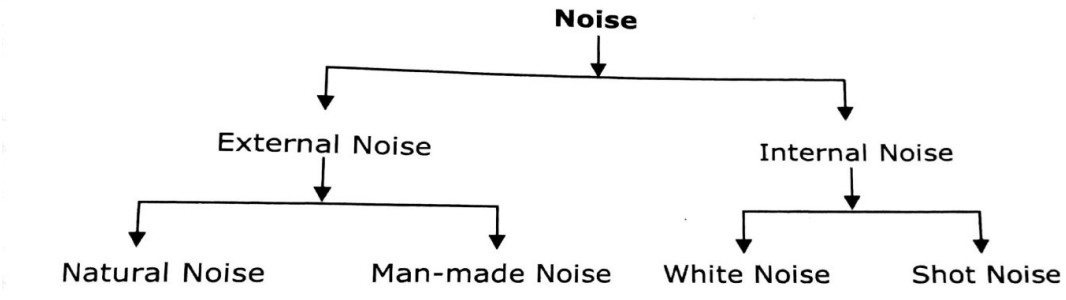
MODEL ANSWER

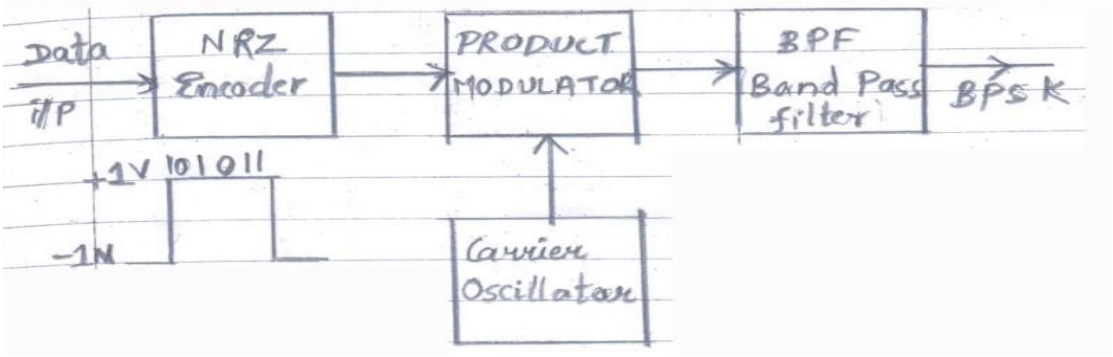
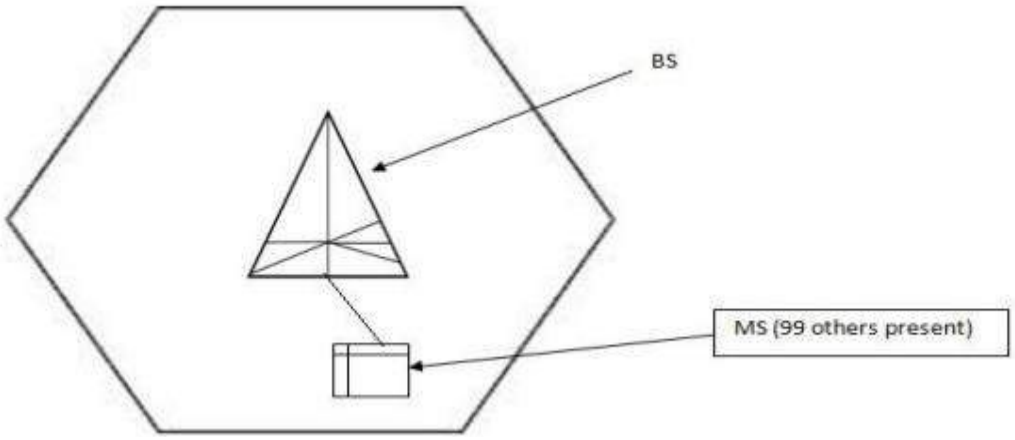
SUMMER– 17 EXAMINATION

Subject Title: Communication Technology **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.		**Attempt any three of the following:**	**12Marks**
a)	**i)**	**State the concept of noise in the electronic communication system.**	**4M**
	Ans:	Noise is an unwanted electrical signal which gets added to the transmitting signal while travelling. The noise gets superimposed on the signal and makes it impossible to separate the signal from noise. It is random, undesirable electric energy that enters the communication system via communication medium and interferes with the transmitted information. Due to noise the quality of signal will be degraded. For example- 1. In radio receiver noise may produce hiss in the loudspeaker output. 2. In pulse communication system, noise may produce unwanted pulses or cancel out the wanted ones. **Types of noise:**  	**(Concept: 3 marks, Types: 1 mark)**

	ii)	**Describe the working of phase shift keying with Block diagram.**	**4M**
	Ans:	NRZ encoder counters binary data into NRZ bipolar signal. Consider, the NRZ bipolar signal to be having amplitude +1V corresponding to binary 1 and -1V corresponding to binary 0. The carrier oscillator generates line wave carrier signal (sinwct). The product modulator multiplies the i/p encoded signal with the carrier signal producing +1 (sinwct) signal and -1 (sinwct). The difference of phase between the two signals is 180^0, thus generating BPSK. The band pass filter (BPF) limits the frequency band of BPSK.  	**(Block Diagram: 2 marks, Description: 2 marks)**
	iii)	**How cell splitting take place in mobile communication with neat diagram?**	**4M**
	Ans:	Cell splitting means to split up cells into smaller cells. The process of cell splitting is used to expand the capacity (number of channels) of a mobile communication system. As a network grows, a quite large number of mobile users in an area come into picture. Consider the following scenario. There are 100 people in a specific area. All of them owns a mobile phone (MS) and are quite comfortable to communicate with each other. So, a provision for all of them to mutually communicate must be made. As there are only 100 users, a single base station (BS) is built in the middle of the area and all these users' MS are connected to it. All these 100 users now come under the coverage area of a single base station. This Coverage area is called a cell.  But now, as time passed by, the number of mobile users in the same area increased from	**(Diagram: 2 marks , Explnation:2 marks)**

100 to 700. Now if the same BS has to connect to these 700 users' MS, obviously the BS will be overloaded. A single BS, which served for 100 users is forced to serve for 700 users, which is impractical. To reduce the load of this BS, we can use cell splitting. That is, we will divide the above single cell into 7 separate adjacent cells, each having its own BS.

