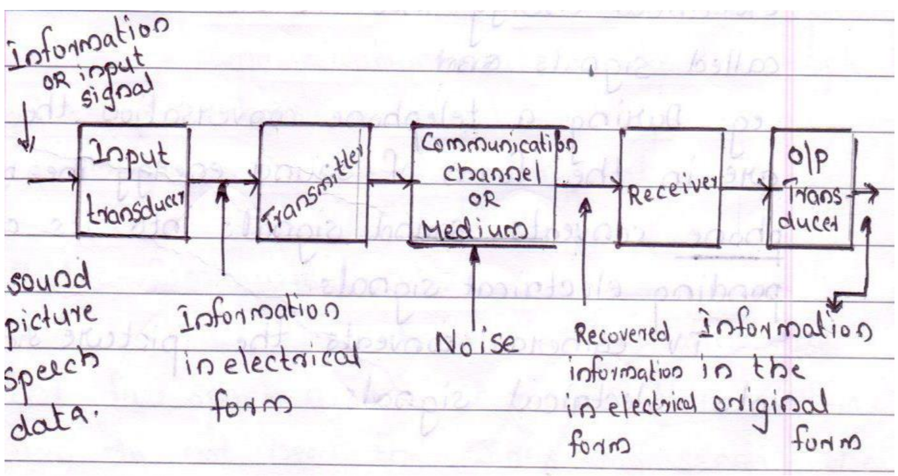
MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2005 Certified)

WINTER – 2016 EXAMINATION

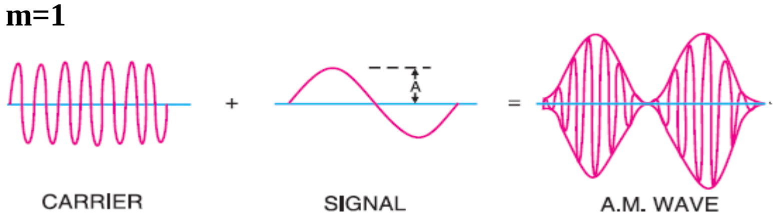
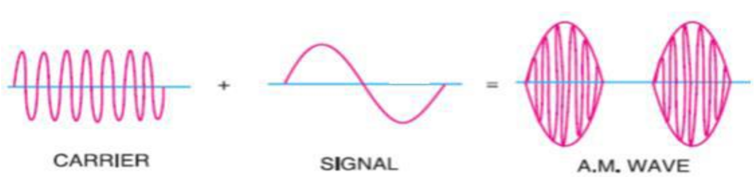
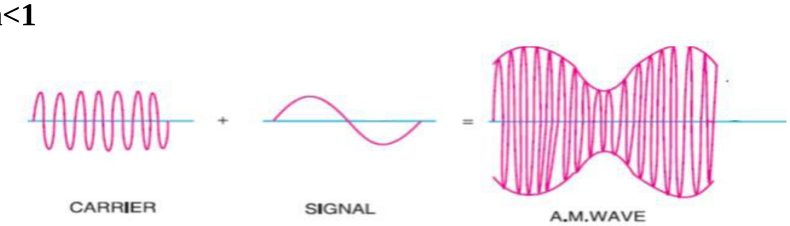
Model Answer **Subject Code: 17519**

Important Instructions to examiners:

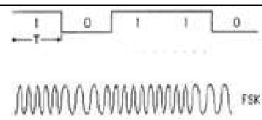
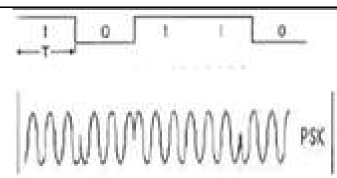
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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)**	**Attempt any three of the following:**	**3x4=12**
	i)	**Draw and explain the block diagram of communication system.**	***4M***
	Ans.	 **Fig: block diagram of communication system** **The main components of a basic communication system are:** 1. Information or input signal	***2M block diagram***

		2. Input transducer 3. Transmitter 4. Communication channel or medium 5. Noise 6. Receiver 7. Output transducer **1. Information or input signal:** The information can be in the form of a sound signal like speech or music or it can be in the form of pictures (T. V. signals) or it can be data information coming from a computer. **2. Input Transducer:** The communication system transmits information in the form of electrical signals. The transducers convert the non-electrical energy into its electrical energy called signals. E.g. During a telephone conversation the words are in the form of sound energy. The microphone converts sound signals into its corresponding electrical signals. TV camera converts the picture signals into electrical signals. E.g. Microphone, TV, Camera. **3. Transmitter:** It is used to convert the information into a signal suitable for transmission over a given communication medium. It increases the power level of the signal. The power level is increased to cover a large range. The transmitter consists of electronic circuits such as amplifier, mixer oscillator and power amplifier. **4. Communication channel or medium:** The communication channel is the medium used for transmission of electrical signals from one place to other. The communication medium can be conducting wires cables optical fiber or free space. Depending on the type of communication medium two types of communication systems will exist. They are 1. Wire communication or line communication 2. Wireless communication or radio communication. **5. Noise:** Noise is random undesirable electric energy that enters the communication system through the communication medium and interferes with the transmitted signal. **6. Receiver:** The reception is exactly the opposite process of	***2M explanation***

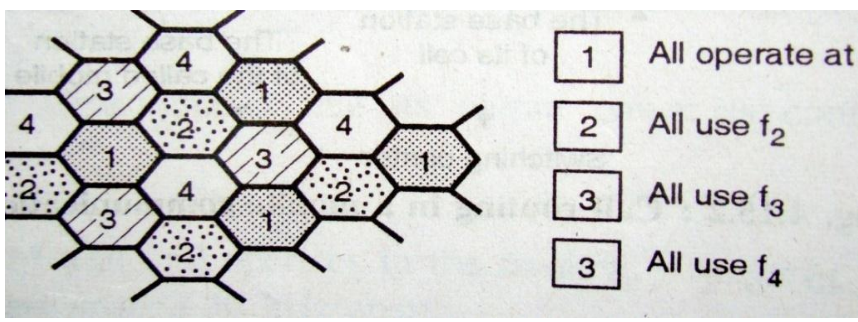
		transmission. The received signal is amplified demodulated converted into a suitable form by the receiver. The receiver consists of electronic circuits like mixer, oscillator, detector amplifier etc. **7. Output Transducer:** The output transducer converts the electrical signal at the output of the receiver back to the original form is sound or TV pictures etc. E.g. Loud speaker: electrical signals sound Picture tubes: electrical signals visual data.	
	ii) Ans.	**Define Modulation index for AM. Draw waveforms for m=1, m>1, m<1.** **Definition:** **Modulation index:** It is the ratio of amplitude of modulating signal to the amplitude of carrier signal. $$m_a = \frac{V_m}{V_c}$$ **Modulation Index (m_a)** =(Vmax-Vmin)/(Vmax +Vmin) 1) **m=1**  2) **m>1**  3) **m<1**  	***4M*** ***Definition 1M*** ***Diagram of waveforms 1M each***

	iii) Ans.	**Compare between FSK and PSK (any four points).**	***4M***

Parameter	FSK	PSK
Definition	In this technique, frequency of the RF carrier is varied in accordance with baseband digital input signal.	In this technique, phase of the RF carrier is varied in accordance with baseband digital input signal.
Band Width	$4f_b$ $2(\delta f + 2f_b)$ f_b=bit frequency	f_b f_b=bit frequency
Noise immunity	High compared to ASK	High compared to ASK
Waveforms		
Bit rate	Suitable upto 1200 bits/sec	Suitable upto 180 bits/sec

Any four points 1M each

	iv) Ans.	**Explain the concept of frequency use in mobile communication.**	***4M***



Relevant diagram 2M

Frequency reuse- Frequency reuse is the process in which the same set of frequencies (channels) can be allocated to more than one cell. Provided the cells are separated by sufficient distance reducing each cells coverage area invites frequency reuse cells using the same set of radio channels can avoid mutual interference, provided they are properly separated. Each cell base station is allocated a group of channel frequencies that are different from those of neighboring cells & base station antennas are chosen to achieve a desired coverage pattern within its cell. However as long as a coverage area is limited to within a cells boundaries the same group of channel frequencies

Concept of frequency reuse 2M

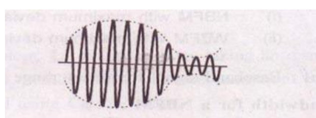
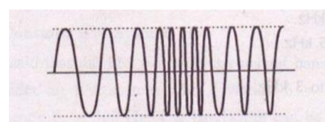
may be used in different cells without interfacing with each other provided the two cells are sufficient distance from one another.

