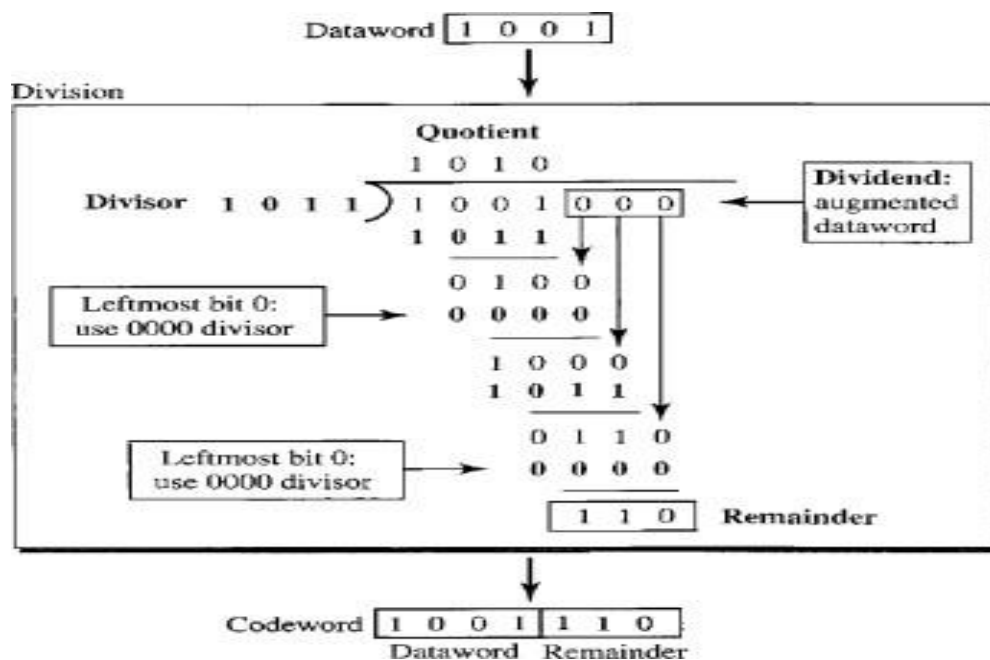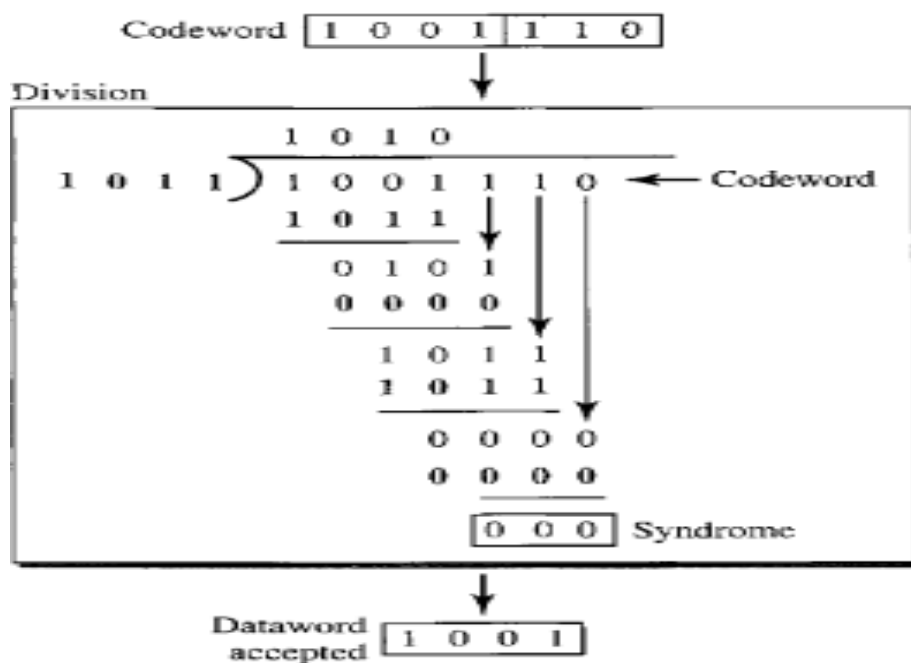

CRC Decoder: The codeword can be changed during transmission. The decoder does the same division process as the encoder. The remainder of the division is the syndrome. If the syndrome is all 0s, there is no error; the data word is separated from the received codeword and accepted. Otherwise, everything is discarded.

