WINTER– 16 EXAMINATION (Subject Code: 17535)

Model Answer

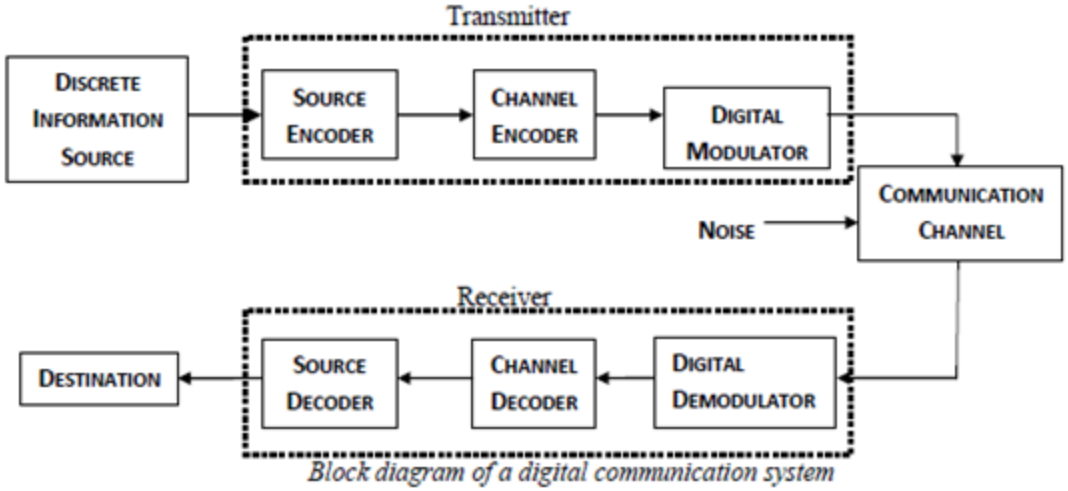
Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto 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 thefigure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constantvalues 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
Q.1	**A)**	**Attempt any THREE:**	**12 M**
	a)	**Compare between analog and digital pulse modulation technique.**	**4 M**
	Ans:		**(Any 4 points: 1 M each)**

SR. NO.	PARAMETER	APM	DPM
1	Nature of signal	Input -Continuous time varying signal Output - discrete time varying signal	Input -Continuous time varying signal Output - Digital signal
2	Variable parameters	Amplitude, position or width	Message is transmitted in form of codes
3	Noise immunity	Poor	Excellent
4	Repeaters	Cannot be used	Can be used
5	Bandwidth	Lower	Higher
6	Multiplexing used	FDM	TDM
7	Types	PAM,PWM,PPM	DM,ADM,PCM,DPCM

b)	**State Shanon's Hartley theorem and write it's statement.**	**4 M**
Ans:	Shannon's Hartley Theorem: The channel capacity of a white, band limited Gaussian channel is given by, $C = B\log_2\left(1+\frac{S}{N}\right)$ Where, B = Channel Bandwidth S = Signal Power N = Noise within the channel bandwidth .	**(Statement : 2M, Explanation:2 M)**
c)	State the need of multiplexing and write it's type.	**4 M**
Ans:	**Need of multiplexing** in the application like telephony there are large numbers of users involved. It is not possible to lay a separate pair of wires from each subscriber to the other entire entire subscriber; this is very expensive and practically impossible. In the Process of multiplexing two or more individual signals are transmitted over a single communication channel. Here we used medium as a coaxial cable or an optical fiber cable because of multiplexing bandwidth utilization is possible. As the data and telecommunications usage increases, so does the traffic. We can accommodate this increase by continuing to add individual lines each time a new channel is needed, or we can install higher capacity links and use each to carry multiple signals. Today's technology includes high-bandwidth transmission media such as coaxial cable, optical fiber and terrestrial and satellite microwaves. Each of these has a carrying capacity (bandwidth) far in excess of that needed for the average transmission signal. If the bandwidth of the link is greater than the transmission needs of the devices connected to it, the excess capacity is wasted. An efficient system maximizes the utilization of all resources. Bandwidth is one of the most precious resources in data communications. **Types of multiplexing:** 1.Analog multiplexing: Frequency division multiplexing Wavelength division multiplexing 2. Digital multiplexing: Time division multiplexing Code division multiplexing	**Need:2M & types:2M**

d)	**Why pseudo-noise sequence used in spread spectrum modulation.**	**4 M**
Ans:	The use of pseudo -noise sequence/codes in spread spectrum modulation makes signals appear wide band and noise like because of which the spectrum signal possess: 1)A low probability to intercept. 2)Resistance to unintended or intended jamming. 3)Sharing of a signal channel among multiple users is possible.	**4 M**
B)	**Attempt any ONE:**	**6 M**
a)	**Draw and explain basic communication system block diagram.**	**6M**
Ans:	 *Block diagram of a digital communication system* **INFORMATION SOURCE:** • An Information source generates a message, examples of which include human voice, television picture, teletype data, atmospheric temperature and pressure. • The message signal can be of an analog or digital type. **SOURCE ENCODER:** • The input to the source encoder (also referred to as the source coder) is a string of symbols occurring at a rate symbols/sec. • The source encoder converts the symbol sequence into a binary sequence of 0's and 1's by assigning code words to the symbols in the input sequence by using either assigning fixed-length binary code word to each symbol or assigns variable-length code words to these blocks. Second function it performs is data	**(Diagram :2M, Each Block Explanation:0.5 M)**

compression.

CHANNEL ENCODER:

- The channel coder provides some amount of error controlled capability to the data to be transmitted.
- It adds some extra bits to the output of the source coder. While these extra bits make it possible for the receiver to detect and/or correct some of the errors in the information bearing bits.

MODULATOR:

- The modulator accepts a bit stream as its input and converts it to an electrical waveform suitable for transmission over the communication channel as they are basically analog in nature.

COMMUNICATION CHANNEL:

- The communication channel provides the electrical connection between the source and the destination.
- The channel may be a pair of wire or a telephone link or free space over which the information bearing signal is radiated.

DEMODULATOR:

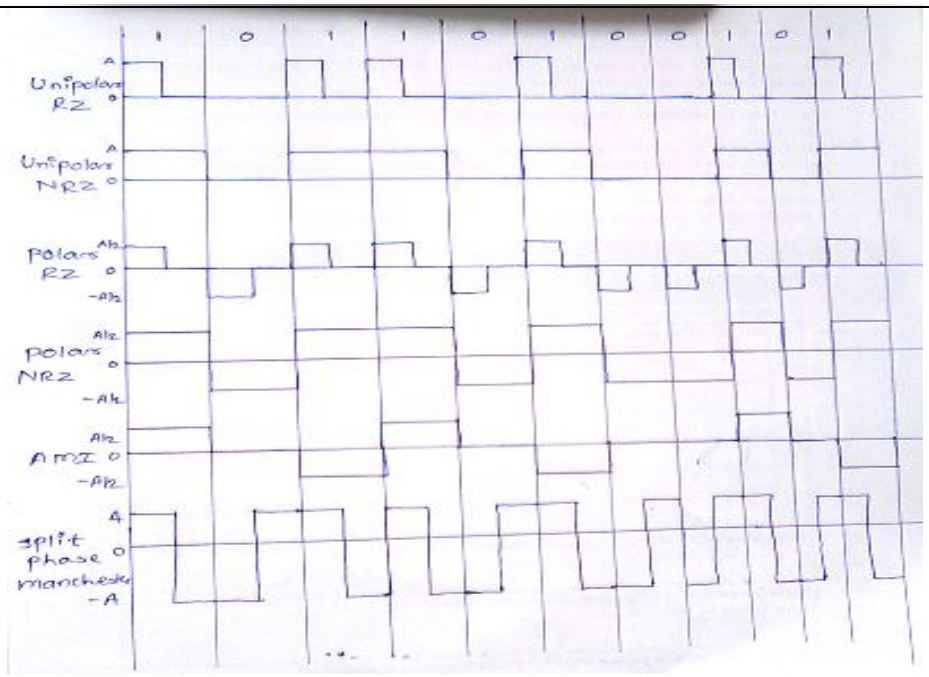
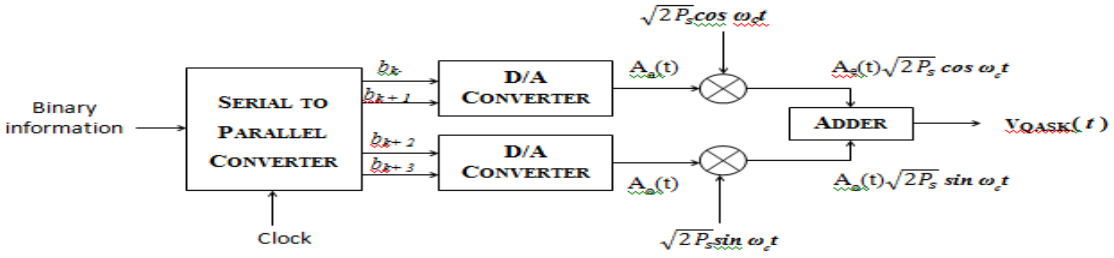
- Modulation is a reversible process and the extraction of the message from the information bearing waveform produced by the modulator is accomplished by the demodulator.

CHANNEL DECODER:

- The channel decoder recovers the information bearing bits from the coded binary stream. Error detection and possible correction is also performed by the channel decoder.

SOURCE DECODER:

- At the receiver, the source decoder converts the binary output of the channel decoder into a symbol sequence.

	b)	**Encode the following binary data stream into unipolar RZ, unipolar NRZ, Polar Return Zero(RZ), Polar NRZ, AMI and split phase Manchester code Data stream: 10110100101**	**6 M**
	Ans:		**(1 M each code)**
Q 2		**Attempt any TWO:**	**16 M**
	a)	**Explain principle of QAM with the block diagram. Also draw constellation diagram of 4-QAM.**	**8 M**
	Ans:		**(Explanation: 3M, Block diagram :3 M, Constellation :2M)**

Explanation:

- The bit stream b(t) is applied to the serial to parallel converter, operating on a clock which has a period of T_s, which is the symbol duration. The bits b(t) are stored by the converter and then presented in the parallel form. The four bit symbols are b_{k+3}, b_{k+2}, b_{k+1}, b_k.
- Out of these four bits, the first two bits are applied to a D/A converter and the other two bits are applied to the second D/A converter.
- The output of the first converter is $A_e(t)$, which is modulated by the carrier $\cos\omega_c t$ whereas the output of the second D/A converter, $A_o(t)$ is modulated by the carrier

$\sin\omega_c t$ in the balanced modulators.

- $A_e(t)$,$A_o(t)$are voltage levels generated by the convertor -3,-1,+1,+3 volts.
- The balanced modulator outputs are added together to get the QAM output signal which is expressed as,

$$v_{QASK}(t) = A_e(t)\cos\omega_c t + A_o(t)\sin\omega_c t$$

OR

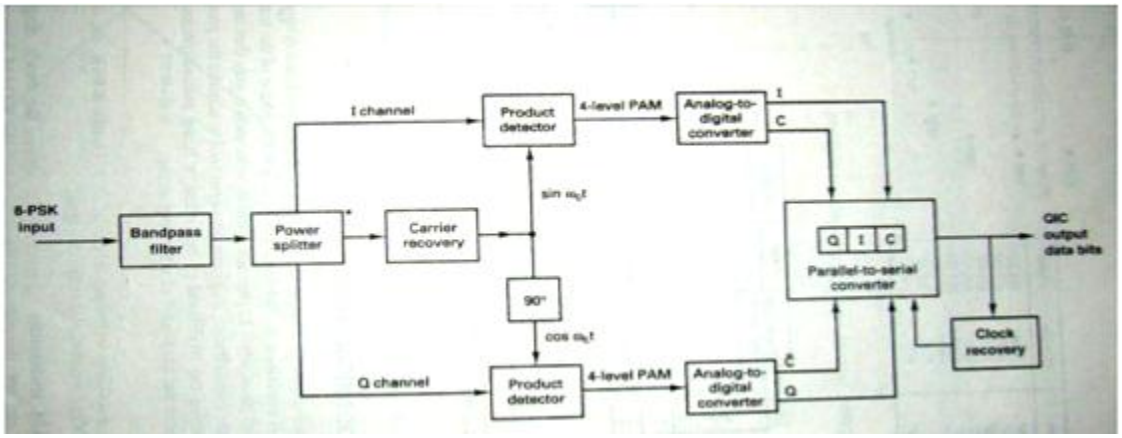
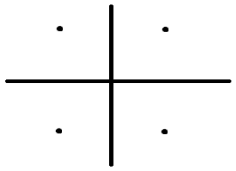
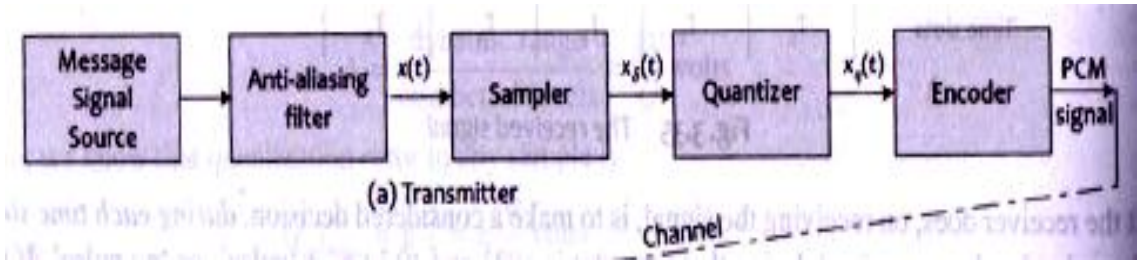


Fig above shows a block diagram of an 8-QAM receiver.