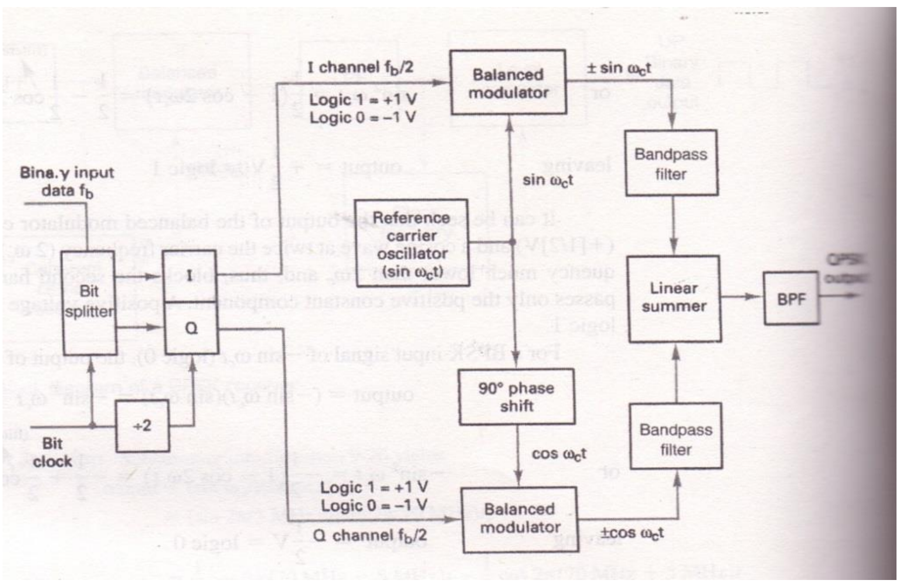
1. **b)** **Attempt any one of the following:** **1x6=6**

i) **Compare AM and FM on the basis of definition, waveform, noise immunity, bandwidth, modulation index and frequencies used for for transmission.** ***6M***

Ans.

1M each

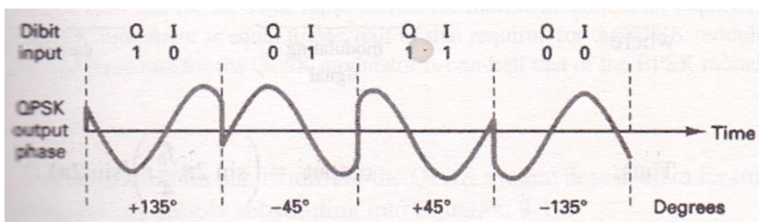
Compare	AM	FM
Definition	Amplitude modulation (AM) is the process of changing the amplitude of a high frequency carrier signal in proportion with the instantaneous value of the modulating signal keeping frequency &Phase constant.	Frequency modulation (FM) is the process of changing the frequency of carrier signal in proportion with the instantaneous value of the modulating signal keeping Amplitude &Phase constant.
Waveform	AM wave: 	FM wave: 
Noise immunity	Less	More
Bandwidth	BW= $2f_m$(f_m -frequency of modulating signal)	Bandwidth =2 $[\delta + f_m]$ (f_m - frequency of modulating signal)
Modulation index	$m_a = \frac{V_m}{V_c}$ V_m - Amplitude of modulating signal V_c- Amplitude of carrier signal	$m_f = \frac{\delta}{f_m}$ δ – frequency deviation f_m - frequency of modulating signal
Frequencies used for transmission	535 – 1605 KHz	88.1 – 108.1 MHz

	ii) Ans.	**Explain the working principle of QPSK with block diagram.** Quadrature Phase Shift Keying or Quaternary Phase shift Keying 1. QPSK is an example of multilevel phase modulation. 2. With QPSK four output phases are possible for a single carrier frequency. 3. Since four output phases are present, there must be four different input conditions. 4. With two bits there are four possible conditions. 00, 01, 10, 11 are possible. 5. With QPSK the binary input data are combined into groups of two bits called dibits. 6. Each dibit code generates one of the four possible output phases ($+45^o$, $+135^o$, -45^o, -135^o)  1. Two bits (a, dibit) are clocked into the bit splitter. 2. One bit is directed to the I channel and the other to Q channel. 3. The I bit modulates a carrier that is in phase reference oscillator (hence the name "I" for in phase channel). 4. The Q bit modulates a carrier that is 90^o out of phase OR in quadrature with the reference carrier (hence the name "Q" for "quadrature" channel. 5. A QPSK modulator is two BPSK modulators combined in parallel. 6. For a logic 1 = + 1V Logic 0 = - 1V	**6M** ***Explanation 2M*** ***Block Diagram 2M***

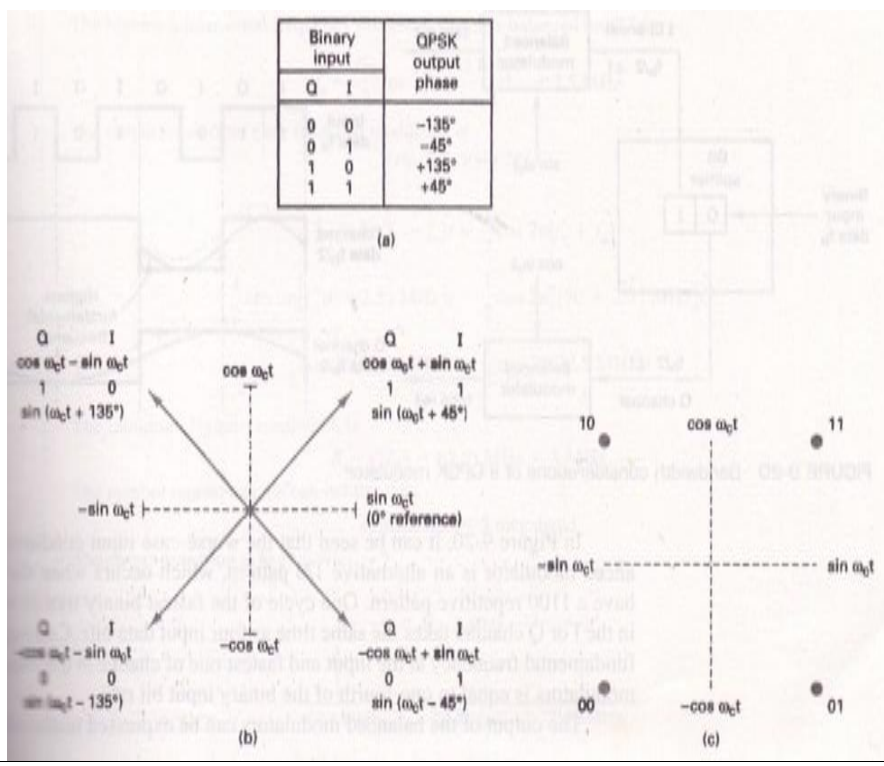
two phases are possible at the output of the I balanced modulator. (+Sin wc t, Sin wc t), and two phases are possible at the output of the Q balanced modulator (+Cos wc t, -Cos wc t). When the linear summer combines the two quadrature (90^o out of phase signals) there are four possible resultant phases given by these expressions:

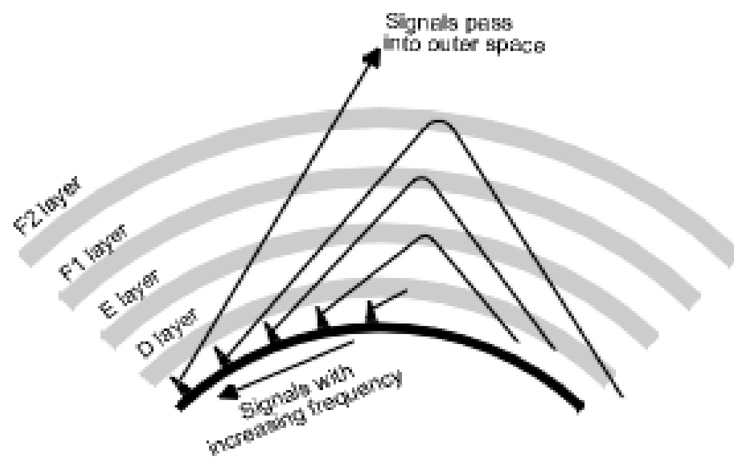
+ Sin w_ct + Cos w_ct
+ Sin w_ct - Cos w_ct
- Sin w_ct + Cos w_ct
+ Sin w_ct - Cos w_ct

Output waveform:



Waveform 2M



2.		**Attempt any four of the following:**	**4x4=16**
	a)	**Describe ionosphere wave propagation with the help of neat sketch.**	***4M***
	Ans.		***Relevant Diagram 2M***
		Electromagnetic waves that are directed above the horizon level are called as sky waves. Typically, sky waves are radiated in a direction that produces a relatively large angle with reference to earth. Sky waves are radiated toward the sky, where they are either reflected or refracted back to earth by the ionosphere. Because of this, sky wave propagation is sometime called as ionosphere propagation. The ionosphere is the region of space located approximately 50km to 400 km above Earth surface. The ionosphere is the upper portion of earth's atmosphere. Therefore it absorbs large quantities of the sun radiant energy, which ionizes the air molecules, creating free electrons. When radio wave passes through the ionosphere the electric field of the wave exerts a force on the free electrons, causing them to vibrate. The vibrating electron decreases current, which is equivalent to reducing the dielectric constant. Reducing the dielectric constant increases the velocity of propagation and causes electromagnetic waves to bend away from the regions of high electron density toward regions of low electron density. As the wave moves farther from earth ionization increase; however, there are fewer air molecules to ionize. Therefore, the upper atmosphere has a higher percentage of ionized molecules than the lower atmosphere. The higher the ion density, the more refraction. Also because of the ionosphere's non uniform composition and its temperature and density variations, it is stratified. Essentially, three layers makeup the ionosphere (the D, E, Flayers).	***Relevant Explanation 2M***

b) Ans.

Define and draw waveforms for PWM and PPM. *4M*

Definition PWM: When width of pulsed carrier varies in accordance with instantaneous value of modulating signal keeping pulse amplitude and pulse position constant is called PWM. *Definition of PWM 1M*

Definition PPM: When position of carrier pulse is varied in accordance with the instantaneous value of modulating signal keeping pulse amplitude and pulse width constant is called PPM *Definition of PPM 1M*

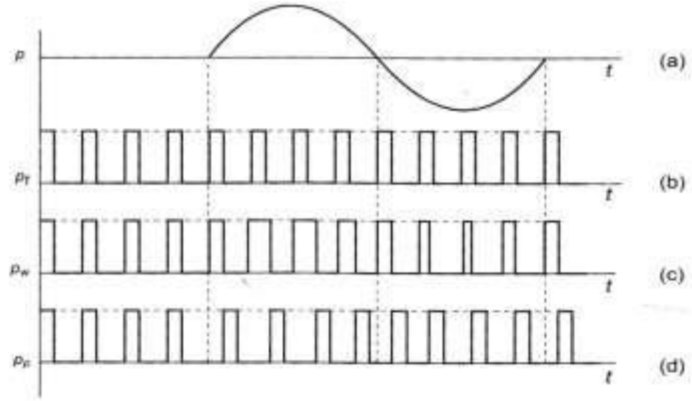
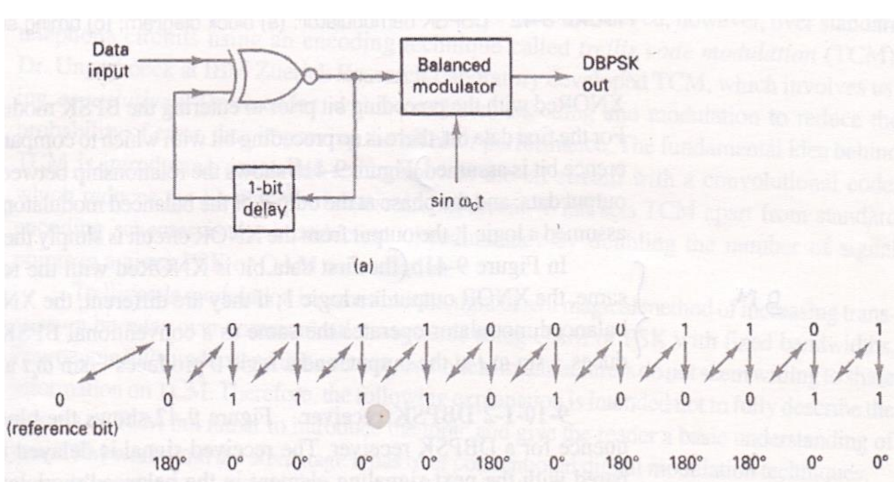


Fig. *Generation of PPM. (a) Message, (b) pulse train, (c) PWM and (d) PPM.*

Diagram 2M

c) Ans.

Draw block diagram of DPSK generation. State the function of each block. *4M*



Block Diagram of DPSK generation

Diagram 2M

Differential phase – shift keying (DPSK) is an alternative form of digital modulation where the binary input information is contained in the difference between two successive signaling elements rather than the absolute phase.

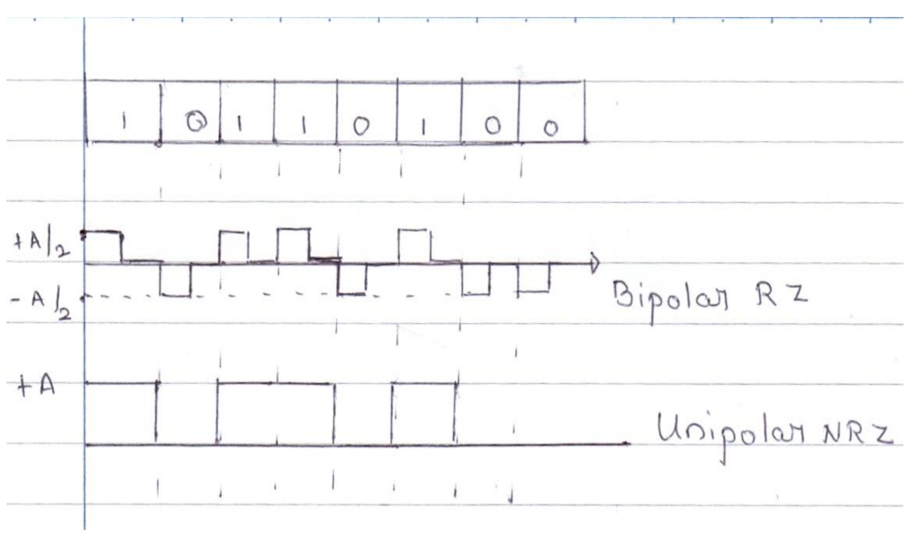
Functions 2M

XNOR: An incoming information bit is XNORed with the preceding bit prior to entering the BPSK modulator (balanced modulator). For the first data bit, there is no preceding bit with which to compare it. Therefore, an initial reference bit is assumed. If the initial reference bit is assumed a logic 1, the output from the XNOR circuit is simply the complement of that bit.

Balanced Modulator: The first data bit is XNORed with the reference bit. If they are the same, the XNOR output is a logic 1; if they are different, the XNOR output is a logic 0. A logic 1 produces + sin$\omega_c t$ at the output of the balanced modulator and a logic 0 produces- sin $\omega_c t$ at the output.

d) With neat waveform sketch, encode the data 10110100 using
i) Bipolar RZ
ii) Unipolar NRZ technique. *4M*

Ans.



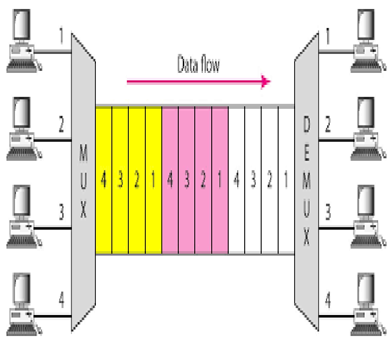
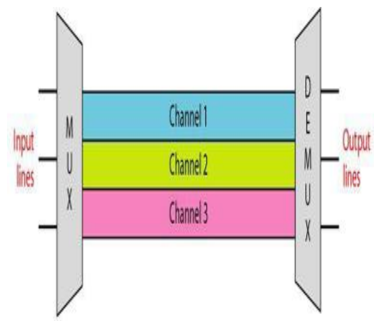
Bipolar RZ 2M

Unipolar NRZ 2M

e) Compare between TDM and FDM (4 points). *4M*

Ans.