Example:

| 4.		**Attempt any THREE of the following:**	**12 M**
	a)	**Explain the frequency modulation process with diagram.**	**4 M**
	Ans	In this modulation technique, the frequency of the carrier signal is modified to reflect the change in the voltage levels of the modulating signal (analog data). The amplitude and phase of the carrier signal are not altered. Noise immunity is more in FM as compared to AM. The frequency used for transmission is 88.1 – 108.1 MHz FM technology is widely used in the fields of computing, telecommunications, and signal processing.	

(i) Modulating signal
(ii) Carrier waveform
(iii) Frequency modulated signal
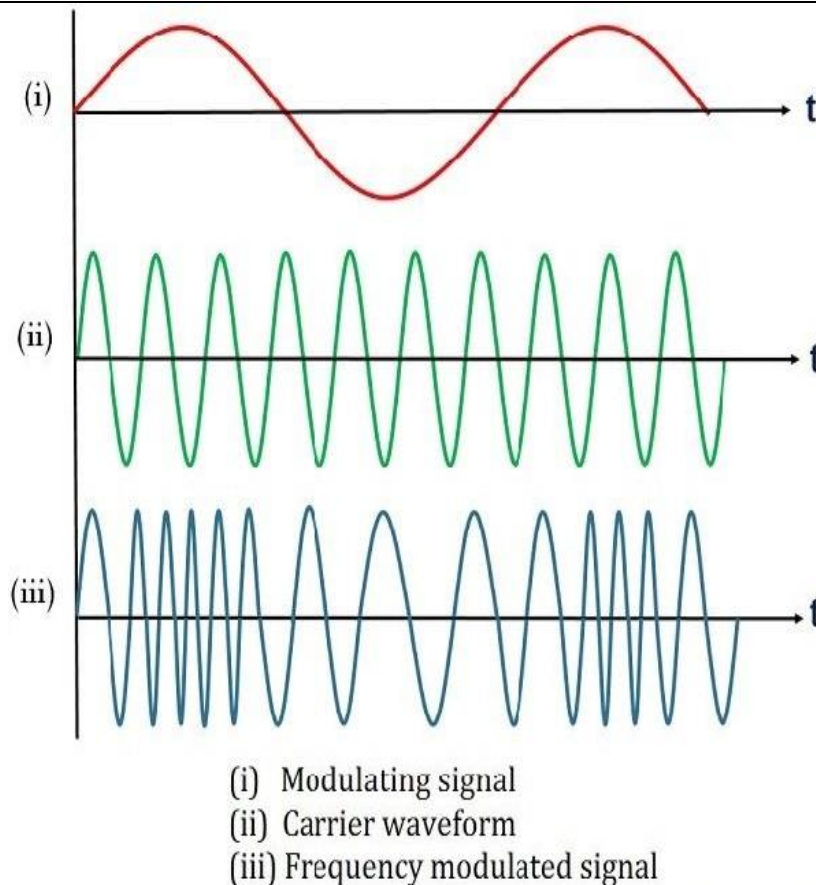
|	b)	**"In multimode step-index fiber density of the core remains constant from the center to the edges". Explain with diagram.**	**4 M**
	Ans	In multimode step-index fibre, the density of the core remains constant from the centre to the edges. A beam of light moves through this constant density in a straight line until it reaches the interface of the core and the cladding. The term step-index refers to the suddenness of this change, which contributes to the distortion of the signal as it passes through the fibre. At the interface, there is an abrupt change to a lower density that modifies the angle of the beam's motion. The suddenness of this change is referred to by the term step-index. This figure shows various beams (or rays) traveling through a step-index fiber. Some beams in the middle go through straight lines by the core and reach the destination without reflecting or refracting. Some beams strike the interface of the core and cladding at that angle which is smaller than the critical angle. These beams penetrate the cladding and are lost. Still, others hit the edge of the core at angles greater than the critical angle and reflect into the core and off the other side, bouncing back and forth down the channel until they reach the destination.	2 M diagram, 2 M explanation
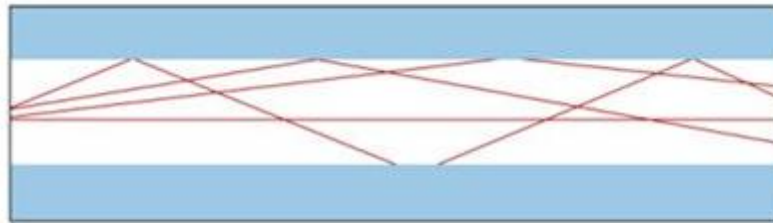
Multimode, Step-Index

