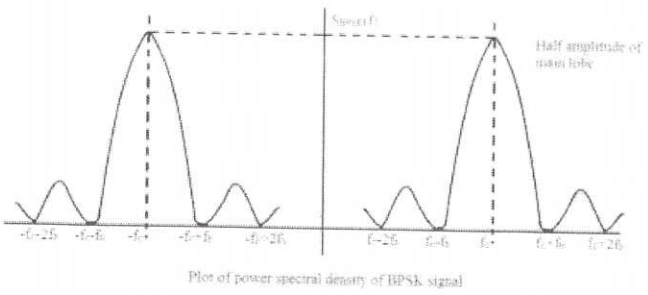
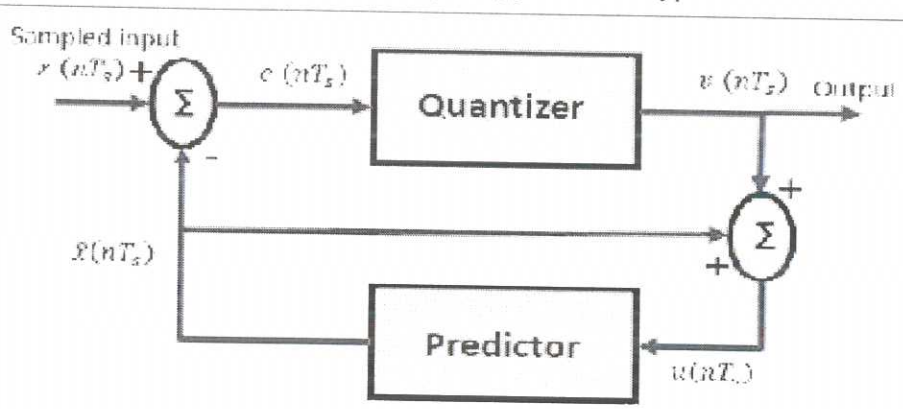
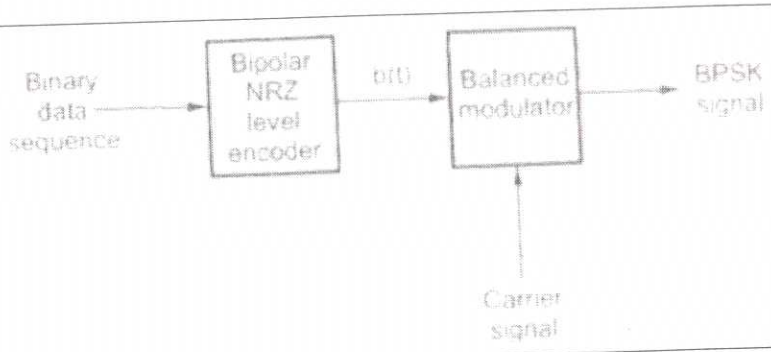
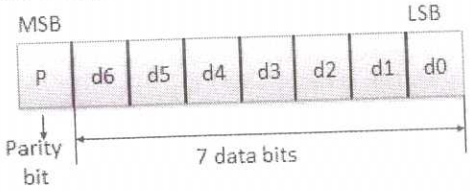
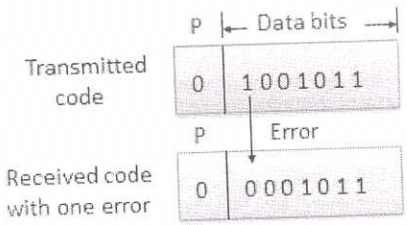
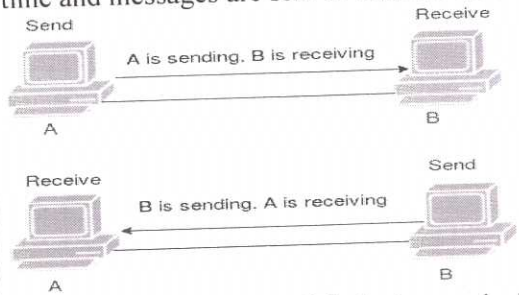
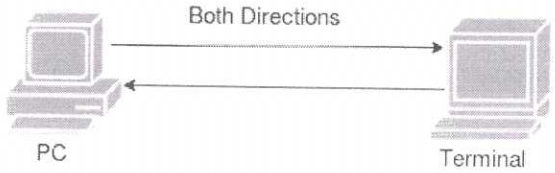
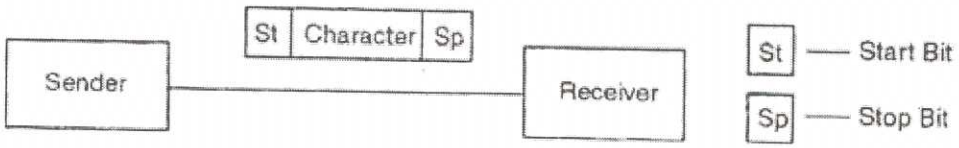
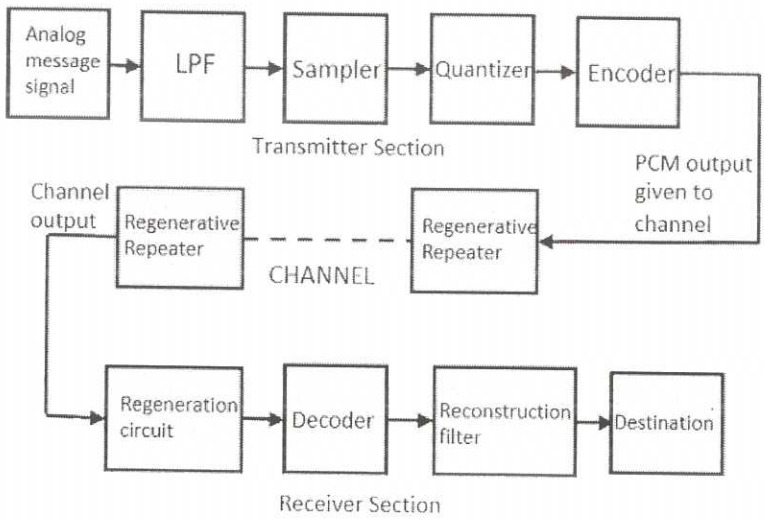
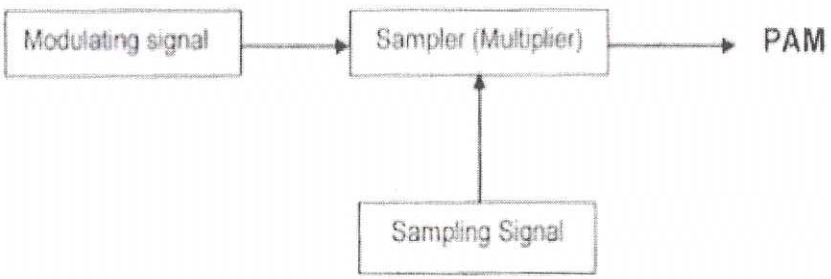
Scheme of evaluation