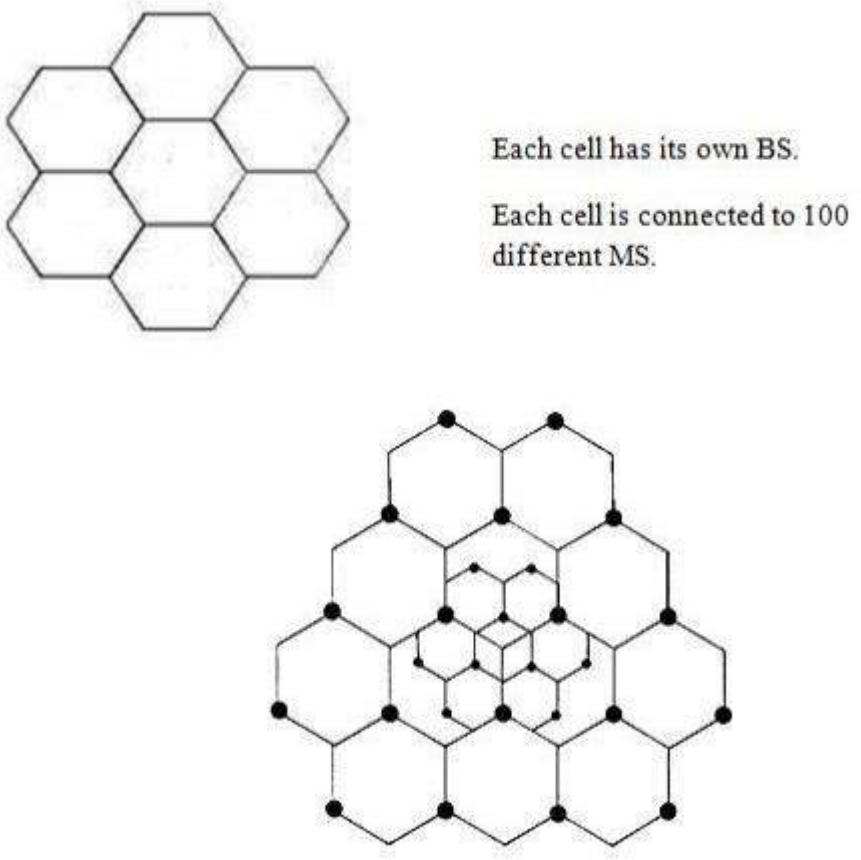
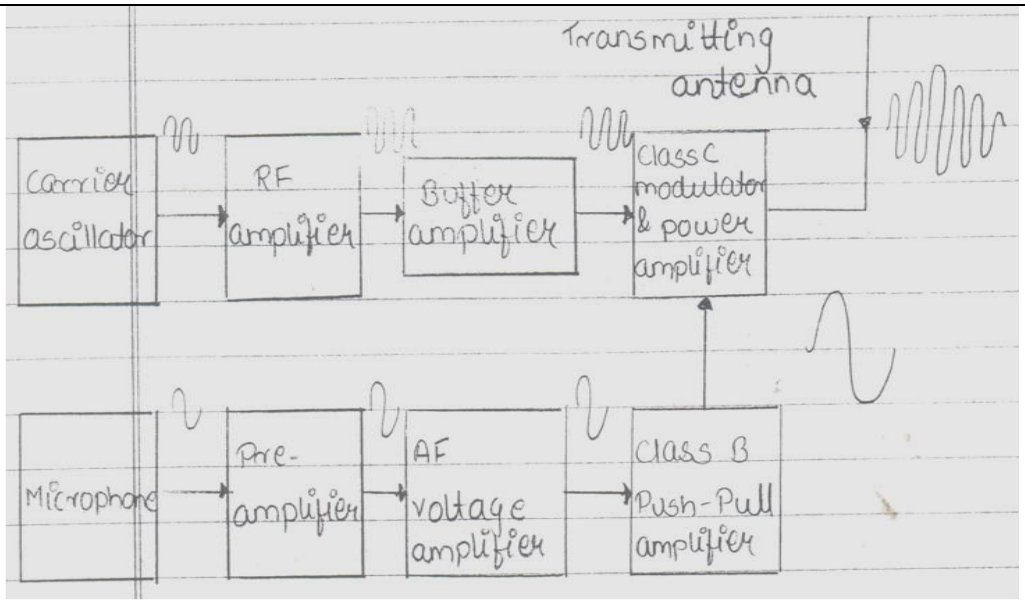
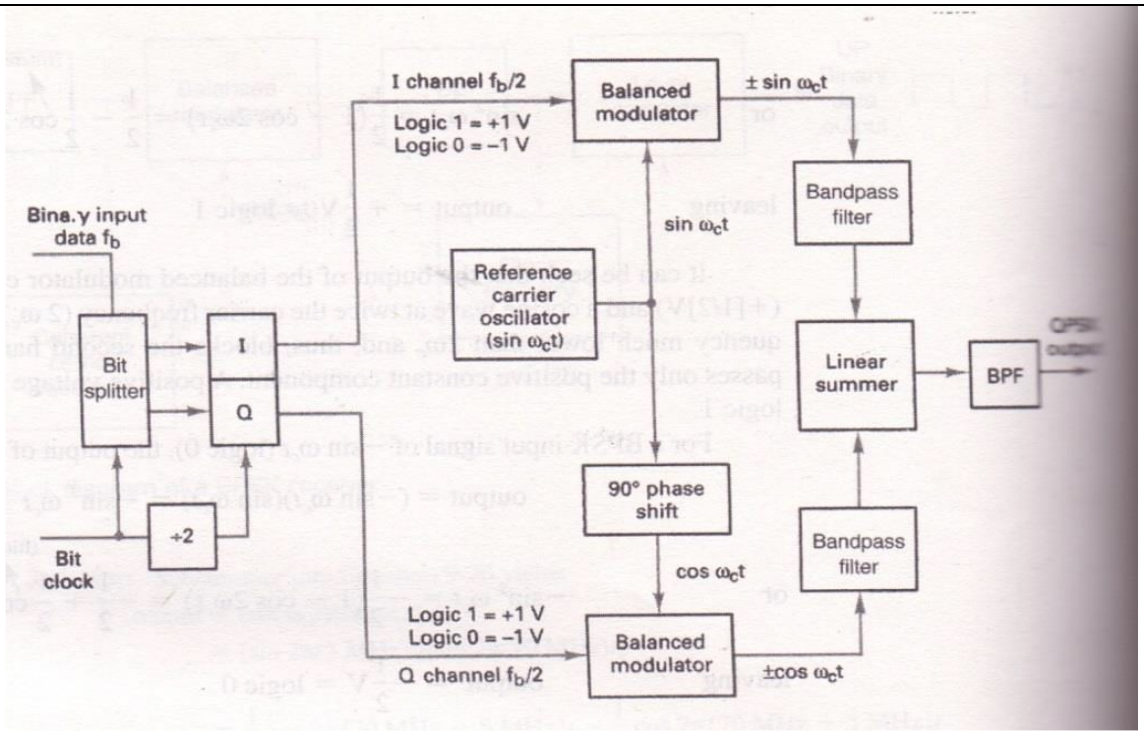


Fig: Cell splitting

The concept of cell splitting can further be applied to the split cells as well. That is, the split up cells can further be split into a number of smaller cells to improve the efficiency of the BS even more.

	iv)	**Draw the block diagram of high level AM transmitter. Explain the function of each block.**	**4M**
	Ans:	 **1. Carrier Oscillator:** It consists of LC or crystal oscillator. Its function is to generate a stable and accurate high frequency sinusoidal signal. **2. RF Amplifier:** It is a high gain amplifier to amplify carrier produced by oscillator. It amplifies RF signal and attenuates other frequencies. **3. Microphone:** It is a pick-up device which converts sound signal into voltage in the order of microvolts (μV). **4. Pre-amplifier:** The output of the microphone is very weak and is fed to the pre-amplifier. It amplifies the μV to mV level. It is a very sensitive amplifier. **5. AF Voltage amplifier:** It is a transistorized low frequency amplifier having bandwith of audio frequency. It amplifies modulating signal from millivolts to volts. **6. Buffer Amplifier:** It is an impedance matching circuit. It matches the output impedance of modulator. It is also used as a isolation circuit for isolating RF amplifier with the modulator. **7. AM modulator:** It uses either base or emitter modulator. It is a class A or Class B type. The output is AM signal. **8. Class B Push pull amplifier:** The modulating signal power required for modulation is very high and hence Class B push pull amplifier is used. **9. Class C modulator & power amplifier:** High level transmitters use collector modulation – it is operated in Class C mode to provide very high efficiency. The output modulated wave is directly fed to the transmitting antenna. **11. Transmitting antenna:** It converts the modulated signal in electrical form into electromagnetic waves. These waves are transmitted through the atmosphere as ground	**(Diagram: 2 marks, Explanation: 2 marks)**