c)	**Compare FHSS and DSSS.**			**4 M**
Ans				Any 4 points, 1M each, Any other relevant point can be considered

FHSS	DSSS
Multiple frequencies are used	Single frequency is used
Frequency reuse is allowed	Frequency reuse is not allowed
Sender need not wait.	Sender has to wait if the spectrum is busy..
Power strength of the signal is high	Power strength of the signal is low
Stronger and penetrates through the obstacles	It is weaker compared to FHSS
It is never affected by interference	It can be affected by interference
It is cheaper	It is expensive
This is commonly used technique	This technique is not frequently used.

d)	**Assuming even parity technique, find the parity bit for following frames :** **(i) 1100111** **(ii) 0111001** **iii) 1011101** **(iv) 0101001**	**4 M**
Ans		1M each for correct answer

Sr No	Data	Parity Bit
1.	1100111	1
2.	0111001	0
3.	1011101	1
4.	0101001	1

|		
e)	**Explain the Wireless LANs 802.11 architecture.**	**4 M**
Ans	A wireless local area network (WLAN) is a wireless distribution method for two or more devices that use high-frequency radio waves and often include an access point to the Internet. A WLAN allows users to move around the coverage area, often a home or small office, while maintaining a network connection. The two types of services are	2 M diagram, 2 M explanation

1. Basic services set (BSS)
2. Extended Service Set (ESS)

1. Basic Services Set (BSS)

The basic services set contain stationary or mobile wireless stationsand a central base station called access point (AP).
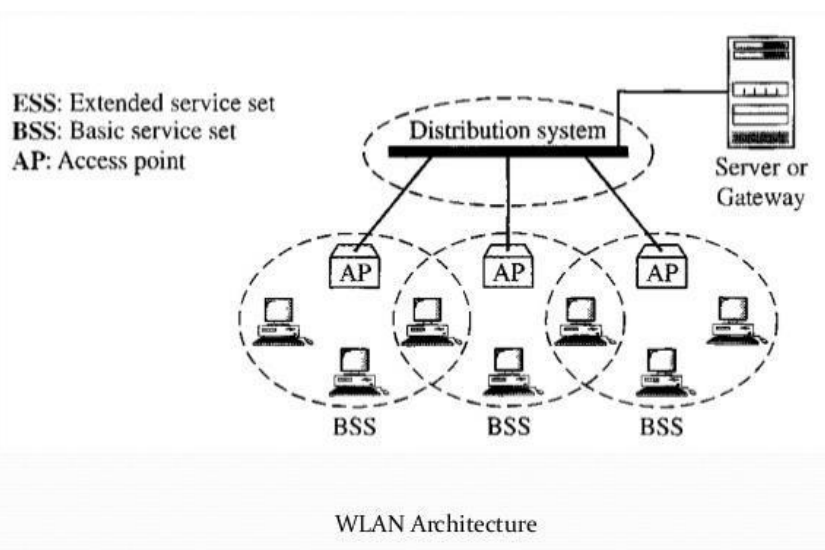
• The use of access point is optional.
• If the access point is not present, it is known as stand-alone network. Such a BSS cannot send data to other BSSs. This type of architecture is known as adhoc architecture.