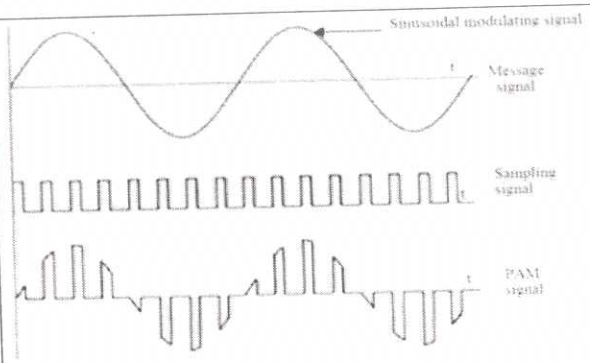
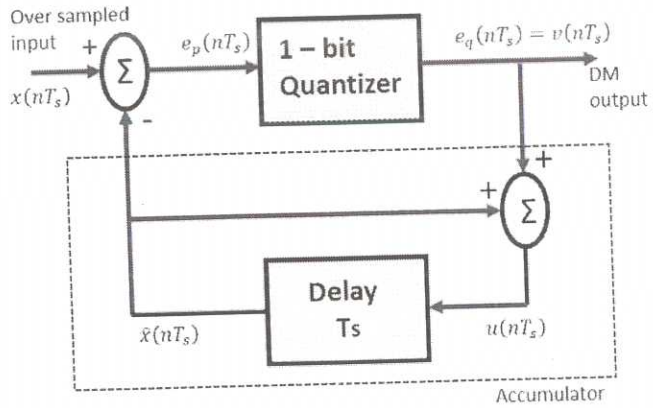
Course : Digital Communication
Version :2015
Code :5201