- The power splitter directs the input 8-QAM signal to the I and Q product detectors and the carrier recovery circuit.
- The carrier recovery circuit reproduces the original reference oscillator signal. The incoming 8QAM signal is mixed with the recovered carrier in the I product detector and with a quadrature carrier in the Q product detector.
- The output of the product detectors are 4-level PAM signals that are fed to the 4 to 2 level analog-to-digital converters (ADCs).
- The outputs from the I channel 4-to-2 level converter are the I and C bits, whereas the outputs form Q channel 4-to-2 level converter are the Q and C bits.
- The parallel to serial logic circuit converts the I/C and Q/C bit pairs to serial I,Q and C output data streams

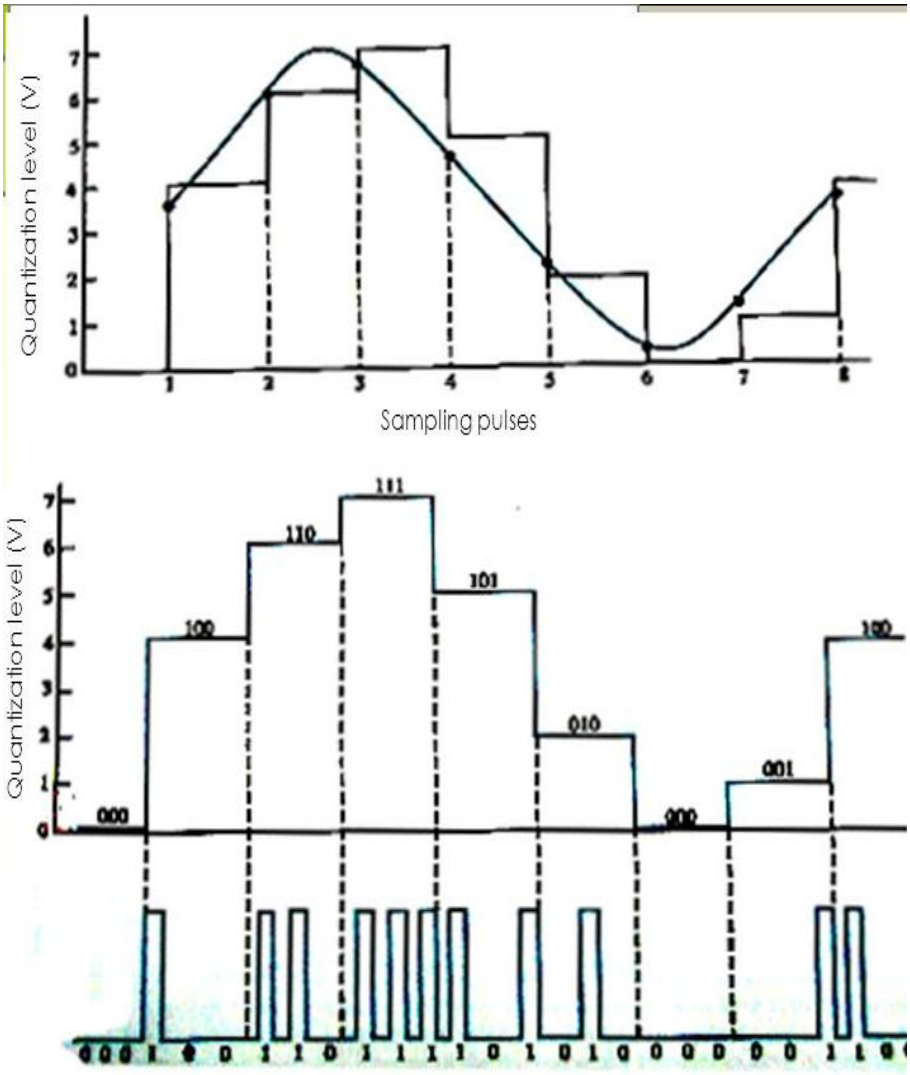
Constellation:

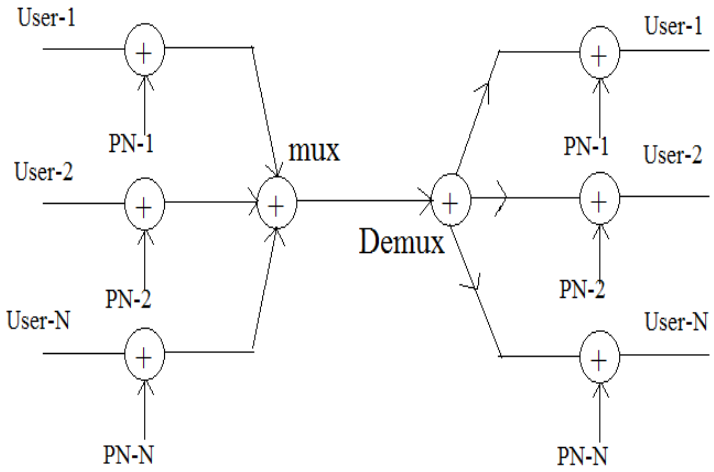


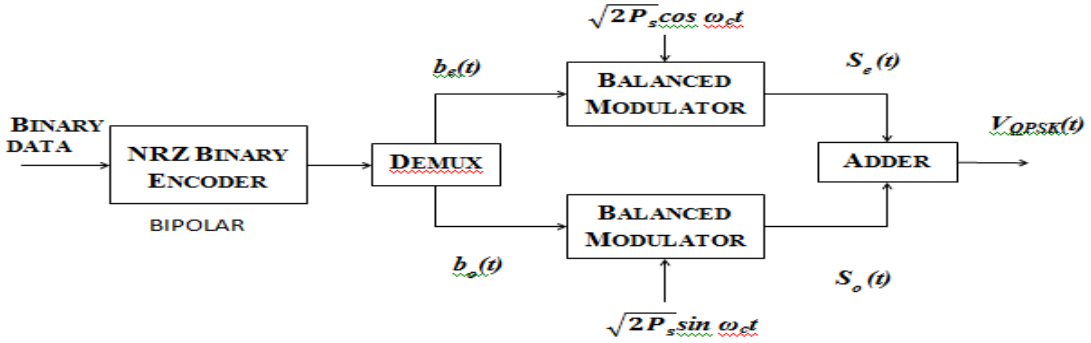
	b)	**Write different types of Pulse Modulation. With the help of block diagram and waveform. Explain PCM transmitter.**	**8 M**
	Ans:	**Types :** 1. Analog Pulse Modulation Systems • Pulse Amplitude Modulation (PAM) • Pulse Width Modulation (PWM) • Pulse Position Modulation (PPM) 2. Digital Pulse Modulation Systems • Pulse Code Modulation (PCM) • Differential Pulse Code Modulation (DPCM) • Delta Modulation (DM) • Adaptive Delta Modulation (ADM) • **Diagram:**  **Explanation:** **PCM TRANSMITTER:** • The analog signal x (t) is passed through a LPF (anti-aliasing filter). The LPF band-limits the signal to $f_m$band-limiting is necessary to avoid the aliasing effect in the sampling process. • The pulse generator generates a train of pulses at a frequency of f_s such that $f_s > 2 f_m$. Thus, the Nyquist criterion is satisfied. • The sampler block carries out flat-top sampling process on the modulating signal at adequately high frequency. Then these samples are subjected to the operation called Quantization in the Quantizer.	**(Types :1M, Diagram :3M , wave form: 2 M, Explanation: 2M)**

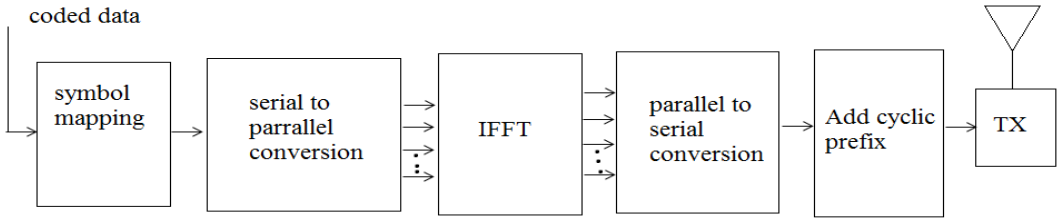
- The quantization process is the process of approximation of the sampled signal. It assigns a particular level to which the sampled value is near to.
- The quantized PAM pulses are applied to an encoder. The encoder converts each quantized level into an N-bit digital word (binary pattern) such that $\mathbf{Q = 2^N}$ where Q is the total number of quantization levels.
- The combination of the Quantizer and the Encoder is called as an Analog-to-Digital Converter (A/D Converter). Thus, the signal transmitted over the communication channel is a digitally-encoded signal.