Compare	TDM	FDM
Defi	Time-division multiplexing	Frequency-division

		nitio n	(TDM) is digital technique to combine data where time is shared	multiplexing (FDM) is an analog technique where total range of frequncy is divided into number of frequency slots. Each slot of frequency is allotted to each channel	***1M each***
		Sche matic Diag ram			
		Prin ciple	• Various channels of different frequencies combined, transmitted through single wire & separated at receiver with help of demultiplexer. • Transmission time is divided into number of times slices. • Then each time slice is allocated to different source node, each of which wants to send data. • Data flow of each connection is divided into units & link combines one unit of each connection to make a frame. • Data rate of link that carries data from ‘n’ connections must be ‘n’ times data rate of a connection to gurantee the	• Various channels of different frequencies combined, transmitted through single wire & separated at receiver with help of demultiplexer. • FDM is applied when bandwidth of a link greater than combined bandwidth of signals to be transmitted. • These modulated signals are then combined into single comosite signal that can be transported by the link. • Carrier frequencies are separated by sufficient bandwidth to accommodate modulated signal. • These bandwidth ranges are channels through	

	flow of data.	which various signals travels. • Channels must be separated by guard bands to prevent signals from overlapping.
Synchronization	Synchronitzation is required	Synchronization is not required

f) Ans. **Explain the concept of Hand-off.** *4M*

Handoff: Cellular system has the ability to transfer calls that are already in progress from one cell-site controller to another as the mobile unit moves from cell to cell within the cellular network.

The transfer of a mobile unit from one base stations control to another base stations control is called a handoff.

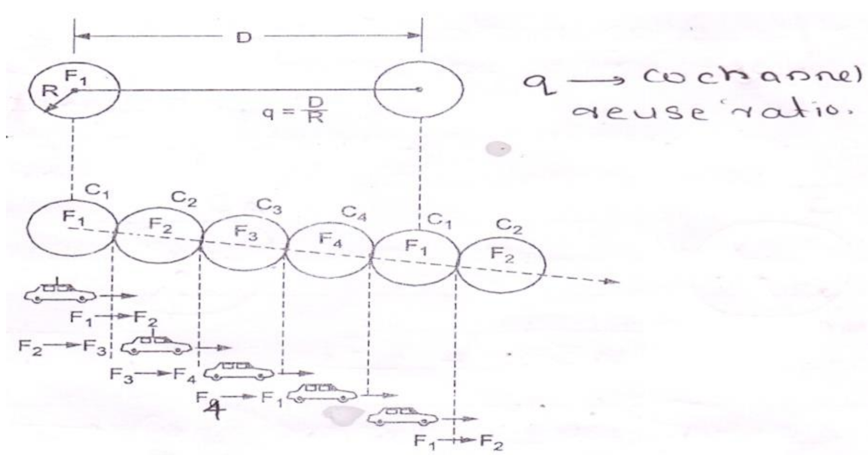


Diagram 2M

The process in which mobile station changes one cell to another, hence from one base station to another base station and mobile station remains connected to this called person is called "handoff" operation of a base station.

- As the vechicle containing the telephone passes through a cell it is served by the cell transceiver.
- The telephone call is routed through the MTSO and to the standard telephone system.
- As the vehicle moves the system automatically switches from one cell to the next.

Explanation 2M

- The receiver in each cell station continously monitors the signal strength of the mobile unit.
- When the signal strength drops below a desired level, it automatically seeks a cell where the signal ffrom the mobile ubit is stronger.
- The computer at the MTSO causes the transmission from the vechicle to be switched from the weaker cell to the stronger cell. It is called "Hand off" Mechanism.

Consider two co-channel cells using the frequencey F_1 seperated by a distance D. The radius R and the distance D are represented by q (co-channel reuse ratio) q =D/R. The other frequency channels such as F_2 F_3 and F_4 are selected between two co-channel cells to provide the communication system in whole area . The corressponding cells are C_2, C_3 and C_4. Suppose a mobile unit is starting a cell in cell C_1 and then moves to C_2. The call be dropped and reinitated in the frequencey channel from F_1 to F_2 while mobile unit moves from cell C_1 to C_2. The process of changing frequency can be done automatically by the system without users mediation. This process is called "Hand off".

The process of reallocating a different voice channel to the mobile cellular phonw as the user moves between cells during a call is called Hand off.

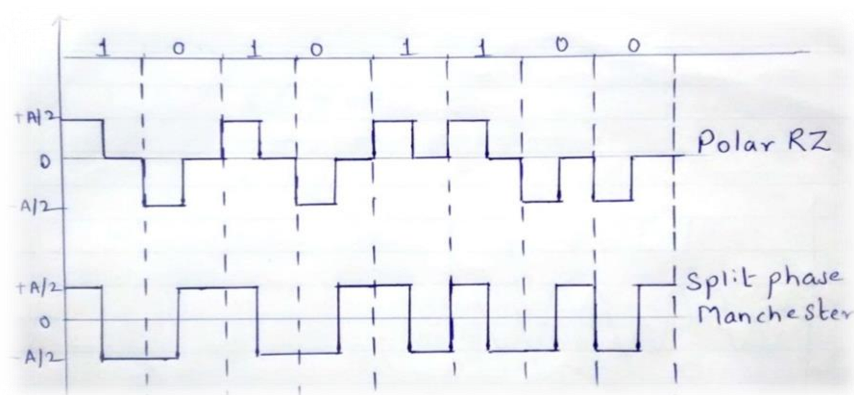
3. **Attempt any four of the following:** **4x4=16**

a) **Compare between DM and ADM (4 Points)** ***4M***

Ans.

Parameters	DM	ADM
Number of bits per sample	It uses only one bit for one sample	Only one bit is used to encode one sample
Step size	Step size is fixed	Step size is variable
Distortions/errors	Slop overload and granular noise	Granular noise
Signaling rate and bandwidth	Low, if the input is slow varying	Lowest
Step size decision	Up/Down counter	Digital Processor
Feedback	Feedback exists in transmitter	Feedback exists.
System Complexity	Simple	Simple
Noise immunity	Very good	Better than DM as it has less errors

Any four points 1M each

		Dynamic range | Wide dynamic range of Analog signal cannot be present | Wide dynamic range of Analog signal can be used due to variable step size	
	b) Ans.	**Calculate Bits per second of PCM system in which sampling frequency is 8 KHz and each sample is converted into 8 bits with A.D.C.** Given N=8, $f_{s} =$ 8 KHZ Bit rate = N x $f_{s} =$ 8 x 8 KHZ Baud rate=Bit rate = 64 K bit/sec (as transmission is binary)	***4M*** ***Analysis /Given Data = 1M, formula = 1M, calculation =2M***
	c) Ans.	**State the bandwidth requirement of** **i) ASK ii) FSK iii) DPSK iv) QPSK** F_b = input bit rate, ΔF = frequency duration i) ASK= F_b ii) FSK= $2(\Delta F + 2 F_b)$ iii) DPSK= F_b iv) QPSK = $F_b/2$	***4M*** ***Bandwidth requirement 1M each***
	d) Ans.	**Draw Polar RZ and split phase Manchester data encoding for 10101100.** 	***4M*** ***Each encoding 2M***

e) **Explain the concept of TDM in details.** *4M*

(Note: Any relevant diagram shall be considered)

Ans. **Time-division multiplexing (TDM)**

Time-division multiplexing (TDM) is digital technique to combine data where time is shared.

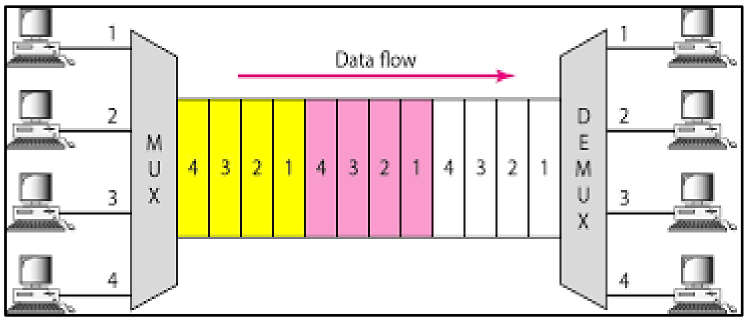


Diagram 2M

- Various channels of different frequencies combined, transmitted through single wire & separated at receiver with help of demultiplexer.
- Transmission time is divided into number of time slices.
- Then each time slice is allocated to different source node, each of which wants to send data.
- Data flow of each connection is divided into units & link combines one unit of each connection to make a frame.
- Data rate of link that carries data from “n” connections must be “n” times data rate of a connection to guarantee the flow of data.

TDM concept 2M

4. **Solve any four of the following:** **4x4=16**

a) **With neat diagram explain mobile communication system.** *4M*

Ans.