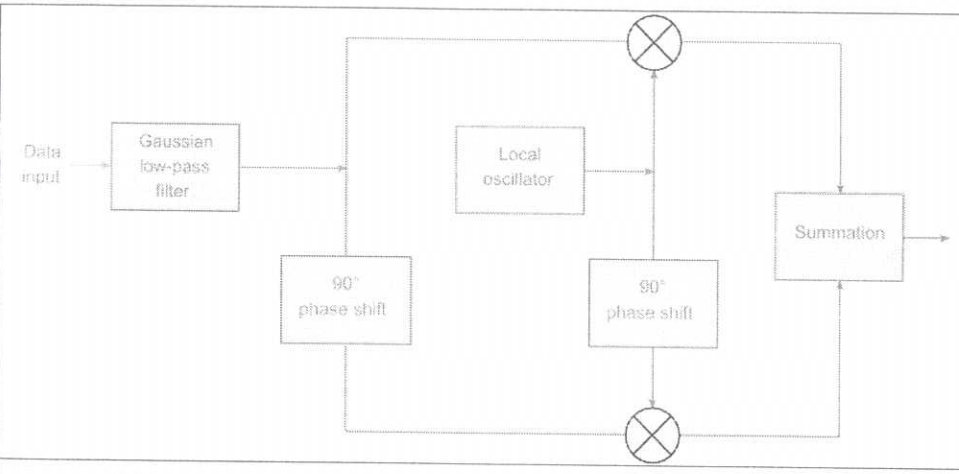
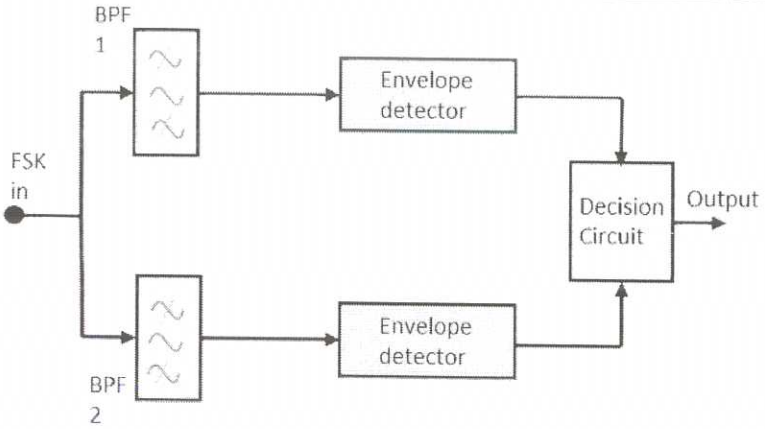
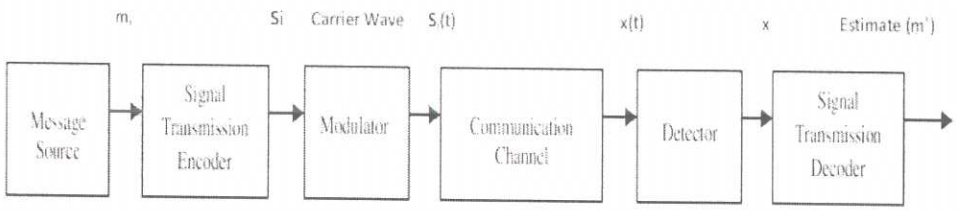
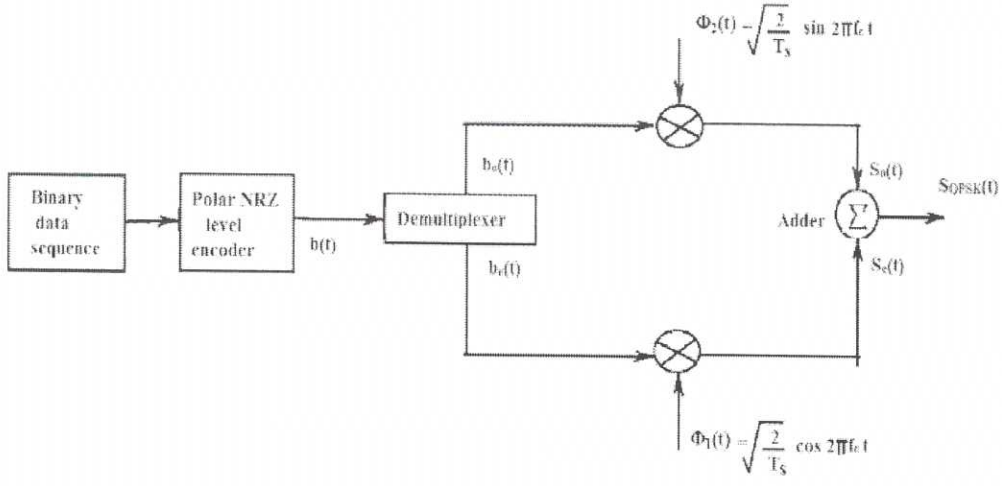
Scoring indicators