Waveform:



	c)	**Draw and Explain the block diagram of Code Division Multiplexing (CDM) system**	**8 M**
	Ans:	 1. In CDM separation is achieved by assigning each user channel its own code. Guard spaces are realized by using codes with necessary distance in code spaces, orthogonal codes. Above fig shows CDM scheme. 2. Good protection against unauthorized reception is the main advantage of CDM. 3. A receiver must be precisely synchronized with the transmitter to apply the decoding correctly. – All the signals received by the receiver should have equal strength, otherwise some signals drain others.	**(Diagram : 4 M, Explaination: 4M)**
Q.3.		**Attempt any <u>FOUR</u>:**	**16 M**
	a)	**Write about advantages and disadvantages of Delta Modulation.**	**4 M**
	Ans:	**<u>ADVANTAGES OF DELTA MODULATION:</u>** 1. Low signaling rate 2. Low transmission bandwidth. 3. The delta modulator transmitter and receiver are less complicated to implement. **<u>DISADVANTAGES OF DELTA MODULATION:</u>** 1. SLOPE-OVERLOAD DISTORTION 2. GRANULAR NOISE	**(Advantages :2M (Any 2) ,Disadvantages: 2M)** **(Any 2)**

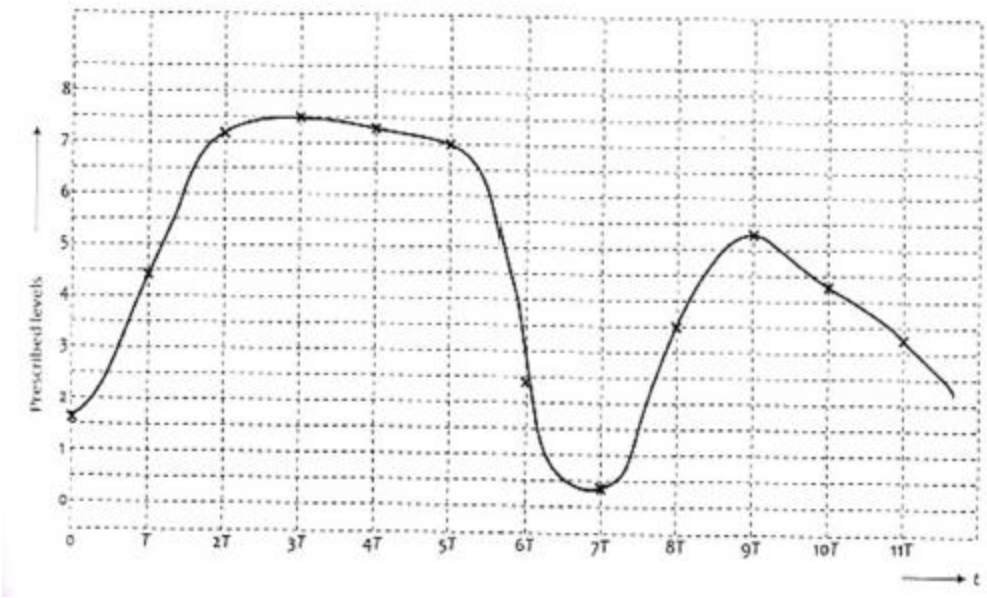
b)	**Draw and Explain QPSK Modulator.**	**4 M**
Ans:	 **Operation:** • The input data sequence is first converted into a bipolar NRZ signal b(t). The value of b(t) = + 1 for logic 1 input and b(t) = - 1 when the binary input is equal to 0. • The De-multiplexer (DEMUX) will divide b(t) into two separate bit streams $b_o(t)$ and $b_e(t)$. The bit stream $b_e(t)$ consists of only the even numbered bits 2, 4, 6, 8, ... whereas $b_o(t)$ bit stream consists of only the odd numbered bits i.e., 1, 3, 5, ... as shown in Figure 3.18. • Each bit in the even and odd stream will be held for a period of $2T_b$. This duration is called as symbol duration T_s. Thus, every symbol contains two bits. • The bit stream $b_e(t)$ is superimposed on a carrier $\cos\omega_c t$ and the bit stream $b_o(t)$ is superimposed on a carrier $\sin\omega_c t$ by using two balanced modulators (or multipliers) to generate $s_e(t)$ and $s_o(t)$. These two signals are basically BPSK signals. • These signals are then added to generate the QPSK output signal $V_{QPSK}(t)$ given by, $\mathbf{V_{QPSK}(t) = b_o(t)\sin\omega_c t + b_e(t)\cos\omega_c t}$	**(Diagram :2 M, Explaination:2M)**
c)	**State sampling theorem and write about it's importance.**	**4 M**
Ans:	**Statement**.: Sampling theorem states that a band-limited signal of finite energy having the highest frequency component f_mHz can be represented and recovered completely from a set of samples taken at a rate of f_s samples per second provided that $\mathbf{f_s \geq 2f_m}$. **Importance :** If the sampling rate $f_s < 2f_x$ (Under Sampling), then the sidebands of the signal overlap and x(t) cannot be recovered without distortion from $X_s(f)$. This distortion is referred to as **Aliasing or Fold-over distortion**.	**(Statement: 2 M, Importance 2M)**

d)	**With the help of OFDM block diagram, Explain it's working.**	**4 M**
Ans:	 *fig : OFDM TRANSMITTER* Digital implementation of OFDM system is achieved through mathematical operations called discrete Fourier transform (DFT) and its counterpart inverse discrete Fourier transform (IDFT). These two operations are extensively used for transforming data between the time domain and frequency domain The input data stream is read. After reading the symbols all symbols are reorganized in to parallel line which is equal to the number of subcarriers. The data is then transmitted in parallel by assigning different blocks to different carriers in the transmission. The IFFT output available in parallel in the form of samples is converted in to a serial output. Few samples are padded at the end in the form of circular shift. The additional block is without any useful information and act as a guard time interval in the time domain to eliminate the effect of multipath delay spread. Cyclic prefix will be removed immediately after RF down conversion stage. So Cyclic prefix is purely overload and normally used method. To generate OFDM successfully the relationship between all the subcarriers must be carefully controlled to maintain the orthogonality of the carriers. For this reason, OFDM is generated by firstly choosing the spectrum required based on the input data and the modulation scheme used. Each subcarrier to be produced is assigned some data to transmit in the IFFT block. The spectrum setting is then converted into its equivalent time domain signal using IFFT. After IFFT stage, the time domain signal must be received in serial form through P/S. The signal thus generated is called OFDM. To generate an up converted RF signal, the signal must be filtered and mixed to desired transmission frequency. Before RF up conversion, the cyclic prefix is added to remove the ISI effect.	**(Diagram : 2 M, Explanation :2M)**

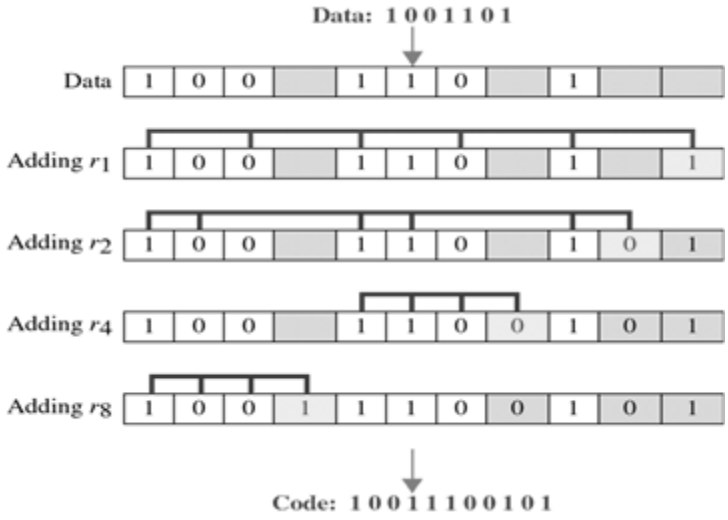
	e)	**Compare between ASK and FSK modulation.(any four points)**	**4 M**
	Ans:		**1M for Each Point** **(Any other relevant point to be considered)**

SR NO	ASK	FSK
1	Poor noise immunity	Better noise immunity
2	Minimum Bandwidth requirement is less and is given by BW = 2fb	Minimum Bandwidth requirement is more and is given by BW = 4fb
3	In ASK amplitude of the carrier carries the binary information	In FSK frequency of the carrier carries the binary information
4	Circuit is very simple to generate.	Circuit complexity is more.