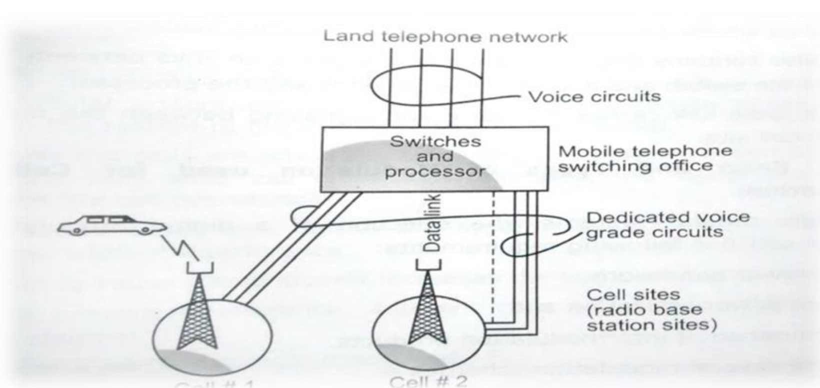
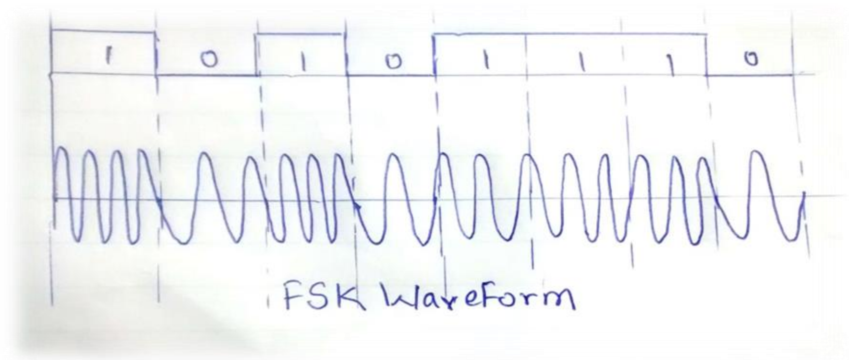


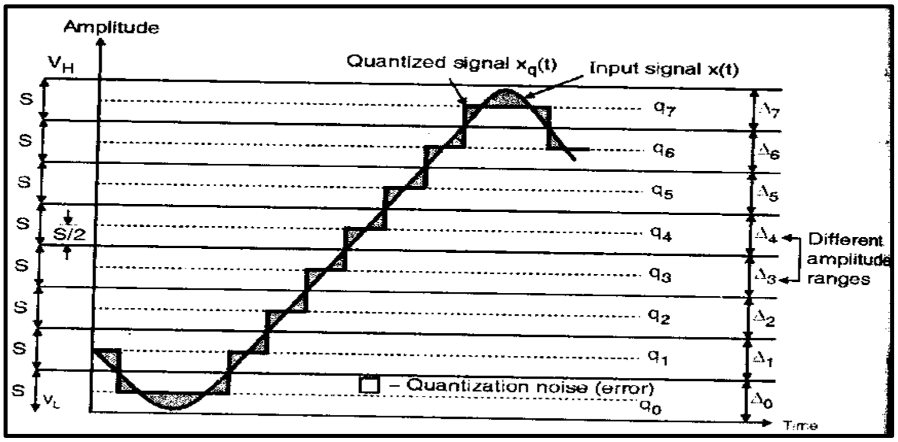
Fig. Cellular Mobile phone System

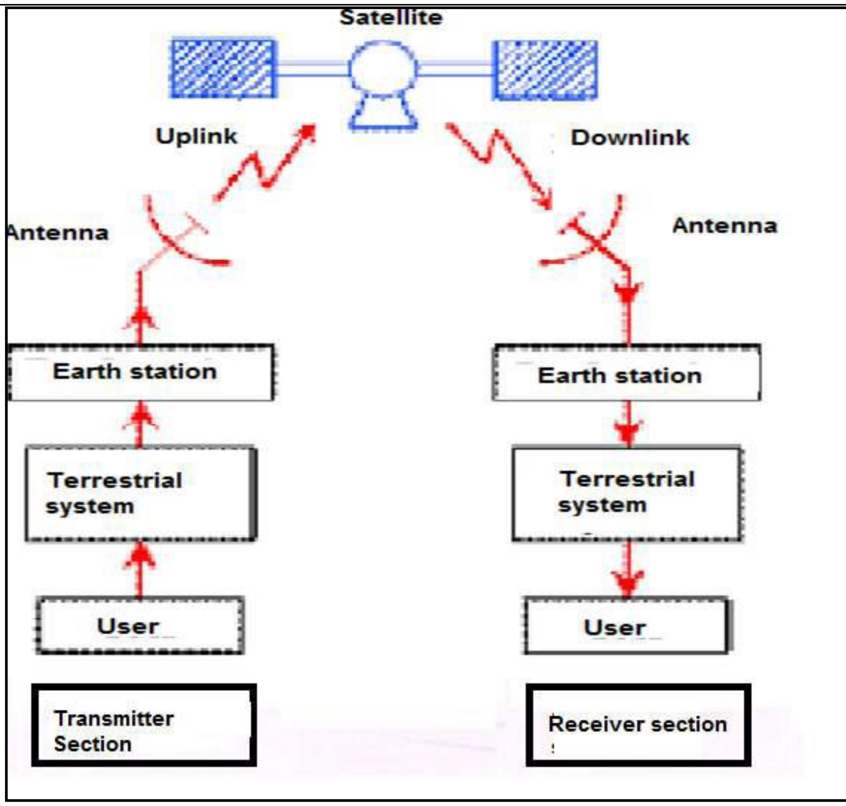
Diagram 2M or (any other diagram showing concept)

		Figure above shows a cellular mobile phone system which consists of • Mobile Station (MS) • Base Station (BS), and • Mobile Telephone Switching Office (MTSO) **1) Mobile Station (MS):** The mobile station contains a transceiver, an antenna, and control circuitry and may be mounted in a vehicle or used as a portable hand-held unit. **2) Base Station (BS):** The base stations consist of several transmitter and receiver which simultaneously handle full duplex communication and generally have towers which support several transmitting frequency and receiving antennas. The BS serves as a bridge between all mobile users and connects simultaneous mobile calls via telephone lines or microwave links to the MSC. **3) Mobile Telephone Switching Office (MTSO):** The MSC co-ordinates the activities of all the base stations and connects the entire cellular system to the PSTN. A typical MTSO handles 100,000 cellular subscribers and 5,000 simultaneous conversations at a time, and accommodates all billing and system maintenance functions as well. Communication between the BS and mobiles is defined by a standard Common Air Interface (CAI) that specifies four different channels. **4) Connections:** The radio and high-speed data links connected the three subsystems. Each mobile unit can use only one channel at a time for its communication link. Each site having multichannel capabilities that can connect simultaneously to many mobile units.	***Explanation 2M***

	b) Ans.	**Draw FSK waveform for the bit sequence 10101110.State the advantages of FSK over ASK. State the disadvantages of FSK.**  **Advantages of FSK over ASK:** 1. Low noise, since amplitude is constant 2. Power requirement is constant 3. Operates in virtually any wires available 4. High data rate 5. Used in long distance communication 6. Easy to decode 7. Good sensitivity 8. It has high security 9. Efficiency is high **Disadvantages of FSK:** 1. The major disadvantage is its high bandwidth requirement. 2. Therefore FSK is extensively used in low speed modems having bit rates below 1200 bits/sec. 3. The FSK is not preferred for the high speed modems because with increase in speed, the bit rate increases. 4. This increases the channel bandwidth required to transmit the FSK signal. 5. As the telephone lines have a very low bandwidth, it is not possible to satisfy the bandwidth requirement of FSK at higher speed. Therefore FSK is preferred only for the low speed modems.	***4M*** ***Waveform – 2M*** ***Any 2 Advantages- 1M*** ***Any 2 Disadvantages- 1M***
	c) Ans.	**State the sequential steps for handset to landline call procedure.** **(*Note: Step wise marking can be considered*)** • The mobile subscriber enters the wireline telephone number into the units memory using a standard touch-Tone keypad. The subscriber then press a send key which transmits the called number as well as the	***4M*** ***Steps for***

		mobile units identification number over a reverse control channel to the base station switch. • If the mobile units ID number is valid, the cell site controller routes the called number over a wireline trunk circuit to the MTSO. • The MTSO uses standard call progress signals to locate the switching path through the PSTN to the destination party. • Using the cell site controller, The MTSO assigns the mobile unit a non busy user channel and instructs the mobile unit to tune to that channel. • After the cell site controller receives the verification that the mobile unit has tuned to the selected channel the mobile unit receives a call progress ring tone while the wireline caller receives a standard ringing signal. • If a suitable switching path is available to the wireline telephone number, the call is completed when the wireline party answers the telephone.	***handset to landline call procedure 4M***
	d) Ans.	**Define quantization. Explain with neat diagram. How to reduce quantization noise?** **Quantization:** Quantization is the process of approximation or rounding off the sampled signal. The quantizer converts sampled signal into approximated rounded values consisting of only finite no. of pre decided voltage levels called as quantization levels. 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 $S = VH-VL / Q$ Diagram of the Process quantization is as shown below-	***4M*** ***Quantization definition -1M*** ***Diagram -2M***

		 The quantization noise is shown by shaded portion of the above waveform. The maximum value of quantization error ± s/2 where s is a step size. Therefore to reduce quantization noise we have to reduce step size by increasing the number of quantization levels i.e. Q. Companding circuits can be used for reducing quantization error or quantization noise. This reduces quantization noise without increasing bandwidth. This is a process of artificially boosting low amplitude signal during transmission and to reduce quantization error. This is called compression. The reverse process of enhancing this compressed signal (expansion) is carried out at the receiver to large the signal back to original value.	***Noise reduction- 1M***
	e) Ans.	**Explain Block diagram of satellite communication.**	***4M*** ***Diagram 2M***



A

satellite is any natural or artificial object located in space, capable of receiving and retransmitting electromagnetic waves.