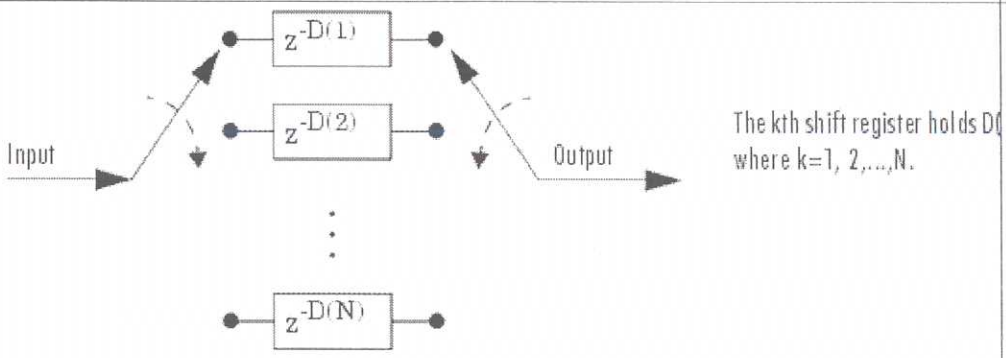
Qn No.	Scoring indicator	Split Score	Sub total	Total
I 1.	A continuous time signal can be represented in its samples and can be recovered back when sampling frequency f_s is greater than or equal to the twice the highest frequency component of message signal. i. e. $f_s \geq 2f_m$.	2	2	10
I 2	 Plot of power spectral density of BPSK signal	2	2	
I 3	• Sideband power is reduced. • The MSK spectrum is less affected by noise and hence leads to good SNR • Helps in achieving good receiver sensitivity. • Spectral efficiency is better and higher while demodulator is less complex.	2	2	
I 4	Message is defined as information conveyed by words or other signs and symbols. A message is the content of the communication process.	2	2	
I 5	Cipher is an algorithm for performing encryption or decryption	2	2	
II 1		Diag (3) Expln (3)	6	42
II 2	**Basis for Comparison** / **PAM** / **PWM** / **PPM** Varying parameter: Amplitude / Width / Position Immunity towards noise: Low / High / High Signal to noise ratio: Low / Moderate / Comparitively high Need of synchronization pulse: Not exist / Not exist / Exist Bandwidth dependency: On pulse width / On rise time of pulse / On rise time of pulse Transmission power: Variable / Variable / Constant Bandwidth requirement: Low / High / High	Any 6 points	6	

II 3		Diag (3) Expln (3)	6
II 4	It is the simplest technique for detecting and correcting errors. The MSB of an 8-bits word is used as the parity bit and the remaining 7 bits are used as data or message bits. The parity of 8-bits transmitted word can be either even parity or odd parity.  The parity bit can be set to 0 and 1 depending on the type of the parity required. For even parity, this bit is set to 1 or 0 such that the no. of "1 bits" in the entire word is even. For odd parity, this bit is set to 1 or 0 such that the no. of "1 bits" in the entire word is odd. Parity checking at the receiver can detect the presence of an error if the parity of the receiver signal is different from the expected parity. 		6
II 5.	• It adds data redundancy • It is power efficient system but not bandwidth efficient due to overhead usage of the data. • Not sufficient for high quality data transmission • FEC decoder is more complicated	4*1.5	6
II 6.	**Half-Duplex Mode** - In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive, and vice versa. Example: Walkie- talkie in which message is sent one at a time and messages are sent in both the directions.  **Full-Duplex Mode** - In full-duplex mode, both stations can transmit and receive simultaneously. Either the link must contain two physically separate transmission paths, one for sending and other for receiving. The capacity is divided between	3*2	6