Q. 4	**A)**	**Attempt any THREE:**	**12 M**
	a)	**Explain channel modelling in communication system.**	**4 M**
	Ans:	Modelling of channel means correlating mathematics with the channel statics. ➢ In the analysis and design of communication system, it will be necessary to model the channel as system and incorporate in to that model as many details of electrical behavior of the channel as possible, so as to make it represent the actual situation as accurately as possible. ➢ Types of channel modellings are as follows: 1. Additive Gaussian noise channel 2. Bandwidth limited linear channel 3. Linear time-variant channel	**Explain:4 M**
	b)	**With the help of neat sketch explain quantization process.**	**4 M**
	Ans:	**Quantization process:** 1. Quantization is the process of approximation or rounding off the sampled signal. The quantizes converts sampled signal into approximated rounded values consisting of only finite no. of pre decided voltage levels called as quantization levels. 2. In the process of A to D conversion, after sampling, quantization is the next step. The input signal x (t) is assumed to have a peak swing of VL to VH volts. This entire voltage range has been divided into Q equal intervals each of size "s". s is called as step size and its value is given as	**2M**

		S= VH-VL / Q Diagram of the Process quantization is as shown below-  	**2M**
c)		**With example explain how Hamming code is used for single bit error correction implications.**	**4 M**
Ans:		**HAMMING CODE:** ● The Hamming code is an error-correcting code used for correcting single-bit errors. It cannot correct multiple-bit errors or burst errors and it cannot identify errors that occur in the Hamming bits themselves. Example of hamming code: Let us consider the data unit be 1001101 which is to be transmitted. 1. We 1st place each bit of the original data in its appropriate position in the 11 bit unit. 2. Calculate even parities for the various bit combinations. 3. The parity value for each combination is the value of the corresponding r bits. 4. 4 parity bits are interspersed with the original data bits and finally transmitted.	**Generation of hamming code at transmitter:2M &** **Decoding at receiver:2 M**

At transmitter end:



At receiver end: Let the received code be 10010100101

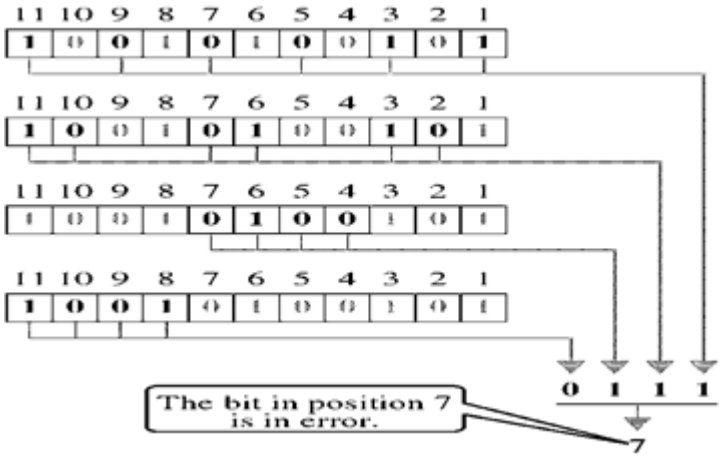
1. We 1st place each bit of the received codeword in its appropriate position in the 11 bit unit.

2. Calculate even parities for r bits w.r.t their bit combinations.

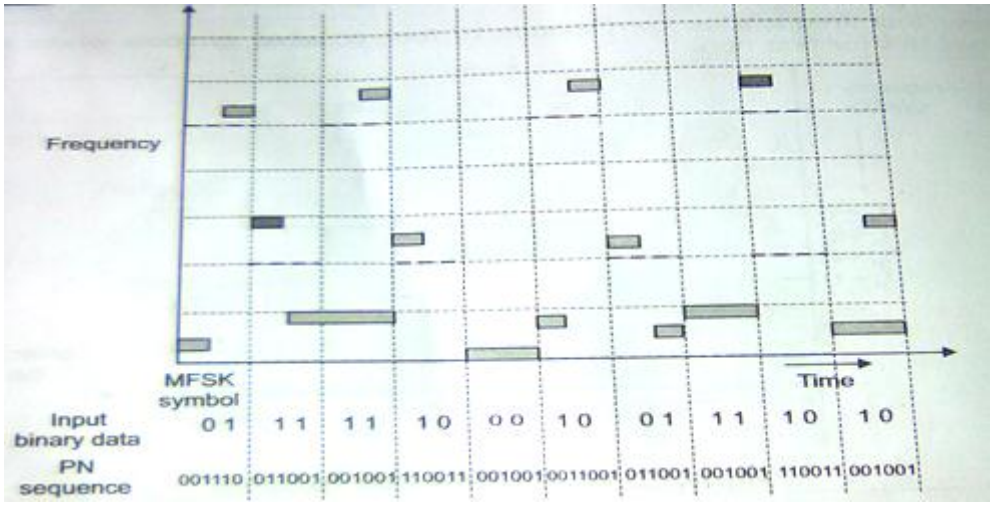
3. The parity value for each combination is the value of the corresponding r bits.

4. The value of 4 parity bits in decimal gives us the information about which bit position error has occurred.

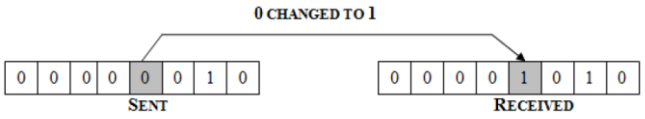
5. Correct that error, discard the redundant bits and finally accept the corrected data unit.



The above example shows the error has occurred in 7th bit position. Change the 7th bit from 0 to 1. Discard the 4 redundant bits and accept the corrected data ie. **1001101**

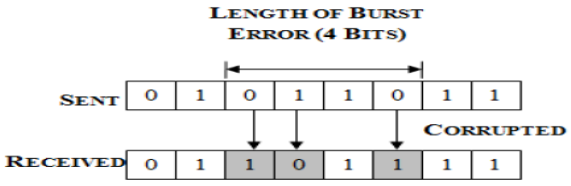
d)	**Explain fast frequency hopping with suitable diagram**	**4 M**
Ans:	Fast frequency hopping means multiple hops are used to transmit one symbol. Thus the hop rate Rh is higher than Rs Rh>Rs The chip rate is equal to hop rate Rc=Rh The fig. shows variation of transmitted frequency of fast hopping with time:  	**2M** **2M**
B)	**Attempt any <u>ONE</u>:**	**6 M**
a)	**State the different types of error present in digital communication system. Find the Hamming weight of following code vector. X=11010100**	**6 M**
Ans:	**<u>Types of error:</u>** **1. 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 from 1 to 0). **2. Burst error:** A burst error or multiple-bit error occurs when two or more bits within a given data string are in error. **Example** Single-bit errors affect only one character within a message. The following figure	**Correct answer for Hamming weight:2 M & each type :2M**

illustrates single-bit error.