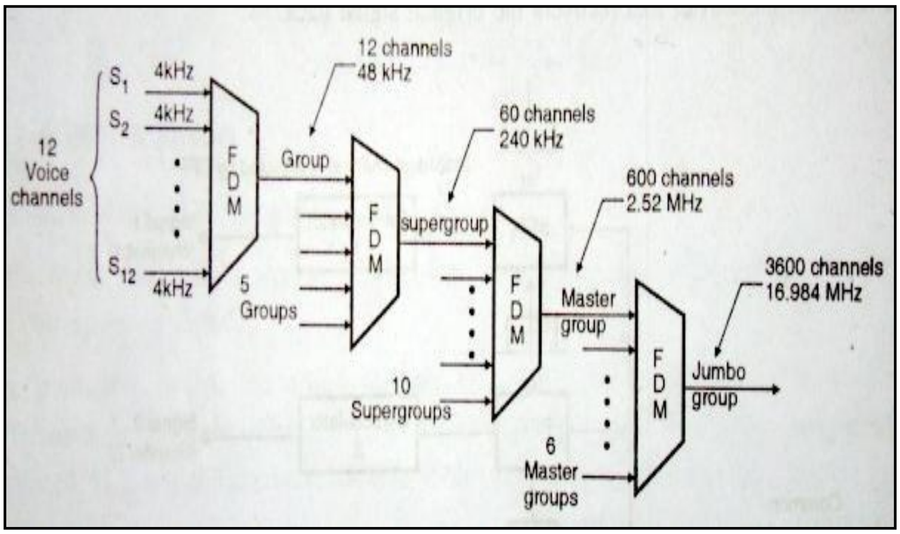
Description 2M

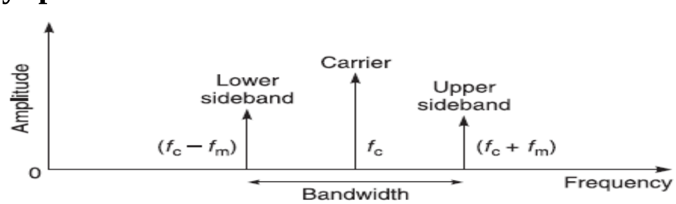
Transmitter

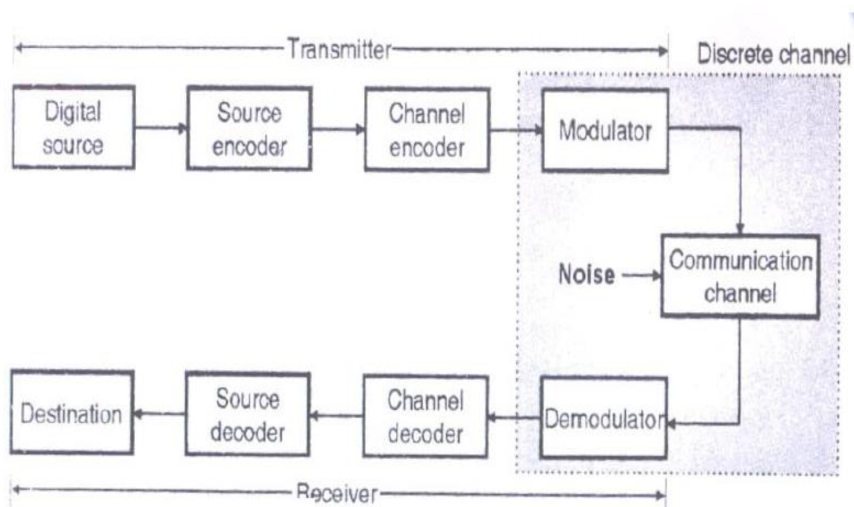
The satellite communication system consists of a satellite that links many earth stations on the ground. When the user is connected to earth station through a terrestrial network (telephone or leased line) the user generates baseband s/g, processes & transmits to the satellite at the earth station.

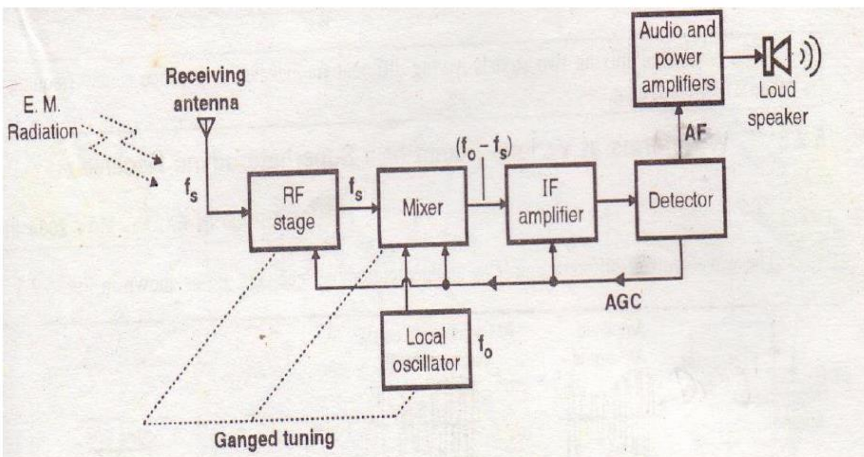
Satellite

It is a large repeater in space. It receives the modulated RF carrier in uplink frequency spectrum from all the earth station in the network. The frequency used for transmission from earth station to space (satellite) is called uplink frequency. The satellite amplifies this carrier & retransmits them to the earth in the down link frequency spectrum. The frequency used for transmission from space to earth (satellite to earth station) is called down link frequency. The uplink & downlink frequency are made different in order to avoid interference of these s/g is space.

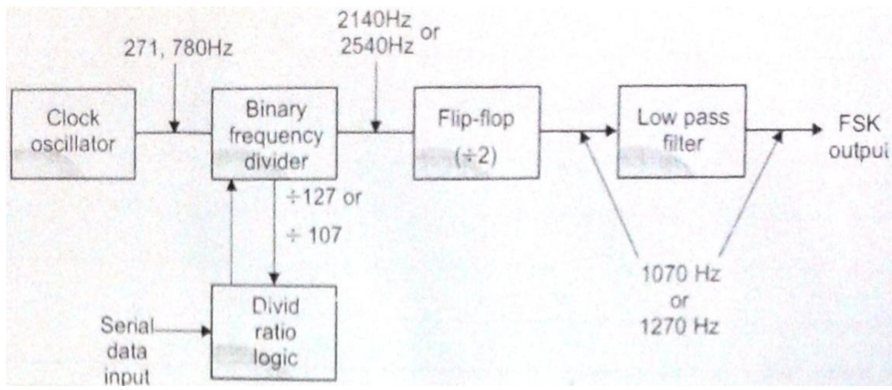
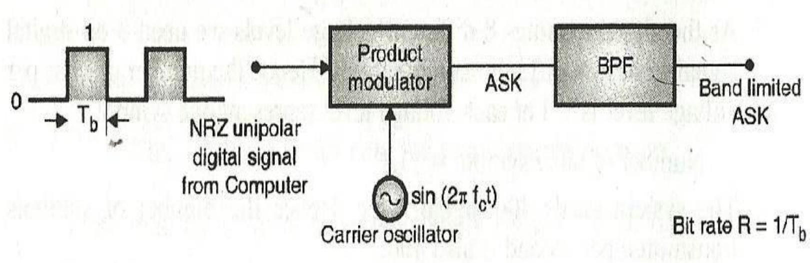
		Receiver The earth station receives s/g from satellite this s/g is processed to get the original baseband s/g which is then send to the user through terrestrial network.	
	f) Ans.	**Draw multiplexing hierarchy in FDM.** **Multiplexing hierarchy in FDM:** 	*4M* *Diagram 4M*
5.	**a)** Ans.	**Solve any four of the following:** **Explain Shannon's theorem related to channel capacity.** The capacity of a channel with bandwidth B and additive Gaussian band limited white noise is $C=B\log_2(1+S/N)$ **bits/sec** Where S & N are the average signal power and noise power respectively at the output of channel N= ηB (if the two sided power spectral density of the noise is η/2 watts/Hz) B= channel bandwidth	**4x4=16** *4M* *Statement 2M* *Equation 2M*
	b) Ans.	**State advantages, disadvantages and application of PCM.** **Advantages –** 1. High noise immunity. 2. Due to digital nature of signal, repeaters can be placed between transmitter and receivers. The repeaters actually regenerate received PCM signal. This is not possible in analog systems. Repeaters further reduce effect of noise. 3. High transmitter efficiency.	**4M** *Any 2 advantages 2M*