	signals travelling in both directions. Example: Telephone Network  			
II 7.	***Asynchronous mode*** Asynchronous mode is also known as *start-stop mode*. This mode is used when data to be transmitted is generated at random intervals. For example, when a user communicates with a computer using a keyboard, the time interval between two successive keystrokes is random. This means that the signal on the transmission line will be in idle state for a long time interval between characters. With this type of communication, the receiver must be able to resynchronize at the start of each new character received. To accomplish this, each transmitted character or byte is encapsulated between an additional start bit and one or more stop bits. This mode is mainly used for the transmission of characters between a keyboard and a computer. Asynchronous transmission can also be used for the transmission of a block of characters or bytes between two computers. The time interval between successive characters is a variable entity.  *Asynchronous Transmission*	Diag (4) Expln (2)	6	
III (a)	 	Diag (4) Expln (5)	9	
III (b)	 	Diag (2) Expln (2) Wave form (2)	6	

				
IV (a)		Diag (3) Expln (5)	8	
IV (b)	The word Companding is a combination of Compressing and Expanding, which means that it does both. This is a non-linear technique used in PCM which compresses the data at the transmitter and expands the same data at the receiver. The effects of noise and crosstalk are reduced by using this technique. There are two types of Companding techniques. They are – A-law Companding Technique • Uniform quantization is achieved at **A = 1**, where the characteristic curve is linear and no compression is done. • A-law has mid-rise at the origin. Hence, it contains a non-zero value. • A-law companding is used for PCM telephone systems. μ-law Companding Technique • Uniform quantization is achieved at **μ = 0**, where the characteristic curve is linear and no compression is done. • μ-law has mid-tread at the origin. Hence, it contains a zero value. • μ-law companding is used for speech and music signals. μ-law is used in North America and Japan.		7	
V (a)	GMSK modulation is based on MSK, which is itself a form of continuous-phase frequency-shift keying, CPFSK. One of the problems with standard forms of PSK is that sidebands extend out from the carrier. To overcome this, MSK and its derivative GMSK can be used.	Diad (3) Expln (4)	7	15

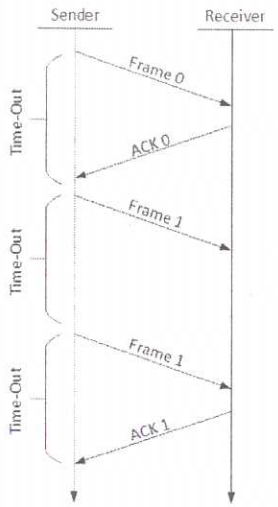
				
V (b)		Diag (4) Expln (4)	8	
VI (a)		Diag (4) Expln (4)	8	15
VI (b)		Diag (4) Expln (3)	7	
VII (a)	Hamming codes are defined as the (n,k) linear block codes. These codes satisfy the following conditions i) Number of check bits $q \geq 3$ ii) Block length $n = 2^q - 1$ iii) Number of message bits $k = n - q$ iv) Minimum distance $d_{min} = 3$ For detecting double errors $d_{min} \geq s + 1$		8	15

	$3 \geq s + 1$ $s \leq 2$ Hence two errors will be detected And $d_{min} \geq 2t + 1$ $3 \geq 2t + 1$ $t \leq 1$ Therefore one error will be corrected			
VII (b)	In practical communication system we usually transmit long sequence of symbols from an information source. Thus we are interested in the average information that a source produces. The flow of information in a system can be fluctuated widely because of randomness involved into selection of the symbols. The mean value of $I(x_i)$ over the alphabet source X with m different symbol is given by $H(X) = E[I(x_i)]$ $= \sum P(x_i) I(x_i)$ $I(x_i)] = - \log_2(x_i)$ $H(X) = \sum P(x_i) - \log_2(x_i)$ $= -\sum P(x_i) \log_2(x_i)$ bits/symbol H(X) is called entropy of the source X. It is the measure of average information content per source symbol	Diad (3) Expln (4)	7	
VIII (a)			7	
VIII (b)	1. Create a list of probabilities or frequency counts for the given set of symbols so that the relative frequency of occurrence of each symbol is known. 2. Sort the list of symbols in decreasing order of probability, the most probable ones to the left and least probable to the right. 3. Split the list into two parts, with the total probability of both the parts being as close to each other as possible. 4. Assign the value 0 to the left part and 1 to the right part. 5. Repeat the steps 3 and 4 for each part, until all the symbols are split into individual subgroups.		8	15
IX (a)	When data-frame is transmitted, there is a probability that data-frame may be lost in the transit or it is received corrupted. In both cases, the receiver does not receive the correct data-frame and sender does not know anything about any loss. In such case, both sender and receiver are equipped with some protocols which helps them to detect transit errors such as loss of data-frame. Hence, either the sender retransmits the data-frame or the receiver may request to resend the previous data-frame. There are three types of techniques available which Data-link layer may deploy to control the errors by Automatic Repeat Requests (ARQ): **Stop-and-wait ARQ:** The sender maintains a timeout counter. When a frame is sent, the sender starts the timeout counter. If acknowledgement of frame comes in time, the sender transmits the next frame in queue. If acknowledgement does not come in time, the sender assumes that either the frame or its acknowledgement is lost in transit. Sender retransmits the frame and starts the timeout counter. If a negative	2*4	8	15