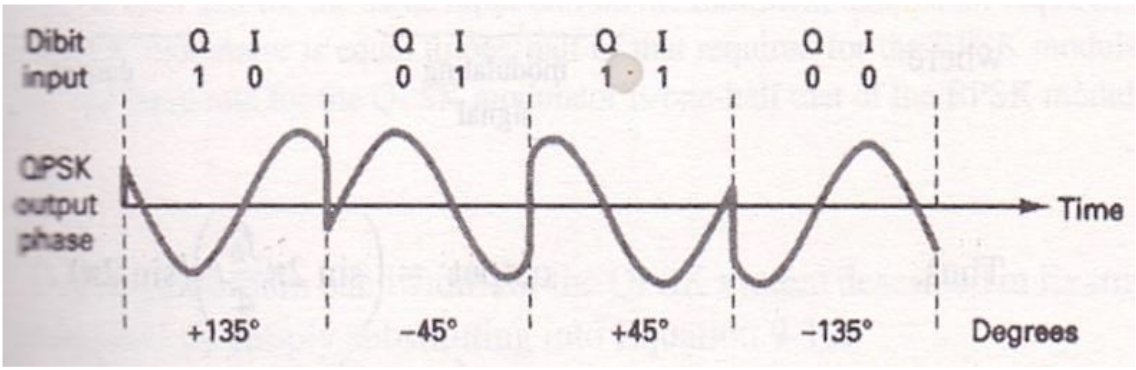
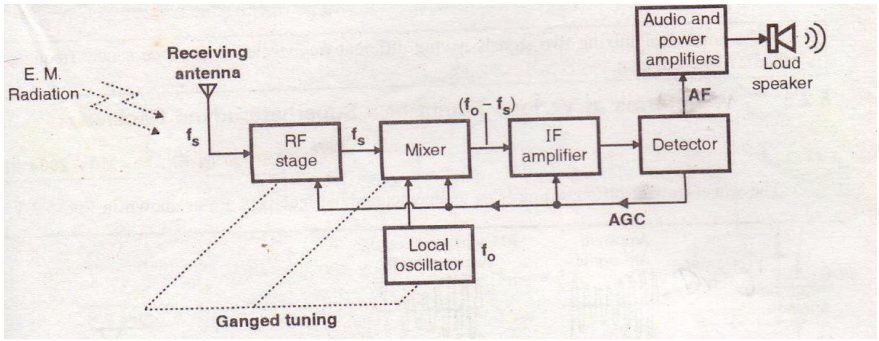
		wave or sky wave to reach the receiver.	
	b)	**Attempt any one of the following:**	**6 Marks**
	i)	**Find out the bandwidth required for FM in which maximum deviation is 8 KHZ and m_f=5. Assume highest needed standards are 8.**	**6M**
	Ans:	Given :- Deviation $\delta = 8$ KHZ Modulation index $(m_f) = 5$ $N = 8$ $\therefore m_f = \frac{\delta}{f_m}$ $f_m = \frac{\delta}{m_f}$ $= \frac{8}{5}$ $f_m = 1.6$ KHZ Bandwidth $(BW) = 2 f_m \times N$ $= 2 \times 8 \times 1.6$ KHZ $= 25.6$ KHZ	**(Given Values: 1 mark, Formula: 1 mark , Calculation of f_m:2 marks , Calculation of Bandwidth: 2 marks)**
	ii)	**Draw the block diagram of QPSK and explain its working principle. State its application.**	**6M**
	Ans:	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, +135º, -45º, -135º)	**(Explanation : 2 marks , Block Diagram: 2 marks, Waveform: 1 mark, Any One Application: 1 mark)**



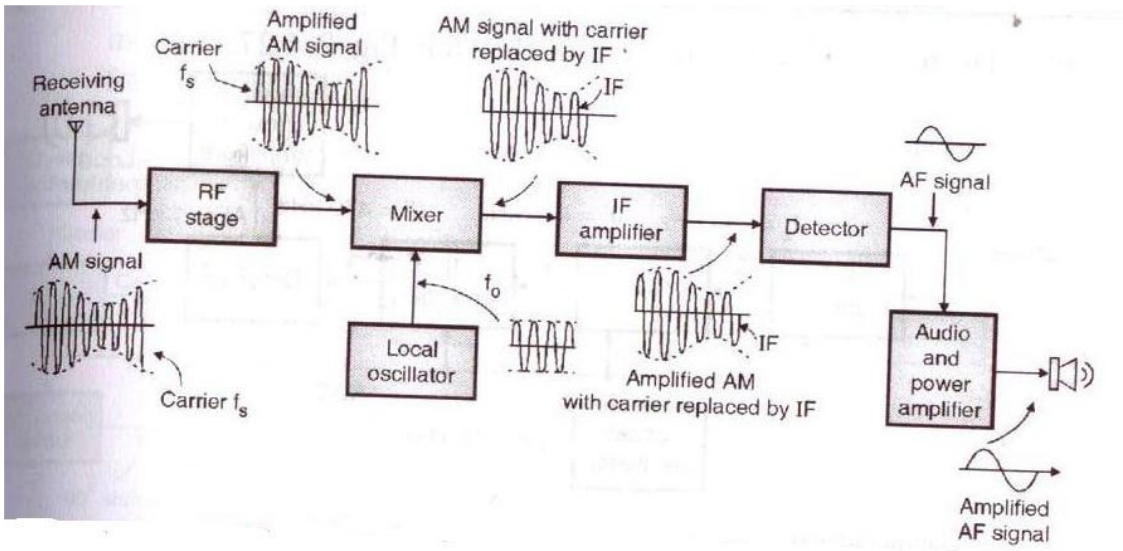
1. Two bits (a, dibit) are clocked into the bit splitter.
2. One bit is directed to the I channel and the other to Q channel.
3. The I bit modulates a carrier that is in phase reference oscillator (Hence the name "I" for in phase channel).
4. The Q bit modulates a carrier that is 90o out of phase OR 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

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

+ Sin $w_c t$ + Cos $w_c t$
+ Sin $w_c t$ - Cos $w_c t$
- Sin $w_c t$ + Cos $w_c t$
+ Sin $w_c t$ - Cos $w_c t$

		Output waveform:  **Application:** 1. In digital T.V 2. In high speed modems 3. Communication between earth station and space shuttle.	
2.		**Attempt any four of the following:**	**16 Marks**
	a)	**State the Sampling Theorem. What is Nyquist criteria?**	**4M**
	Ans:	**Sampling Theorem:** In any pulse modulation technique, the sampling frequency should be greater than or equal to twice the maximum frequency of the modulating signal to reconstruct the original information at the receiver with minimum distortion. $f_s \geq 2\ f_m$ **Nyquist Criterion:** Nyquist rate is the minimum sampling rate required to represent the continuous signal c(t) in its sampled form. According to sampling theorem, the Nyquist rate is, $f_s = 2f_m$	**(Sampling Theorem: 2 marks, Nyquist criterion: 2 marks)**
	b)	**Draw the block diagram of superheterodyne receiver. Explain the function of each block (for AM).**	**4M**
	Ans:	 	**(Block Diagram: 2 marks, Explanation of Block: 2 marks)**

OR



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 fs.

Mixer: The mixer receives the signal from the RF amplifier at frequency (fs) and from the local oscillator at frequency (f_0) such that $f_0 > fs$.

Intermediate frequency (IF): The mixer is a non-linear circuit. It will mix the signals having frequency and to produce signals having frequencies fs, f0 , f0-fs , f0+ fs.