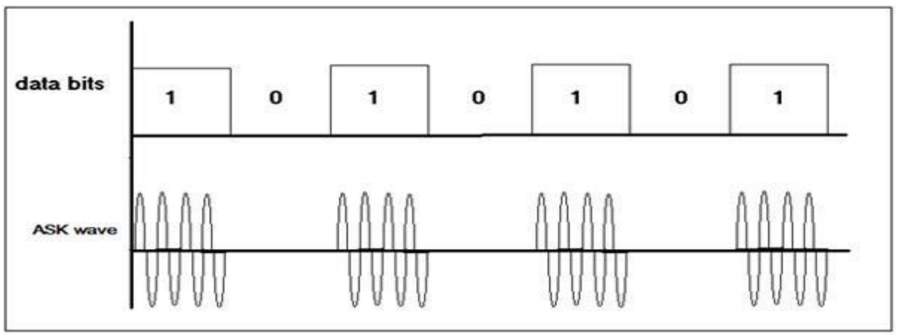
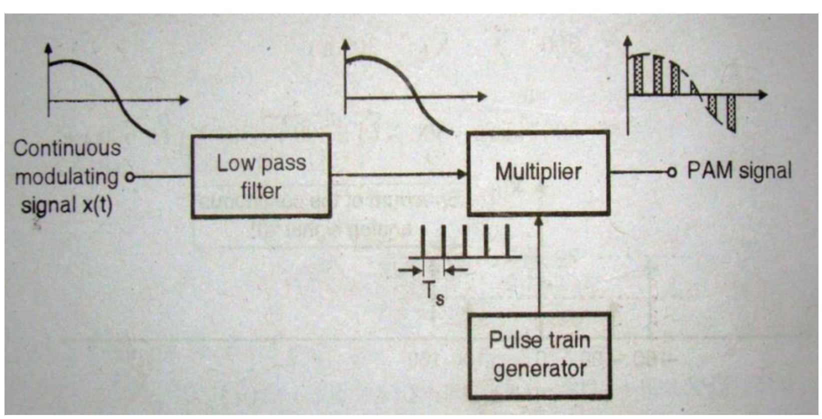
		4. It is possible to store PCM signal due to its digital nature. 5. It is possible to use various coding techniques so that only desired person can decode received signal. 6. Good signal to noise ratio (SNR) **Disadvantages :** 1. Encoding, decoding and quantizing circuit of PCM is very complex. 2. Require large bandwidth compared to other systems **Applications:** 1. In space communication where space craft transmits signal to earth. 2. In telephony.	***Any 1 disadvantage 1M*** ***Any 1 application 1M***
	c) Ans.	**State the applications of satellite communication systems(any 4)** 1. The main application of satellite is communication. Satellites are used as relay station in sky. 2. The main application of satellite is surveillance or observation. E.g.: a. Military satellites are used for reconnaissance. b. Intelligence satellite collects information about enemies and potential enemies. c. Observation satellites are used as Metrological satellites and weather satellites. d. Satellites can spot diseased crop area mineral resources source of pollution etc. 3. TV signals can be transmitted through satellites for redistribution. 4. Satellite can be used in navigation e.g. - Global positioning system (GPS) 5. Telephone system uses satellites for long distance calls.	***4M*** ***Any 4 points 1M each***
	d) Ans.	**Draw and explain frequency spectrum of AM. State its advantages and disadvantages.** **Frequency spectrum of AM –**  **Explanation –**	***4M*** ***Frequency spectrum of AM 1M***

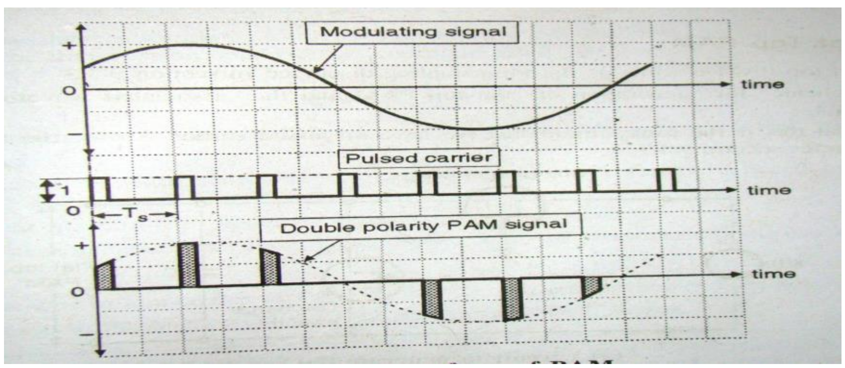
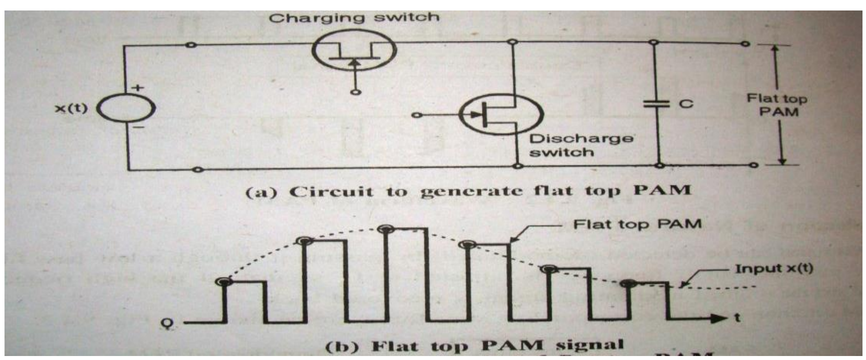
		1. AM wave consist of three frequency components namely carrier, lower sideband and upper sideband. 2. Lower sideband is sinusoidal component which has frequency of (f_c-f_m) and amplitude of $(mE_c/2)$ 3. Upper sideband is sinusoidal component which has frequency of (f_c+f_m) and amplitude of $(mE_c/2)$ 4. Carrier has frequency f_c and amplitude of E_c **Advantages –** 1. AM transmitters are not complex. 2. AM receivers are simple and easy to detect. 3. Less expensive. 4. Covers large distance. **Disadvantages –** 1. Requires large bandwidth. 2. Requires large power. 3. Get affected due to noise.	***Explanation 1M*** ***Any 1 advantage 1M*** ***Any 1 disadvantage 1M***
	e) Ans.	**Draw the block diagram of digital communication system.**  **Digital communication system**	***4M*** ***Correct diagram 4M***
	f) Ans.	**Define and explain Baud rate and Bit rate.** **Baud rate:** • Baud rate is the number of signal units per second. • Baud is the unit of signaling seed or modulation rate or rate symbol transmission. **Bit rate:**	***4M***