Single-bit error

Burst errors can affect two or more characters within a message. The length of the burst is measured from the first corrupted bit to the last corrupted bit. Some bits in between may not have been corrupted as shown in Figure .



Burst error of length 4

The hamming weight of the code vector x= 11010100 is 4

b) Explain the working of direct sequence spread spectrum, with the help of suitable block diagram. — **6 M**

Ans: — **(Diagram :3M, Explanation:3M)**

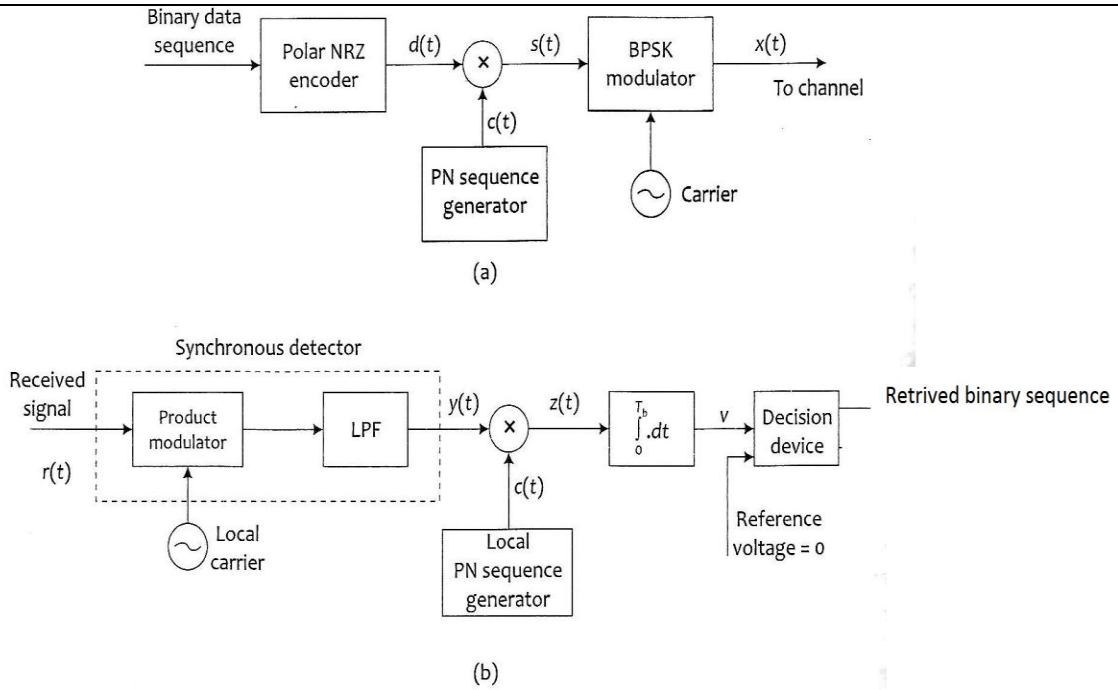
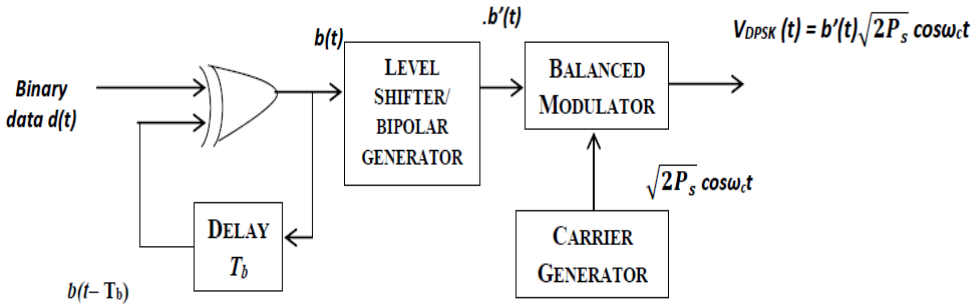


Fig : Direct sequence spread spectrum system using BPSK (a) Transmitter (b) Receiver

- In practice the data sequence after spreading is carrier modulated, generally using either BPSK, QPSK or MSK. Then it is transmitted over the channel.
- At the receiving end, the received signal is first subjected to coherent detection using locally generated carrier signal that is to be arranged in phase and frequency synchronism with the carrier used at the transmitter.
- The output of the coherent detector is then subjected to de-spreading by multiplying it with a locally generated PN sequence generator that is identical to and in synchronism with the one at the transmitter.
- After de-spreading it is integrated over a bit duration T_b to get the voltage v which is used for decision making.

Q.5		**Attempt any TWO:**	**16 M**
	a)	**Draw and explain DPSK transmitter working principle.**	**8 M**
	Ans:	**DPSK MODULATOR:** The generation block diagram of DPSK signal is shown in Figure 3.16. The data stream to be transmitted, d(t), is applied to one input of an exclusive-OR logic gate. To the other gate input the output of the exclusive-OR gate b(t) delayed by time T_b allocated to one bit is applied. This second input is then b(t - T_b).	**Dig:4marks,explaination :4marks**



d(t)		b(t - T_b)		b(t)	
Logic Level	Voltage	Logic Level	Voltage	Logic Level	Voltage
0	-1	0	-1	0	-1
0	-1	1	1	1	1
1	1	0	-1	1	1
1	1	1	1	0	-1

From figure, b(t) is given by, $b(t) = d(t) \quad b(t - T_b)$

Input Data d(t)		1	0	1	1	1	0
Delayed input $b(t - T_b)$		0	1	1	0	1	0
XOR Output b(t)	0	1	1	0	1	0	0
Output Phase		0°	0°	180°	0°	180°	180°
DPSK input (at Receiver)	180°	0°	0°	180°	0°	180°	180°
Recovered data stream		1	0	1	1	1	0

It is observed that when d(t) = 0, $b(t) = b(t - T_b)$ and when d(t) = 1, $b(t) = b(t - T_b)$.
As seen in Figure 3.16,b(t) is applied to a level shifter which assigns a positive voltage level when b(t) = 1 and a negative voltage level when b(t) = 0. The level shifter output is then applied to a balanced modulator to which a carrier signal $\sqrt{2}P_s\cos\omega_c t$ is also applied. The modulator output, which is the transmitted signal is given by,

$$\mathbf{V}_{DPSK}(t) = b'(t)\sqrt{2P_s}\cos\omega_c t$$

$$= (\pm 1)\sqrt{2P_s}\cos\omega_c t$$

b) **Draw block diagram of TDMA technology and explain it's operation. Give the advantage of TDMA over FDMA.** **8 M**

Ans: **TDMA technology :** **[dig:2marks,explaination : 3 marks, advantage of TDMA:3 marks]**

- In TDMA, each user has all the bandwidth, all the power and part of the time. It is frequently used with data and digital voice transmission. TDMA sends data in buffer and hence it is bursty communication. It is non-continuous. TDMA cannot send an analog signal directly due to buffering required. It is used for digital data.
- In this method, all the earth stations share transponder time. Each earth station in the network is allocated a time slot in a periodic sequence.
- It is a method of time division multiplexing, digitally modulated carrier between participating earth stations within the satellite network through a common satellite transponder. With TDMA, each earth station transmits a short burst of digitally modulated carrier during a precise time slot (called **epoch**) within a TDMA frame.
- Each earth station's burst is synchronized so that it arrives at the satellite

transponder at a different time. Consequently, only one earth station's carrier is present in the transponder at any given time thus avoiding collision with another station's carrier.