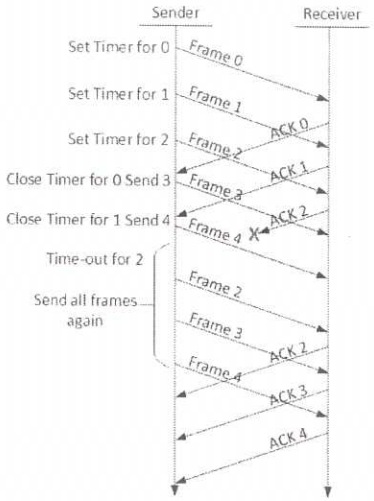
acknowledgement is received, the sender retransmits the frame.

Go-Back-N ARQ - 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 or has not receive any ACK for a particular frame, it retransmits all the frames after which it does not receive any positive ACK.

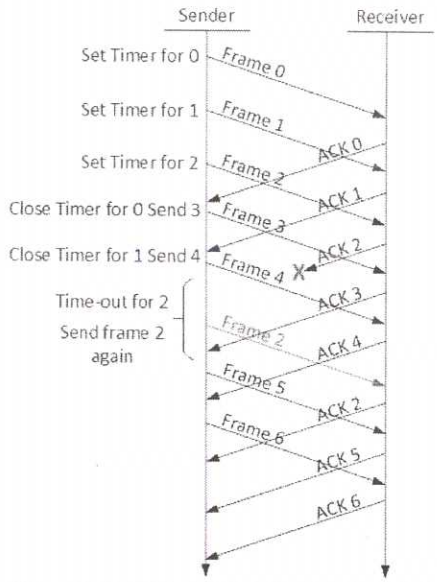
Selective Repeat ARQ - In Selective-Repeat ARQ, the receiver while keeping track of sequence numbers, buffers the frames in memory and sends NACK for only frame which is missing or damaged. The sender in this case, sends only packet for which NACK is received.