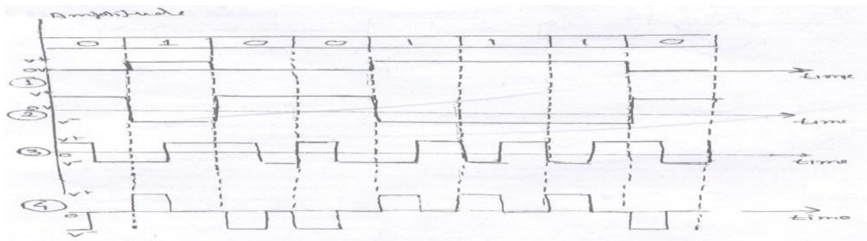
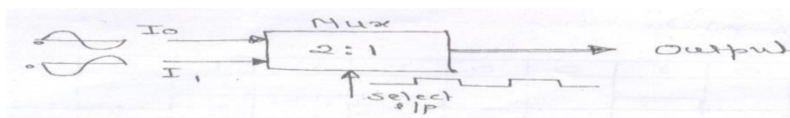
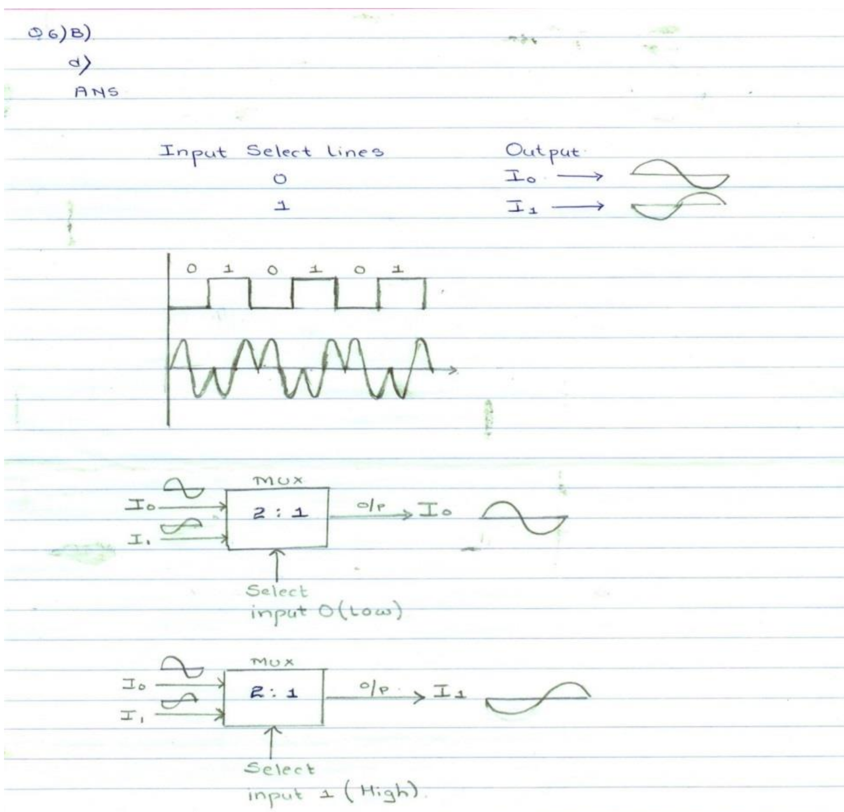
		• Bit rate is the number of bits transmitted per second. • Data rate is also known as bit rate. Bit rate = 1 /Bit interval • If the bit duration is Tb (known as bit interval), then bit rate will be 1/Tb • Bit rate should be as high as possible. • With increase in data rate the bandwidth of transmission medium must be increased in order to transmit the signal without any distortion.	*2M for each definition and explanation*
6.	**A)** **i)** Ans.	**Attempt Any ONE.** **Draw the block diagram of AM super heterodyne AM Radio Receiver. State the function of each block.**  **Function of block-** The AM signal transmitted by the transmitter travels through the air and reaches the Receiving antenna. The signal is in the form of electromagnetic waves. It induces a very small voltage into the receiving antenna. **RF amplifier:** The RF amplifier is used to select the wanted signal and rejects the unwanted signals present at the antenna. It reduces the effect of noise. At the output of RF amplifier we get the desired signal at frequency f_s. **Mixer:** The mixer receives the signal from the RF amplifier at frequency (f_s) and from the local oscillator at frequency (f_0) such that $f_0 > f_s$. **Intermediate frequency (IF):** The mixer is a non-linear circuit. It will mix the signals having frequency and to produce signals having	**1x6=6** *6M* *Diagram 3M* *Explanation 3M*

		frequencies f_s, f_0 , f_0-f_s , f_0+ f_s. Out of these the difference of frequency component i.e. f_0-f_s is selected and all other are rejected. This frequency is called intermediate frequency (IF). **IF = f_0-f_s** **Ganged Tuning:** In order to maintain a constant difference between the local oscillator frequency and the incoming signal frequency ganged tuning is used, this is simultaneous tuning of RF amplifier mixer and local oscillator. This is obtained by using ganged tuning capacitors. **IF amplifier**: The IF signal is amplifier by one or more IF amplifier stage. **Detector**: The amplifier IF signal is detected by the detection to obtain the original modulating signal. Normally practical diode detectors are used as detector. **Audio and Power Amplifier**: The recovered modulating signal is amplified to the adequate power level by using the Audio and Power Amplifier and given to the Loudspeaker. Loudspeaker converts the electrical signals into sound signals. **AGC (Automatic Gain Control)**: This circuit controls the gain of RF and IF amplifiers to maintain a constant output voltage level even when the signal level at the receiver input is fluctuating. This is done by feeding a controlling D.C. voltage to the RF and IF amplifiers. The amplitude of this dc voltage is proportional to the detector output.	
	ii) Ans.	**Draw block diagram of FSK transmitter. State function of each block.** **FSK:** Frequency shifting keying (FSK) is a digital modulation in which frequency of sinusoidal carrier is shifted between two discrete values of frequency where amplitude & phase remains constant. IN FSK, a binary information signal directly modulates the frequency of analog carrier.	***6M***

		 Note that binary 1 corresponds to frequency 1270 Hz and binary 0 to frequency 1070 Hz As shown in block diagram, **Clock Oscillator**: Generates frequency of 271780Hz. **Divide ratio logic**: Produces frequency division by 127 **Frequency divider:** when data input is zero, the frequency divider output will be 1/127 of its input. Then output frequency will be 2140 Hz. **Flip Flop:** this divides the 2140 Hz frequency by 2, producing the desired 1070Hz output corresponding to binary "0" similarly, we get 1270 Hz frequency at binary "1" in which frequency divider will divide 107. **Low pass filter:** Removes higher frequency harmonics producing sine wave output.	***Diagram 3M*** ***Explanation 3M***
6.	**B)** **i)** Ans.	**Attempt any three.** **Explain the working principle of Amplitude Shift Keying Modulation (ASK) with suitable waveforms.** **Working Principle:** In ASK binary information signal directly modulates amplitude of analog carrier. **Block Diagram of ASK Generation:**  	**3x4=12** ***4M*** ***Working principle 1M*** ***Diagram of ASK generation 1M***

		Carrier Oscillator – Generates carrier i.e. sinewave of frequency f_c Digital Signal – Act as modulating or information signal. Product Modulator – It is multiplier which multiplies modulating and carrier signal. Due to multiplication ASK output will be present only when binary '1' is to be transmitted. BPF – Band pass filter allows only wanted frequency. **Waveform –** 	***Explanation 1M*** ***Waveform 1M***
	ii) Ans.	**Draw diagram of PAM generation to obtain flat top sampling. Explain the operation with suitable waveforms.** ***(Note: Any one of below mentioned or other relevant diagram may also be considered)*** In Pulse Amplitude Modulation system (PAM), the amplitude of the pulsed carrier is changed in proportion with the instantaneous amplitude of the modulating signal x(t). The carrier is in the form of train of pulses. **1. Generation of PAM:** 	***4M*** ***Diagram of PAM 1M***

		Low Pass Filter: The continuous modulating signal x (t) is passed through low pass filter. Low pass filter will band limit this signal to fm. Band limiting is necessary to avoid the aliasing effect in the sampling process. **Pulse train generator**: This generates a pulse train at a frequency fs such that fs>2fm to satisfy the nyquist criterion. **Multiplier:** this block simply multiples the information signal and carrier signal and uniform sampling takes place to generate PAM signal as shown below.	***Explanation 2M***
		 **OR** **2. Flat top PAM:**  (a) Circuit to generate flat top PAM (b) Flat top PAM signal	***Waveform 1M***
		Working: The sample and hold circuit consists of two FET switches and a capacitor as shown. A gate pulse will be applied to charging switch will turn ON the capacitor charges through it to the sample value. The charging switch is then turned OFF; hence both FET's are OFF for duration of 'τ' seconds and the capacitor will hold he voltage across it constant for this period. Thus the pulse is stretched to 'τ' seconds. At the end of the pulse interval pulse is applied to discharge switch and turns it ON and capacitor discharges through it and output voltage reduces to zero.	

	iii)	**Identify the types of encoding technique for the following four waveforms.** 	*4M*
	Ans.	1) Unipolar NRZ 2) Polar NRZ-L 3) Manchester 4) Polar RZ	***1M each Encoding Technique***
	iv)	**Draw output waveform for following setup.** 	*4M*
	Ans.		***Correct output waveforms 4M***