- The transponder is an RF to RF repeater that simply receives the earth stations transmissions, amplifies them and retransmits them in a downlink beam that is received by all participating earth stations. Each earth station receives the bursts from all other earth stations and must select from them the traffic destined only for itself.

TDMA FRAME:

- A TDMA frame consists of one or two reference bursts and several traffic bursts. A new frame starts with fresh reference bursts. A set of two TDMA frames is illustrated in Figure for three stations.

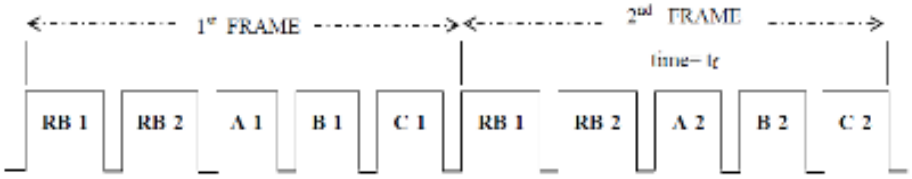


Figure: TDMA frame structure

- RB are the reference bursts and A, B and C are the traffic bursts. A guard band is used between bursts. There is no transmission during the guard time. It prevents overlapping that may occur between various bursts.
- The frame time t_f is the time interval from the start of the reference burst RB-1 to the end of the last traffic burst (TB) of the frame. Typical frame time lies between 0.75 ms to 20 ms.
- The bursts transmitted from the earth stations in their respective slots are received at a receiving station as shown in Figure 5.17. RB will enable the correct bursts to be recognized by the concerned station while the other bursts will be ignored.

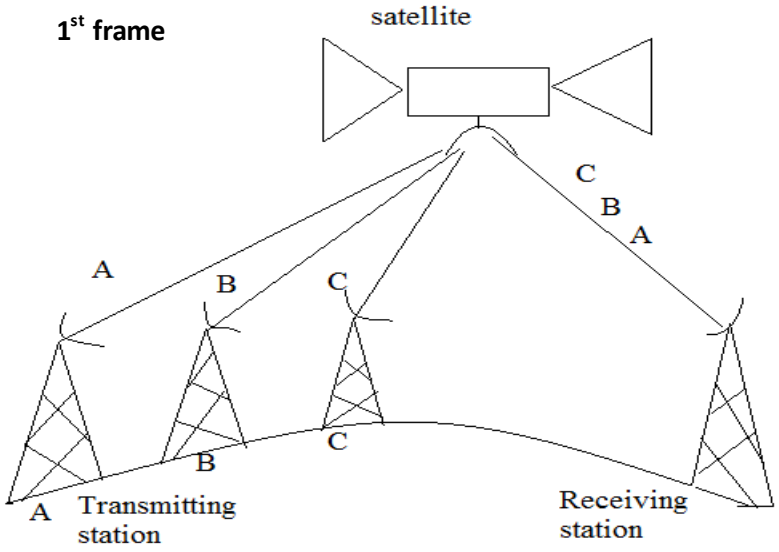


Figure: **Diagram of TDMA system**

As the transmission is done in burst mode, prior to transmission, input bits are temporarily stored in the transmitter's memory storage and then sent during the assigned slot of time as burst signals.

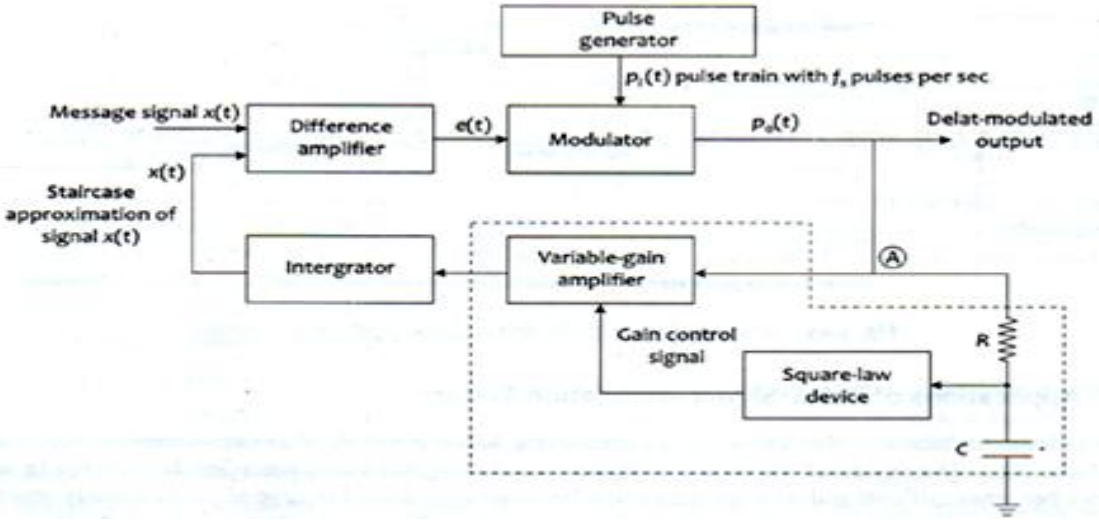
Advantage of TDMA over FDMA:

1. Intermodulation products are absent as there is one carrier only in all time slots.
2. Due to the absence of intermodulation products, TWT can be operated with maximum power output or saturation level.
3. It is easier to change the capacity between nodes by simply changing the duration and position of each burst in the TDMA frame. It is very flexible.
4. Transmission bit rate in TDMA is higher in FDMA due to burst mode of operation.
5. As the transmission is taking place in bursts, its interception by unauthorized elements is difficult. Hence it is more secure than FDMA.
6. TDMA adapt to transmission of data as well as voice communication.

c)	**Write about the importance of spread spectrum modulation. List out application of spread spectrum modulation.**	**8 M**
Ans:	**Importance of spread spectrum modulation :** 1. In combating the intentional interference (jamming): • It is important in communications that the jammer who is trying to disrupt the communication does not have prior knowledge of the signal characteristics except for the overall channel bandwidth and the type of modulation being used. • If digital information is just encoded, a sophisticated jammer can easily mimic the signals emitted by the transmitter and confuse the receiver. Therefore to combat this problem, the transmitter introduces an element of unpredictability or randomness in each of the transmitted coded signal waveforms which is known only to the intended receiver but not to the jammer. 2. In rejecting the unintentional interference from some other user: • Interference from other users arises in multiple access communication systems in which a number of users share a common channel bandwidth. At any given time, a subset of users may transmit information simultaneously over a common channel to corresponding receivers. • By assigning different codes to different users, the transmitted signals in the common spectrum may be distinguished from one another. Thus, a particular receiver can recover the transmitted information intended for it by knowing the code or key used by the corresponding transmitter. 3. To avoid the self -interference due to multipath propagation • A signal can take multiple paths while travelling over a communication channel. The signal components following different path lengths will result in dispersed signal at the receiver. This time dispersive propagation may be viewed as self-interference. This may be suppressed by introducing a pseudo-random pattern in the transmitted signal. 4. Hiding a signal by transmitting it at a low power and thus making it difficult for an unintended listener to detect in the presence of background noise. This low average power signal is achieved by spreading its bandwidth using coding and hence, this signal is also called as low probability of intercept (LPI) signal. 5. Achieving message privacy in the presence of other listeners: • The message privacy can be achieved by superimposing a pseudo-random pattern on the transmitted message. The message can be demodulated by the intended users that know the pseudo random pattern used at the transmitter.	**(1mark for each point – any 4point)** **&** **(1mark for each apply – any 4appl)**

Application of spread spectrum modulation.