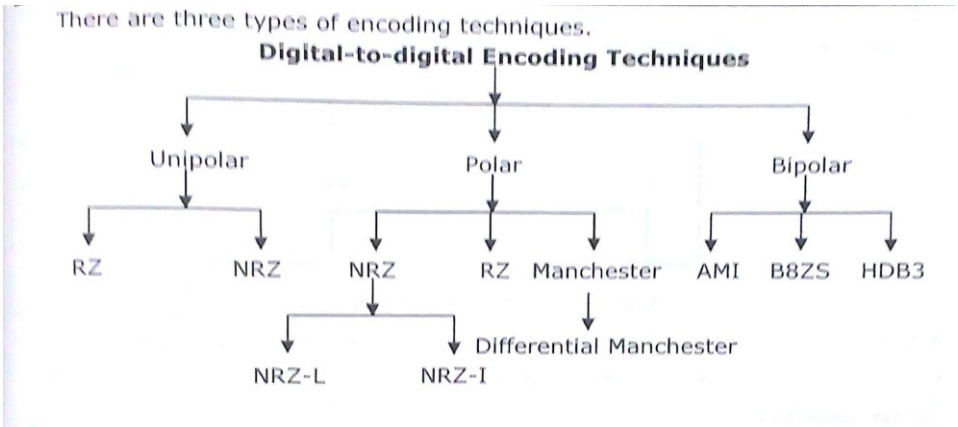
Out of these the difference of frequency component i.e. f0-fs is selected and all other are rejected. This frequency is called intermediate frequency (IF). **IF = f0-fs**

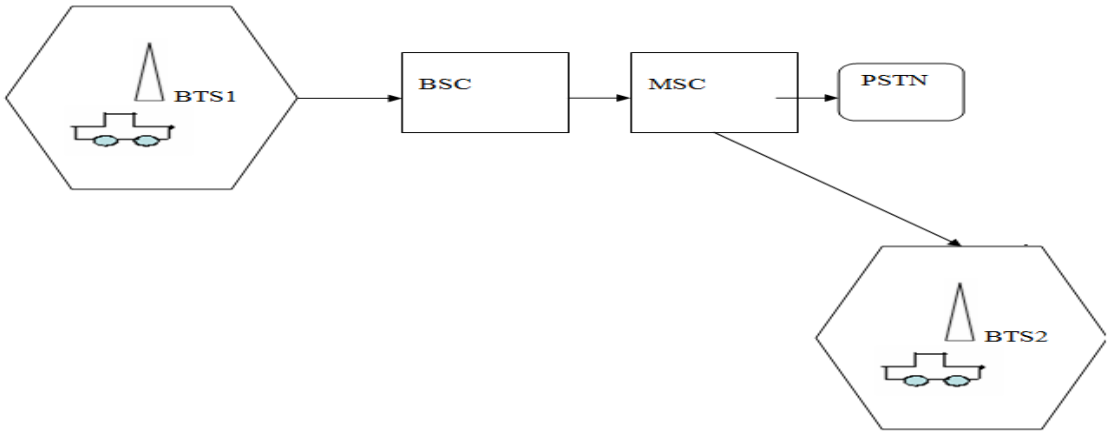
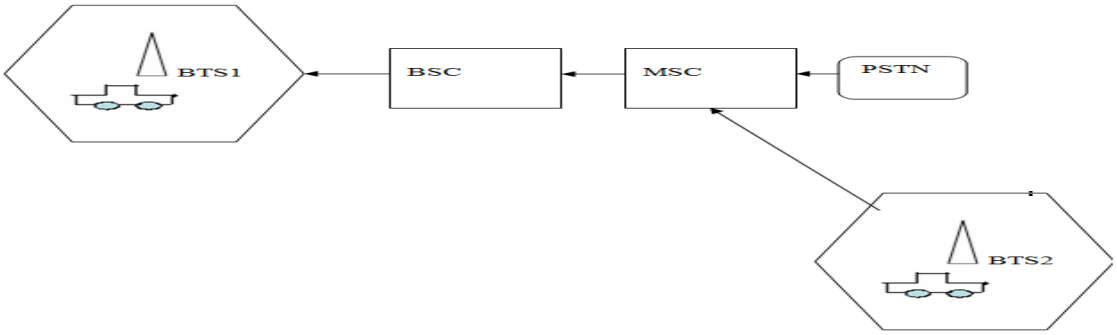
Ganged Tuning: In order to maintain a constant difference between the local oscillator frequency and the incoming signal frequency ganged tuning is used, this is simultaneous tuning of RF amplifier mixer and local oscillator. This is obtained by using ganged tuning capacitors.

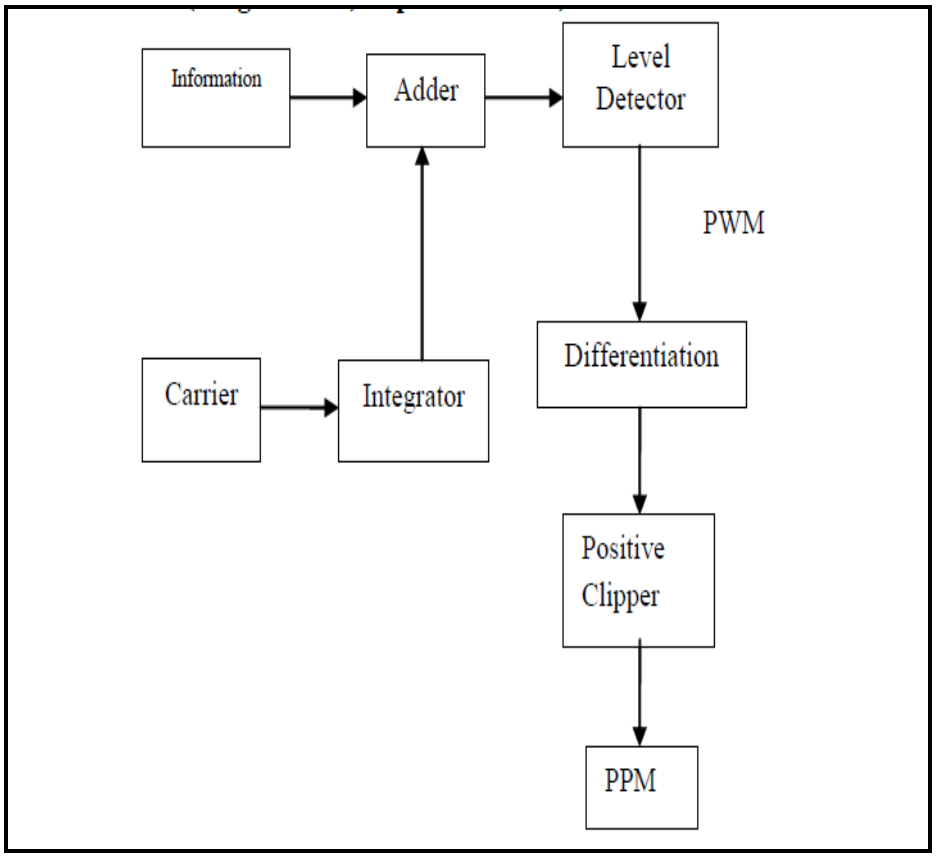
IF amplifier: The IF signal is amplifier by one or more IF amplifier stage.

Detector: The amplifier IF signal is detected by the detection to obtain the original modulating signal. Normally practical diode detectors are used as detector.

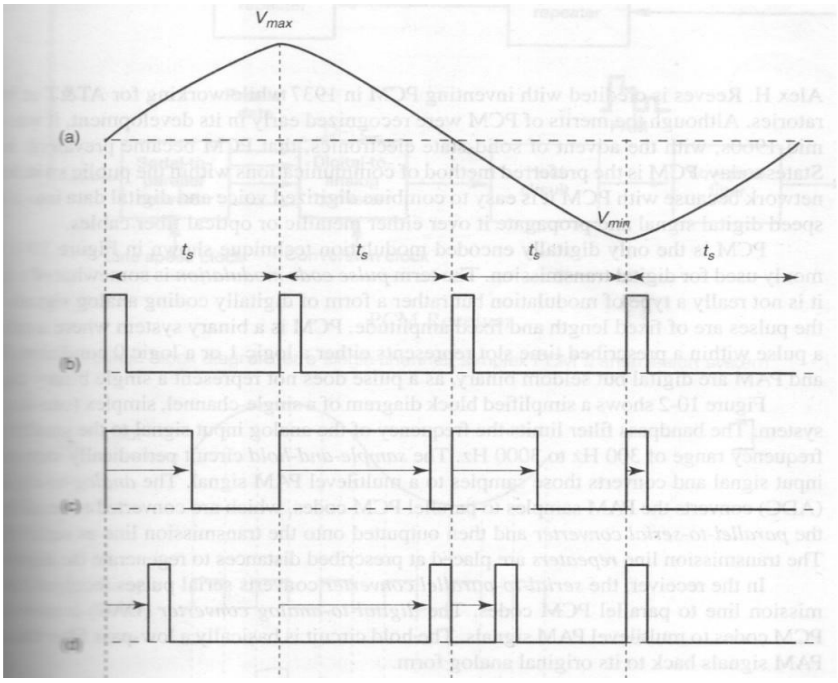
Audio and Power Amplifier: The recovered modulating signal is amplified to the adequate power level by using the Audio and Power Amplifier and given to the Loudspeaker. Loudspeaker converts the electrical signals into sound signals.