The BSS in which an access point is present is known as an infrastructure network.
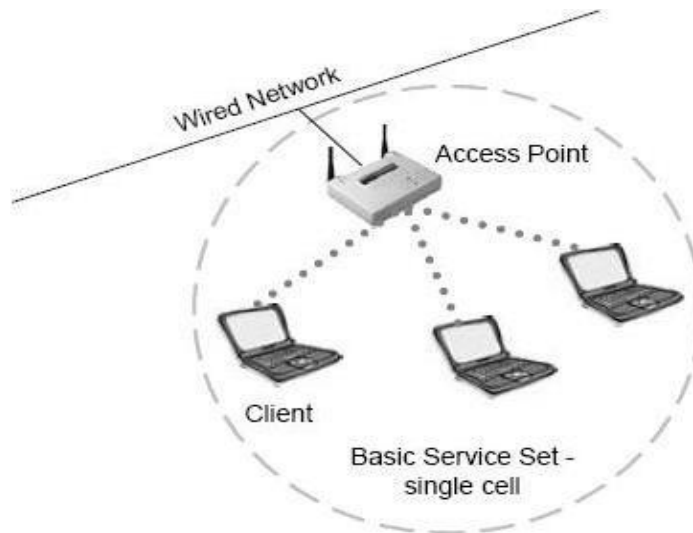
2.Extend Service Set (ESS)

An extended service set is created by joining two or more basicservice sets (BSS) having access points (APs).

WLAN Architecture

5.		**Attempt any TWO of the following:**			**12 M**
	a)	**Compare twisted-pair cable, coaxial cable and fiber optic cable (any 6 points).**			**6 M**
	Ans				Any six points – 1 M for each point

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 easy	Installation is difficult

	b)	**Explain the flow and error control selective repeat automatic repeat request technique.**	**6 M**
	Ans	**Selective Repeat ARQ.** It is also known as Sliding Window Protocol and used for error detection and control in the data link layer. In the selective repeat, the sender sends several frames specified by a window size even without the need to wait for individual acknowledgement from the receiver as in Go-Back-N ARQ. In selective repeat protocol, the retransmitted frame is received out of sequence. In Selective Repeat ARQ only the lost or error frames are retransmitted, whereas correct frames are received and buffered. The receiver while keeping track of sequence numbers buffers the frames in memory and sends NACK for only frames which are missing or damaged. The sender will	2 M for Concept 2 M diagram 2 M Process explanation

send/retransmit a packet for which NACK is received.
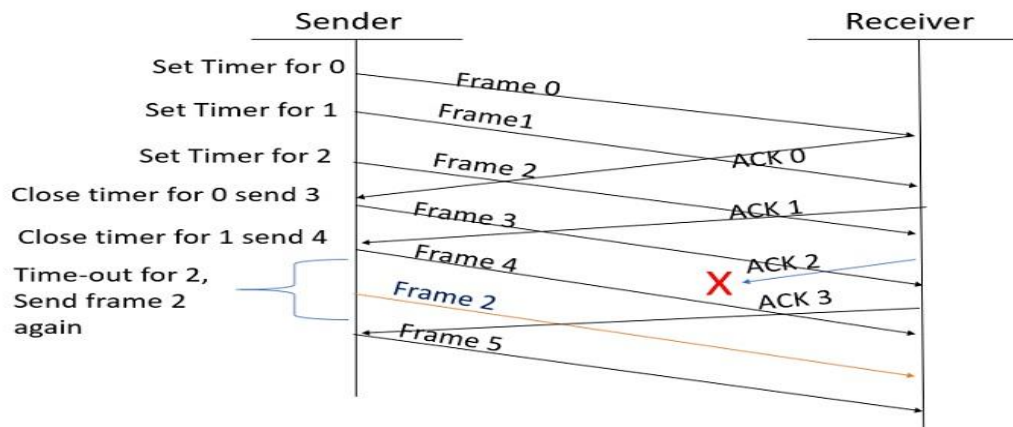
Explanation

Step 1 − Frame 0 sends from sender to receiver and set timer.

Step 2 − Without waiting for acknowledgement from the receiver another frame, Frame1 is sent by sender by setting the timer for it.

Step 3 − In the same way frame2 is also sent to the receiver by setting the timer without waiting for previous acknowledgement.

Step 4 − Whenever sender receives the ACK0 from receiver, within the frame 0 timer then it is closed and sent to the next frame, frame 3.

Step 5 − whenever the sender receives the ACK1 from the receiver, within the frame 1 timer then it is closed and sent to the next frame, frame 4.