Stop and wait ARQ

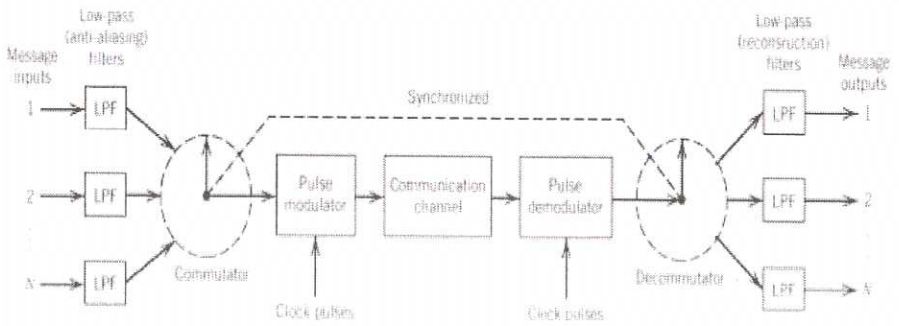


Go back N ARQ



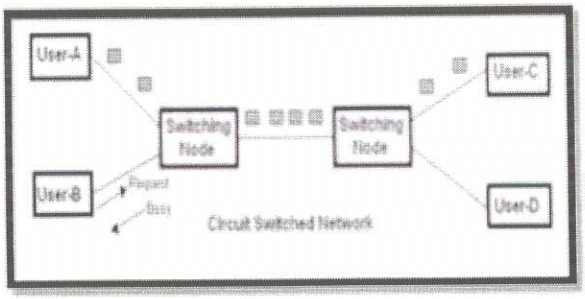
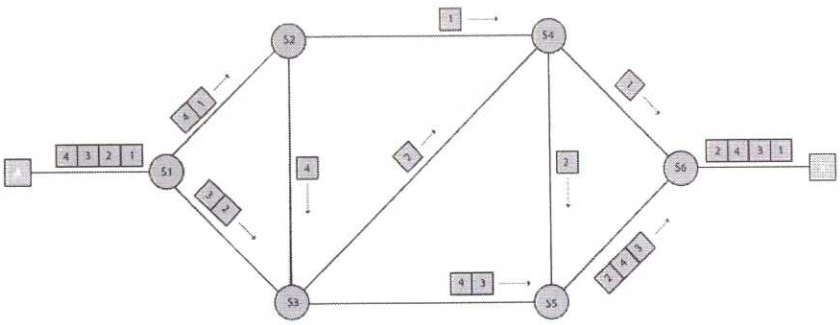
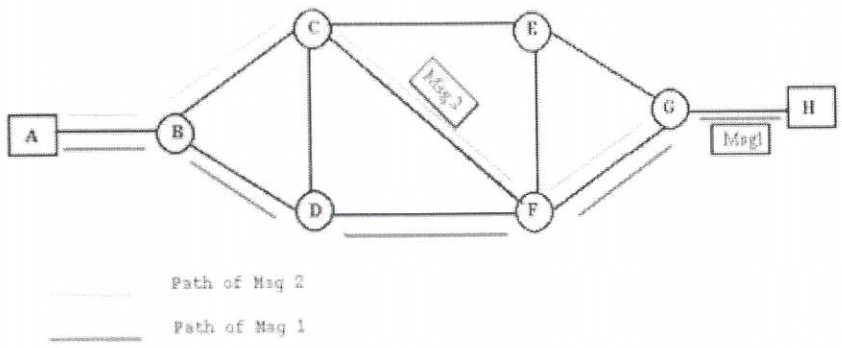
Selective repeat ARQ

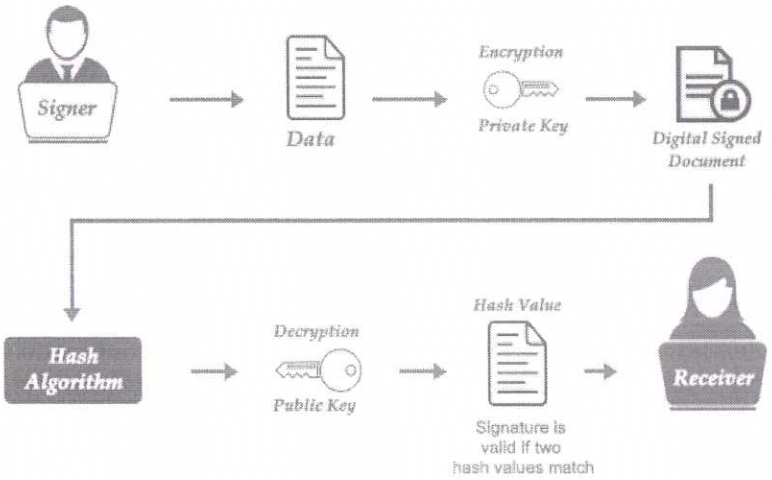
IX (b)



Diag (4) Expln (3)

7

X (a)	A network consists of many switching devices. In order to connect multiple devices, one solution could be to have a point to point connection in between pair of devices. But this increases the number of connection. Hence a better solution for this situation is SWITCHING. A switched network is made up of a series of interconnected nodes called switches. There are basically three types of switching methods are made available. **1)**Circuit Switching **2)** Packet Switching **3)** Message Switching **Circuit Switching** - In the circuit switching, between two nodes there is a dedicated channel for the transmission of data. The circuit is dedicated between two nodes the channel guaranty full bandwidth of the channel for the transmission. The circuit switching is mainly used for voice circuits.  **Packet Switching** - In Packet Switching, messages are broken up into packets and each of which includes a header with source, destination and intermediate node address information. Individual Packets in packet switching technique take different routes to reach their respective destination.  **Message Switching** - In case of Message Switching it is not necessary to established a dedicated path in between any two communication devices. Here each message is treated as an independent unit and includes its own destination source address by its own. Each complete message is then transmitted from one device to another through internetwork.  	9	9	15

X (b)		Diag (3) Expln (3)	6	