		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.	
	c)	**Explain Shanon's theorem on the channel capacity.**	**4M**
	Ans:	The capacity of a channel with bandwidth B and additive Gaussian band limited white noise is **C=B log2 (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.	**(Statement: 2 marks ,Equation: 2 marks)**
	d)	**What are the types of Encoding technique? Why encoding is necessary in digital communication?**	**4M**
	Ans:	 **Necessity of encoding in communication system:** The digital data which is coming from a digital computer or some other source cannot be put directly on the communication channel, because the format of this signal is not suitable for its direct transmission. This data is first converted into suitable format or line code and then transmitted over a communication channel. For example, when we transmit the data from our computer to printer, both the original data and transmitted data are digital. In this type of encoding the binary 1's and 0's generated by computer are translated into sequence of voltage pulse that can be propagated over a wire.	**(Types: 2 marks, Necessity of Encoding: 2 marks)**

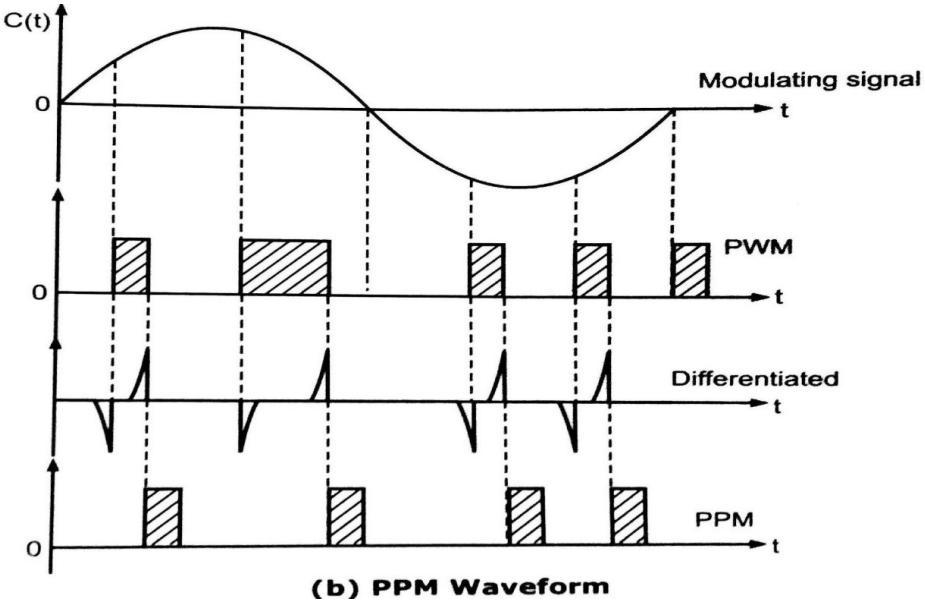
	e)	**Explain forward and reverse call processing.**	**4M**
	Ans:	**Forward call processing:**  Mobile originated calls go to BTS first and then BSC .The BSC forwards this call to MSC .The MSC does the authentication and call routing as per the dialed number .If the call is to another mobile subscriber then for another mobile process for that call is the same as for mobile terminated call. **Reverse call processing:**  Mobile terminated calls first came to MSC where HLR/VLR inquiry is carried out and as per the information, the MS is paged in suitable BSC. The BSC forwards this page to all children BTS where the actual paging is done. After BTS gets a response from the mobile, it allocates a channel for this call. On ending of call BTS informs BSC and MSC.	**(Forward call Processing: 2 marks, Reverse call Processing: 2 marks)**
	f)	**State application of satellite communication.**	**4M**
	Ans:	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.	**(Any four:1 mark Each)**

		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.	
3.		**Attempt any four of the following:**	**16 Marks**
	a)	**State the diagram of implementation of Pulse Position Modulation (PPM) from PWM. Draw the waveform of PPM.**	**4M**
	Ans:		**(Implementation:2 marks, Waveform: 2 marks)**

PPM Waveform:



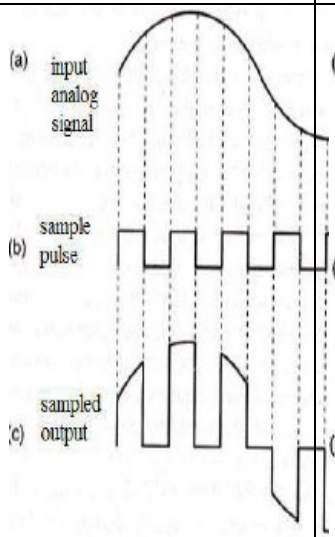
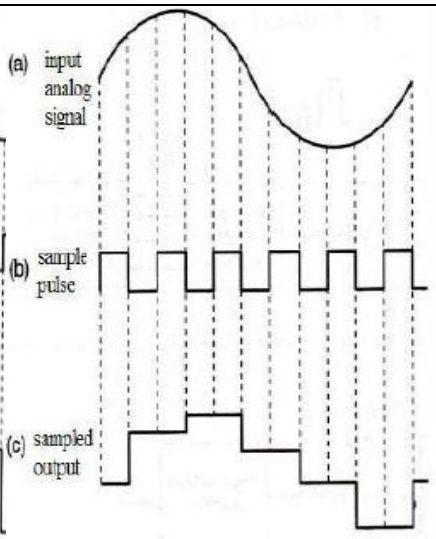
OR