Step 6 − If the sender doesn't receive the ACK2 from the receiver within the time slot, it declares timeout for frame 2 and resends the frame 2 again, because it thought the frame2 may be lost or damaged.

	c)	**Enlist any three features of mobile generations :** **(i) Third-Generation (3G)** **(ii) Fourth-Generation (4G)**	**6 M**
	Ans	**The features of 3G are:** • Speed of up to 2 Mbps • Increased bandwidth and data transfer rates • Send/receive large email messages. • Large capacities and broadband capabilities • Much faster than 2G **The features of 4G are:** • Better download speed.	Any three features of 3G: –3 M marks Any three features of 4G: –3 M marks

		• Extremely high voice quality. • Easy access to Internet, IM, social networks, streaming media, video calling. • Higher bandwidth. • Much faster than 3G. • Support interactive multimedia, voice, video. • High speed, high capacity, and low cost per bit (Speeds of up to 20 Mbps or more). • Global and scalable mobile networks. • Ad hoc and multi-hop networks.	
6.		**Attempt any TWO of the following:**	**12 M**
	a)	**Compare synchronous time-division multiplexing and statistical time-division multiplexing (any 6 points).**	**6 M**
	Ans		1 M for each comparison

Sr.No.	Synchronous TDM	Statistical TDM
1.	The data flow of each input connection is divided into units and each input control one output time slot.	The slots are allotted dynamically. Input line is given slots in output frame only if it has data to send.
2.	In this, number of slots in each frame are equal to number of input lines.	In this, number of slots in each frame are less than the number of input lines.
3.	The maximum bandwidth utilization is done when all inputs have data to send.	The volume of link is normally less than the sum of the volume of each channel.
4.	In this de-multiplexer at receiving end decomposes each frame, discards framing bits and draw out data unit in turn. This draw out data unit from frame is then passed to destination device.	In this de-multiplexer at receiving end decomposes each frame, by checking local address of each data unit. This draw out data unit from frame is then passed to destination device.
5.	It uses synchronization bits at the beginning of each frame.	It does not used synchronization bits.

	6.	Slots in this carry data only and there is no need of addressing.	Slots in this contain both data and address of the destination.
	7.	In this, buffering is not done, frame is sent after a specific interval of time whether it has data to send or not.	In this, buffering is done and only those inputs are given slots in output frame whose buffer contains data to send.

|			
b)		**Explain the two approaches used in variable-size framing.**	**6 M**

	Ans	**Variable-sized Framing**
		
		Each frame that needs to be transferred in this case may have a variable size. Therefore, additional processes are maintained to indicate when one frame ends and the next one begins. Local area networks employ it.
		
		In variable-sized framing, there are two techniques to define frame delimiters:
		
		• **Length Field** − Here, the size of the frame is decided by a length field. It is used in Ethernet (IEEE 802.3).
		
		• **End Delimiter** − Here, the size of the frame is defined by a pattern that serves as a delimiter. In Token Rings, it is used. The following two methods are employed to prevent the problem if the pattern is present in the message.
		
		    o **Byte Stuffing** − To distinguish the message from the delimiter, a byte is added. This technique is also known as character-oriented framing.
		
		    o **Bit Stuffing** − To distinguish the message from the delimiter, a byte is added. This technique is also known as character-oriented framing.
		
		What is Byte Stuffing?
		
		Byte stuffing is the process of adding an extra byte when there is a flag or escape character in the text. Take an example of byte stuffing as shown in the below diagram.
		
		The sender sends the frame by adding 3 extra ESC bits and the destination machine received the frame and it removes the extra bits to covert the frame into the same message.
			Diagram 2 M Explanation 1 M Each types 2 M

Character – Oriented Framing

What is Bit Stuffing?

Most protocols use a special 8-bit pattern flag 01111110 as the delimiter to define the beginning and the end of the frame. Bit stuffing is done at the sender end and bit removal at the receiver end.

If we have a 0 after five 1s. We still stuff a 0. The receiver will remove the 0. Bit stuffing is also called bit-oriented framing.