6. The **spread spectrum** Communications is widely used today for Military, Industrial, Avionics, Scientific, and Civil uses.
7. Bluetooth Technology.
8. CDMA radios: It is useful in multiple access communications wherein many users communicate over a shared channel. Here the assignment of a unique spread spectrum sequence to each user allows him to simultaneously transmit over a common channel with minimal mutual interference. Such access technique often simplifies the network control requirements considerably.
9. High Resolution Ranging: **spread spectrum** communications is often used in high resolution ranging. It is possible to locate an object with good accuracy using spread spectrum techniques. One example where it could be used is Global Positioning System (GPS). Here an object can use signals from several satellites transmitting spread spectrum signals according to a predefined format to determine its own position accurately on the globe.
10. WLAN: Wireless LAN (Local Area Networks) widely use spread spectrum communications.
11. Cordless Phones: Several manufacturers implement Spread Spectrum in Cordless phones. The advantages of using spread spectrum in cordless phone include the following:
    - Security: Inherently, ass communication is coded.
    - Immunity to Noise: SS modulation is immune to noise when compared with other modulation schemes such as AM and FM.
    - Longer Range: Due to noise immunity, it is possible to achieve a longer range of communications, for a very small transmitted power.
12. Long-range wireless phones for home and industry
13. Cellular base stations interconnection.

Q.6		Attempt any FOUR:	16 M
	a)	Draw and explain Adaptive Delta modulation. Transmitter block diagram.	4 M
	Ans:		Digram:2 M & Explain:2 M

Block diagram of Adaptive Delta modulation Transmitter:

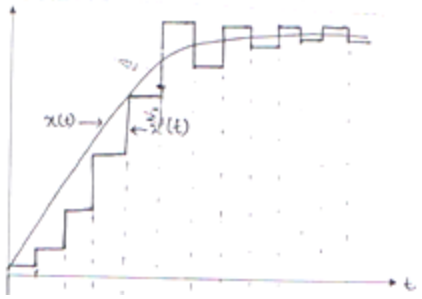
Pulse generator produces train of pulses. Variable gain amplifier and square law device controls the capacitor charging as per the input signal.

If input signal varies slowly or is constant in nature, the charge on the capacitor will be zero due to reverse polarity pulses generated, so amplitude of output pulse of variable gain amplifier will not change and thus help in reduction of granular noise.

If input signal varies steeply , the capacitor will be either positively or negatively charged so amplitude of output pulse of variable gain amplifier will increase with some factor and thus help in reduction of slope overload effect.

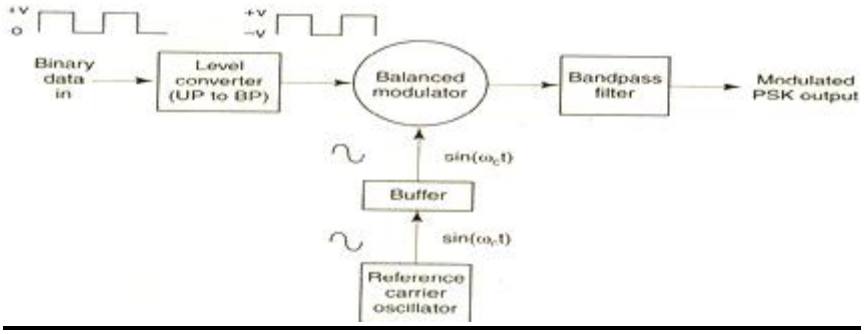
Thus in ADM wide range of analog signal can be used due to variable step size and have better utilization of bandwidth.

Waveform of Adaptive Delta modulation Transmitter:



ADM waveforms

	b)	**Generate the Cyclic Redundancy check (CRC) for the data word 110010101 using divisor 10101.**	**4 M**
	Ans:	Data word : 110010101 Divisor: 10101 Number of digits in divisor: 5 Append to dataword with: 5-1 = 4 Zero's So, now data will be: 110010101 0000 10101) 1100 1010 1000 10101 X11000 10101 X11011 10101 X11100 10101 X10011 10101 XX11000 10101 X11010 10101 X11110 10101 X1011 Reminder Now, append the reminder at end of data word. So, the transmitted data word will be 110010101 1011	**4M**

	c)	**Write about M-ary encoding. State any two advantages and disadvantage.**	**4 M**
	Ans:	**M-ary encoding** • In an M-ary signaling scheme, we can send one of the 'M' possible signals/symbols such as S_1, S_2…..S_N (t) during each signaling interval of duration of 't' seconds. ▪ The number of symbols is M and given as, $M=2^N$, where N = no. of bits that are grouped to form a symbol. ▪ These signals will extend over a period of NTb ,where Tb is duration of one bit. • Due to grouping of n bit per symbols, 2^N=M possible symbols can be generated. • M-ary ASK, M-ary-PSK and M-ary-FSK are the possible signaling scheme **Advantages** 1) Conserves channel Bandwidth 2) Increase in system performance. **Disadvantages** 1) Increase in probability of error. 2) Increase in transmitted power 3) Low SNR/high BER	**M-ary encoding :1 mark & Advantages:-2 mark any one advantage & Disadvantages:1 mark any one disadvantage**
	d)	**Draw and explain PSK transmitter block diagram.**	**4 M**
	Ans:	1.The simplest digital modulation technique is shift keying (PSK). 2.It is a digital modulation technique in which the phase of the analog carrier is changed with respect to the binary input information keeping its frequency and amplitude constant. 3.If binary input is logic 1, phase of analog carrier is shifted by 0^0. 4.If binary input is logic 0,phase of analog carrier is shifted by 180^0. **Block diagram of PSK transmitter:** 	**Diagram: 2M & Explain:2 M**

Working of PSK transmitter:

Digital signal acts as modulating or information signal which is fed to first level converter to change voltage levels from [+V to zero] to [+V to –V].
The level shifted signal and analog carrier sin (ωct) is given as i/p to balance product modulator.
When the binary input is positive we get the carrier signal as it is and ,
When binary input is negative we get the carrier signal phase shifted by 180 degree.
Output of balance modulator is fed to BPF to allow only wanted frequency to pass through it.

e) Explain specifications of T-carrier system. **4 M**

Ans: **Explain:4 M**

Table 3.3 Bit rates and capacities of T-carriers

DS number and T-carrier No		Bit rate in Mbps	No of 64 kbps PCM VF voice channels	Transmission media used
	DS-0	0.064	1	Twisted wire pairs
DS-1	T-1	1.544	24	Twisted wire pairs
DS-2	T-2	6.312	96	Twisted wire pairs / Fiber
DS-3	T-3	44.736	672	Coaxial cable / Radio / Fiber
DS-4	T-4	274.176	4032	Coaxial cable / Fiber
DS-5	T-5	560.160	8064	Coaxial cable / Fiber

OR

The bit rates and the capacities of these DS lines, also called as the T-carriers is given in the table below. The T-1 carriers carry binary digital signals which are represented using a bipolar RZ line code.