Bit – Oriented Framing
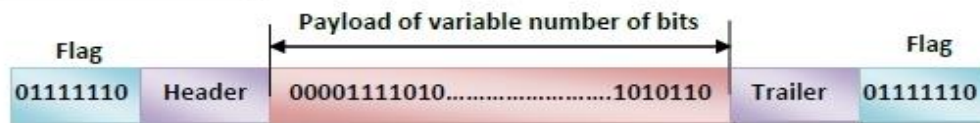
c)	**Explain the virtual-circuit network and give its two applications.**	**6 M**
Ans	**Virtual Circuit** is the computer network providing connection-oriented service. It is a connection-oriented network. In virtual circuit resource are reserve for the time interval of data transmission between two nodes. This network is a highly reliable medium of transfer. Virtual circuits are costly to implement.	Explanation 2 M, diagram 2 M application 2M(any 2 applications)

Working of Virtual Circuit:

- In the first step a medium is set up between the two end nodes.
- Resources are reserved for the transmission of packets.
- Then a signal is sent to sender to tell the medium is set up and transmission can be started.
- It ensures the transmission of all packets.
- A global header is used in the first packet of the connection.
- Whenever data is to be transmitted a new connection is set up.
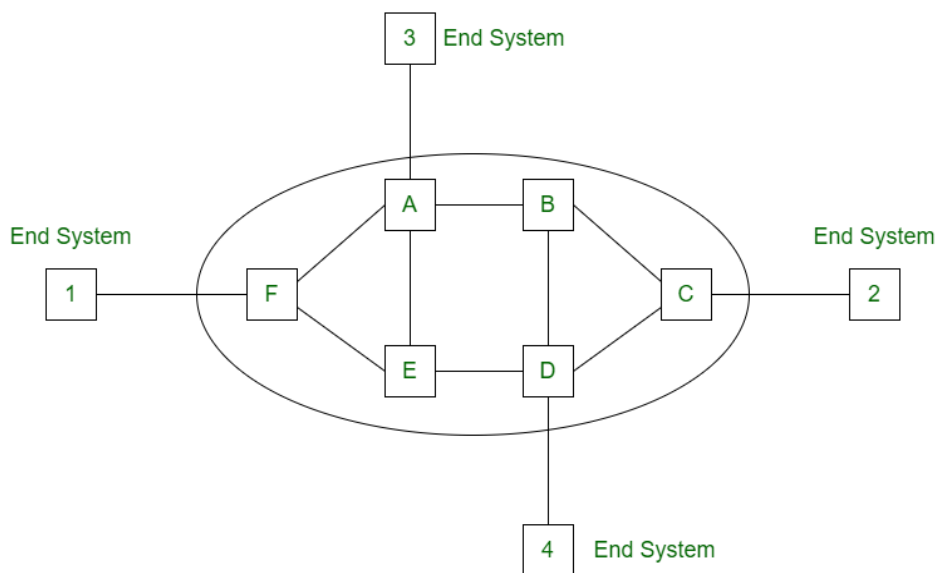
Advantages of Virtual Circuit:

1. Packets are delivered to the receiver in the same order sent by the sender.
2. Virtual circuit is a reliable network circuit.
3. There is no need for overhead in each packet.
4. Single global packet overhead is used in virtual circuit.

Disadvantages of Virtual Circuit:

1. Virtual circuit is costly to implement.
2. It provides only connection-oriented service.
3. Always a new connection set up is required for transmission.

```
                       ┌───┐
                     3 │   │ End System
                       └─┬─┘
                         │
                 ┌───────┼───────┐
          ┌───┐  │    ┌─A─┐ ┌─B─┐ │         ┌───┐
End System│   │  │    │ A │─│ B │ │End System│   │
        1 │ 1 │──┼──┤F├    └───┘  ├─┤C├──────│ 2 │
          └───┘  │    └───┘ ┌───┐ │└───┘     └───┘
                 │    ┌─E─┐ │ D │ │
                 │    │ E │─│ D │ │
                 └────┼─────┼────┘
                      └──┬──┘
                         │
                       ┌─┴─┐
                     4 │ 4 │ End System
                       └───┘
```

Applications:

1) The virtual circuit allows packets of information to pass between the two connections. Typically, these circuits are used in networks with fast transfer speeds, such as asynchronous transfer mode (ATM) connections.

2) frame relay

3)In virtual circuit network, A VCI(virtual channel identifier) has multiple circuits per communication channel and is primarily used for managing the unique identification of each created circuit.