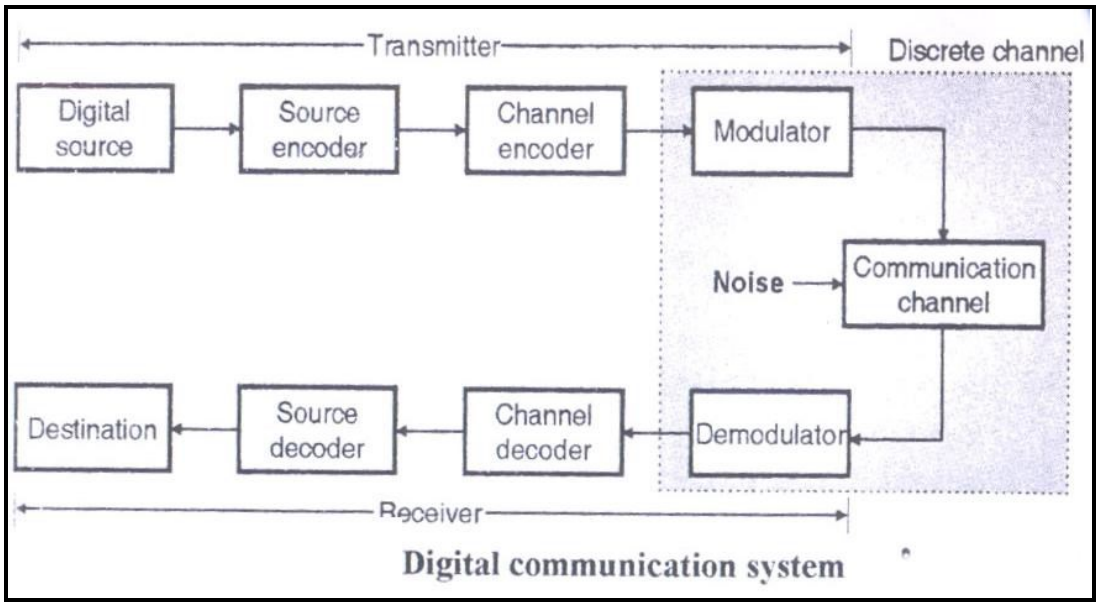
(b) PPM Waveform

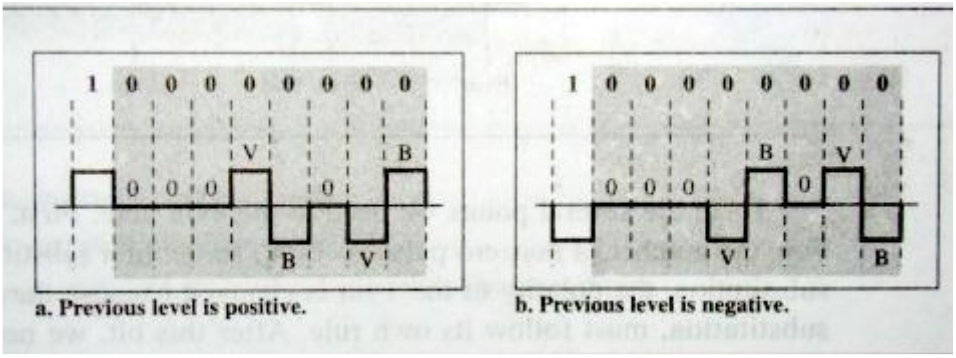
b) Compare Natural sampling and Flat Top sampling on the following points. 4M
1) sampling rate 3) Bandwidth requirement
2) signal Power 4) Waveform

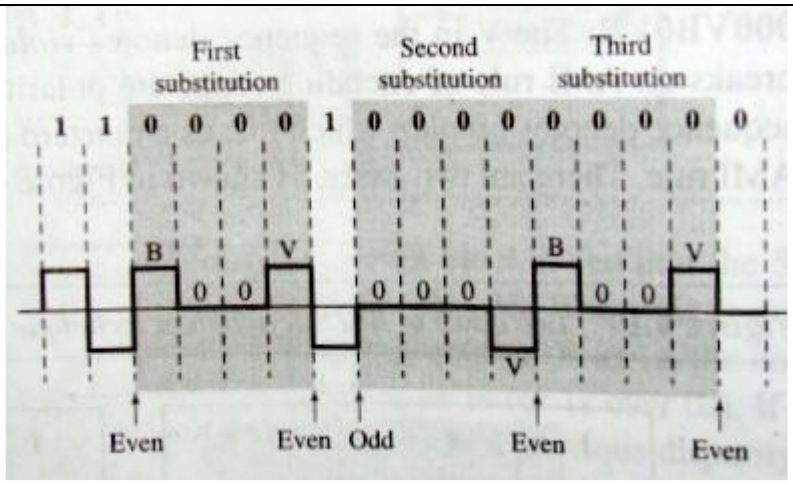
Ans:

Sr No	Parameters	Natural Sampling	Flat Top Sampling
1	Sampling Rate	Sampling rate is greater than equal to Nyquist rate i.e. fs≥2fm	fs≥2fm, satisfies Nyquist criteria.
2	Bandwidth requirement	Increase with reduction in pulse width	Increase with reduction in pulse width
3	Signal Power	Increases with increase in pulse width τ	Increases with increase in pulse width τ
4	Waveform		

(Each Point:1 mark)

	c)	**Draw the block diagram of digital modulation system. State the function of each block.**	**4M**
	Ans:	 **Digital communication system** In a block diagram of digital communication system three basic signal processing Operations have been included. They are; 1. Source coding 2. Channel codlings and 3. Modulation The source information is assumed to be digital. If it is analog then it must be converted First to digital. **Source encoder:** The source encoder converts the digital signal generated at the source output into another signal in digital form. Source encoding is used to reduce or eliminate redundancy for ensuring an efficient representation of the source output. Different source coding techniques are PCM, DM, and ADM etc. Due to source encoding BW requirement for transmission is reduced. **Channel encoder:** Channel encoding is done to minimize the effect of channel noise. This will reduce the number of errors in the received data and will make the system more reliable. Channel coding technique introduces some redundancy. The output of the channel encoder is a series of code words which include the message and some parity bits. These additional parity bits introduce redundancy. **Modulator:** Modulation is used for providing an efficient transmission of the single over the channel. The modulator can use any of the CW digital modulation techniques such as ASK. FSK or PSK. **Discrete channel:** The discrete channel consists of modulator, channel and detector. It is called as discrete channel because its inputs as well as output are in then discrete form. **Demodulator:** the demodulator is used for demodulation**.** **Channel decoder:** The channel decoder is at the receiver and it maps the channel output	**(Block Diagram:2 marks, State function: 2 marks)**

		into a digital signal in such a way that effect of channel noise is reduced to a minimum. The channel decoder converts these code words into digital messages. **Source decoder:** Source decoder is at the receiver and it behaves exactly in an inverse way to the source Decoder. It delivers the destination (user) the original digital source output.	
	d)	**Explain B8ZS and HDB3 Encoding techniques with waveforms.**	**4M**
	Ans:	**B8ZS coding scheme (Bipolar with 8 zeroes substitution)**: This is used in USA. In this eight consecutive zeroes are substituted by 000VB0VB, the first violation pulse (V) is of the same polarity as the last pulse. B pulse then follows the inverse polarity rule. The following V is of the same polarity as preceding B pulse. The last B pulse is of inverse polarity. The receiver recognizes the pattern & interprets the octet as consisting of all zeroes. It is also having error monitoring capacity.  a. Previous level is positive. b. Previous level is negative. **HDB3 Code:** It is a modification of AMI code & overcomes the problem of long string of binary 0s. If there are more than three consecutive zeros, a violation pulse (V) is substituted for the fourth zero. The violation pulse has the same polarity as the last pulse & it is easily identified at the receiver end. If there is long string of zeros then every fourth pulse will be violation pulse & all violation pulses in string will be of same polarity. To overcome this additional bipolar (B) pulse to enable detection of violation pulses. Therefore, the consecutive four zeros (0000) are substituted by 000V or B00V sequence.	**(B8Z5 Encoding: 2 marks, HDB3 Encoding: 2 marks)**



e) Explain the working of satellite communication with bock diagram. **4M**

Ans:

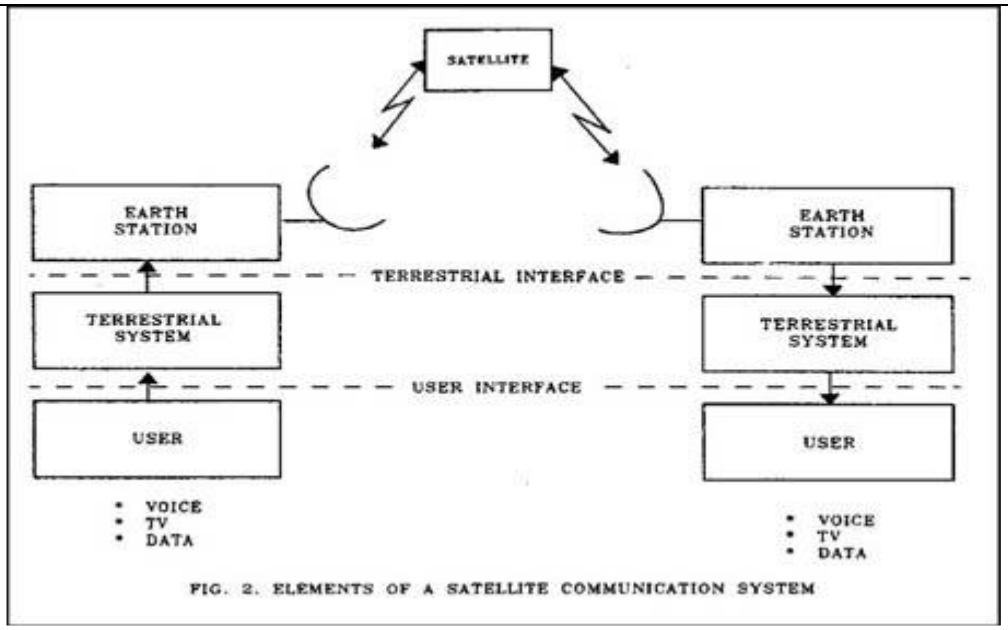


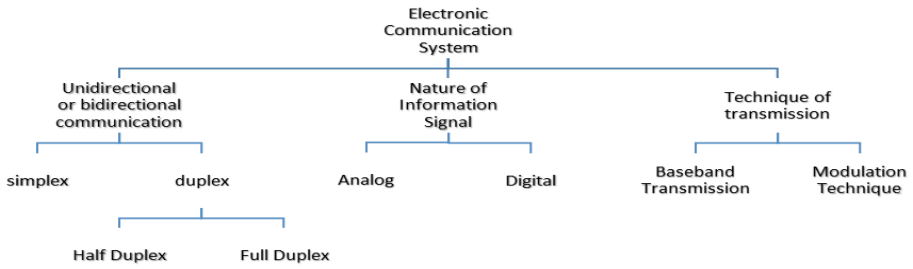
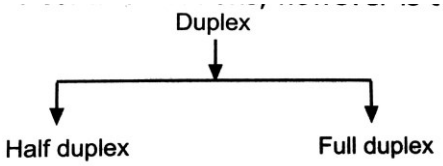
FIG. 2. ELEMENTS OF A SATELLITE COMMUNICATION SYSTEM

(Block Diagram:2 marks, Working:2 marks)

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

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 signal, 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 signal is space. **Receiver:** The earth station receives signal from satellite this signal is processed to get the original baseband signal which is then send to the user through terrestrial network.	
4.	**a)**	**Attempt any three of the following:**	**12 Marks**
	i)	**What are the types of electronics communication? Explain any one. State application of communication.**	**4M**
	Ans:	**Types of Electronic communication:**  **Simplex:** i) In simplex communications, the information travels in one direction only, so called unidirectional system. **Duplex:** The bulk of electronic communications however is two way communications.  **Half duplex:** i) Half duplex is bidirectional or two way communication system. ii) Half duplex can transmits as well as receives information but not simultaneously. **Full Duplex:** i) Full duplex is truly bi- directional o two way communication system. ii) Full duplex can transmits as well as receives information simultaneously. **Analog Signal:** Analog signal is the signal in which, voltage or current varies continuously with time.	**(Types of Electronic Communication: 2 marks, Explanation (Any one):1 mark, Application (Any two):1 mark)**

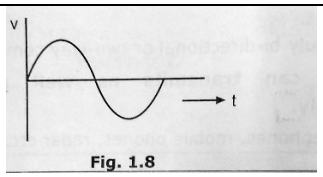
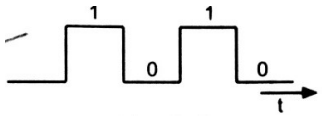


Fig. 1.8

Digital signal: Digital signal are the discontinuous signals which has only two levels, high and low or one and zero.
Example: Data from computers.



Baseband Transmission: The electrical equivalent of original information is known as the baseband signal. The communication system in which the baseband signals are transmitted directly is known as baseband transmission.

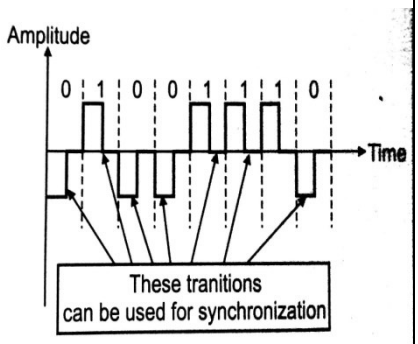
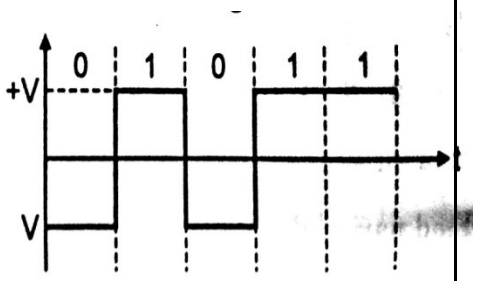
Modulation Technique: To overcome the drawbacks of baseband transmission and to transmit baseband signals by radio, modulation techniques must be used.

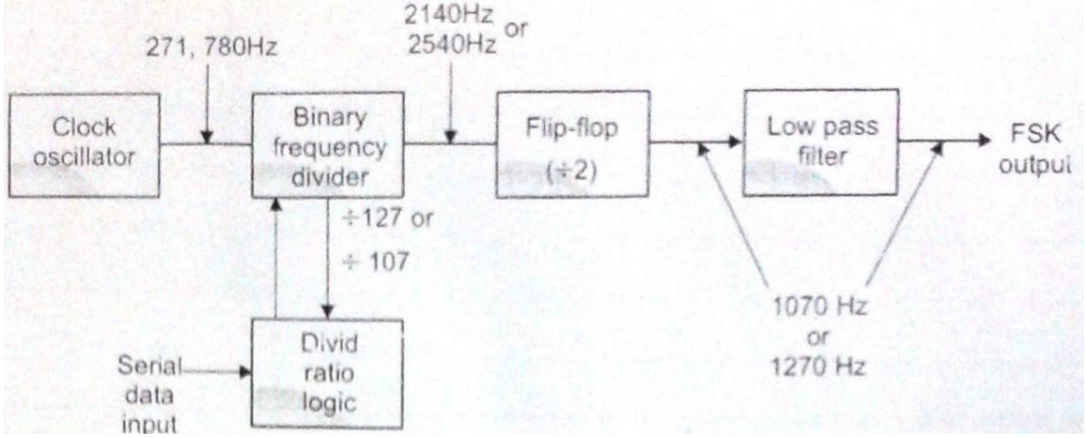
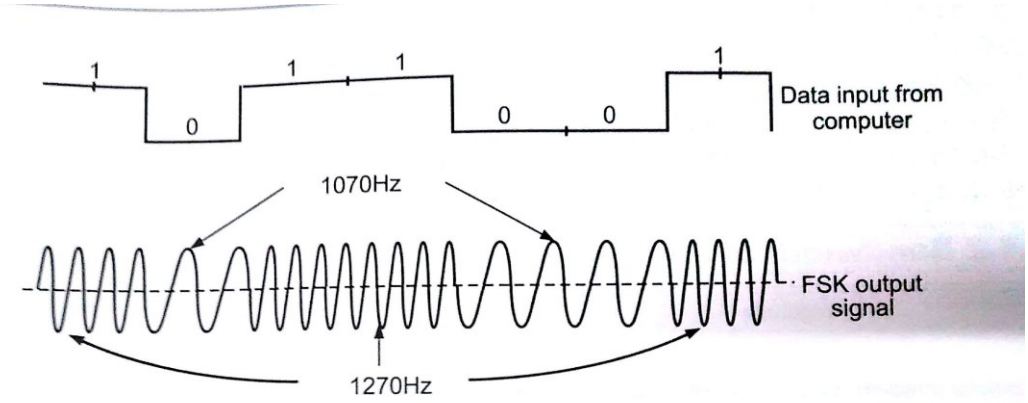
Applications of communication:

1. AM and FM broadcasting
2. TV broadcasting
3. Telemetry
4. Cable TV
5. Remote control
6. Walky Talky
7. Amateur radio
8. Fax
9. Pager
10. Telephone
11. Mobile Phone
12. Radar

ii) Compare polar and bipolar Encoding technique. **4M**

Ans: **(Any 4 Point: 4 marks)**

Sr No	Parameters	Polar	Bipolar
1	Type of voltage level used	Polar encoding uses two voltage levels of amplitude- one positive and one negative	Bipolar encoding uses three voltages levels: Positive, Negative and Zero.
2	Number of voltage level used	Two voltage levels	Three voltage levels
3	Types	NRZ-L, NRZ-I,RZ,Manchester, Differential Manchester	AMI,B8ZS,HDB3
4	Advantages	DC component problem of unipolar encoding is eliminated	The problem of synchronizing string of consecutive 0's is solved by HDB3
5	Encoded signal		

	iii)	**Describe the working of FSK with Block Diagram.**	**4M**
	Ans:	 **(or any other relevant block diagram)** **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. 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.  **FSK Input-Output Waveforms**	**(Block Diagram:2 marks, Description: 2 marks)**

	iv)	**List the different types of hand off. Explain any one in detail.**	**4M**
	Ans:	1. Hard Handoff 2. Soft Handoff 3. Queued Handoff 4. Delayed Handoff 5. Intersystem Handoff 6. Intrasystem Handoff 7. Mobile Assisted Handoff (MAHO) **1. Hard Handoff:** • The definition of a hard handover or handoff is one where an existing connection must be broken before the new one is established. • Hard handoff allocate different frequency of user. • In hard hand off a handset always communicates with one BS at any given time • Hard handoff is typically used in TDMA and FDMA systems. • Hard handoff is not very complicated. • Since the radio link between the BS and the handset is broken before it is connected in hard handoff, the link transfer may fail due to long network response time even if radio channels are available in the new BS. **2. Soft handoff:** • Soft handoff is defined as a handover where a new connection is established before the old one is released. • Soft hand off allocate same frequency. • In soft handoff a handset may connect up to three or four radio links at the same time. • Soft handoff used in CDMA and some TDMA systems. • Soft handoff is more complicated than hard handoff. • On the other hand, soft handoff degrades channel availability because a handset may consume multiple radio channels. **3. Delayed handoff:** • A Delayed handoff is a two hand off level algorithm. It provides more opportunity for a successful hand off. • The MTSO always handles the handoff first and the originating calls second. If no neighboring cells are available after the second handoff level is reached, the call continues until the signal strength drops below the threshold level then the call is dropped. • Lower handoffs help in handling call processing more adequately. • It makes the hand off occur at the proper location and eliminates possible interference in the system.	**(List types of Handoff: 2 marks, Explain (anyone):2 marks)**

4. Queued hand off:

- Queued hand off is more effective than two threshold level handoffs.
- The MTSO will queue the requests of handoff calls instead of rejecting them if the new cell sites are busy..
- With Queuing of originating calls only, the probability of blocking is reduced.
- It is effective when implementing a simple queue for hand off calls which reduces call drops.

5. Intersystem Handoff: If during an ongoing call a mobile unit moves from one cellular system to a different cellular system which is controlled by different MTSO, a handoff procedure which is used to avoid dropping of call referred as Intersystem Handoff takes place.

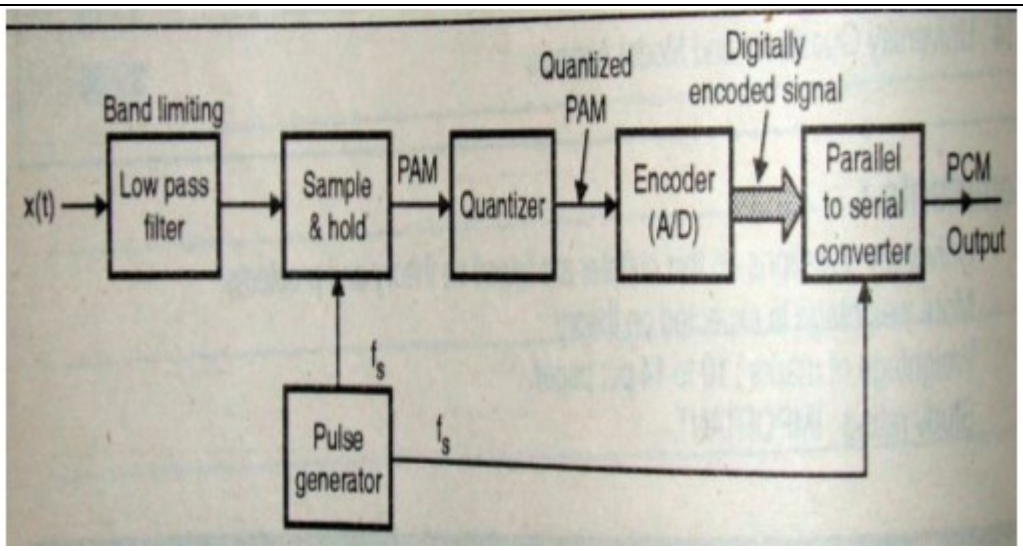
- An MTSO engages in this handoff system when a mobile signal becomes weak in a given cell and MTSO cannot find another cell within its system to which it can transfer the call then in progress.
- Before implementation of Intersystem Handoff, the MTSO compatibility must be checked and in an Intersystem Handoff a local call may become a long distance call as the mobile moves out of its home system and becomes a roamer in a neighboring system.

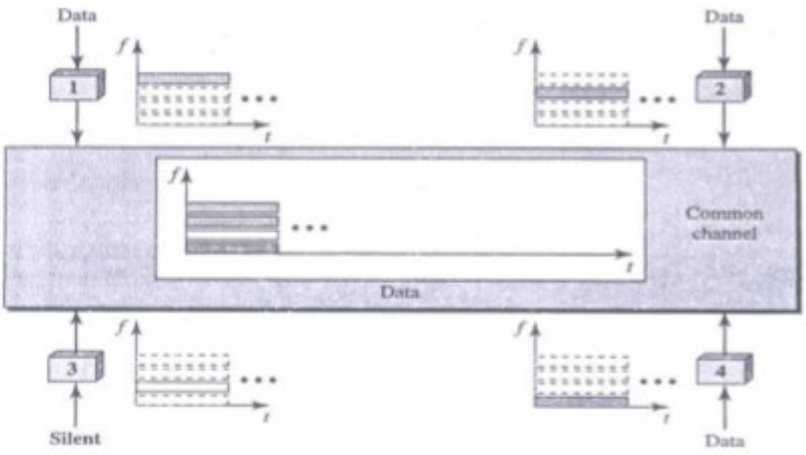
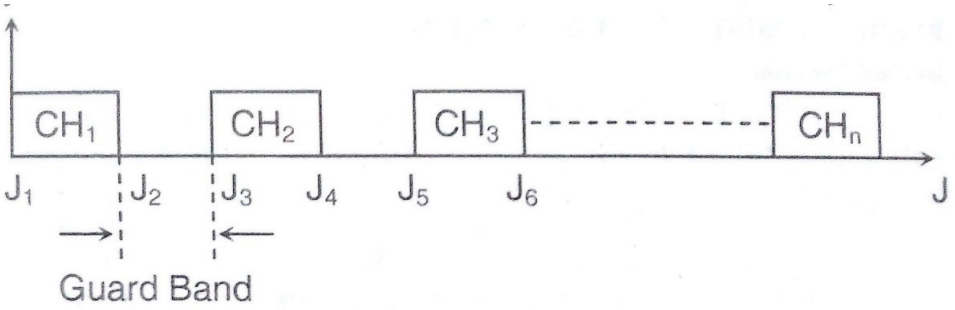
6. Intrasystem Handoff: if during an ongoing call a mobile unit moves from one cellular system to an adjacent cellular system which is controlled by the same MTSO, a handoff procedure which is used to avoid dropping of call referred to as Intra System Handoff takes place.

- An MTSO engages in this handoff system when a mobile signal becomes weak in a given cell and the MTSO finds another cell within its system to which it can transfer the call in progress.
- In Intra System Handoff local calls always remain local calls only since after handoff also the call is handled by the same MTSO.

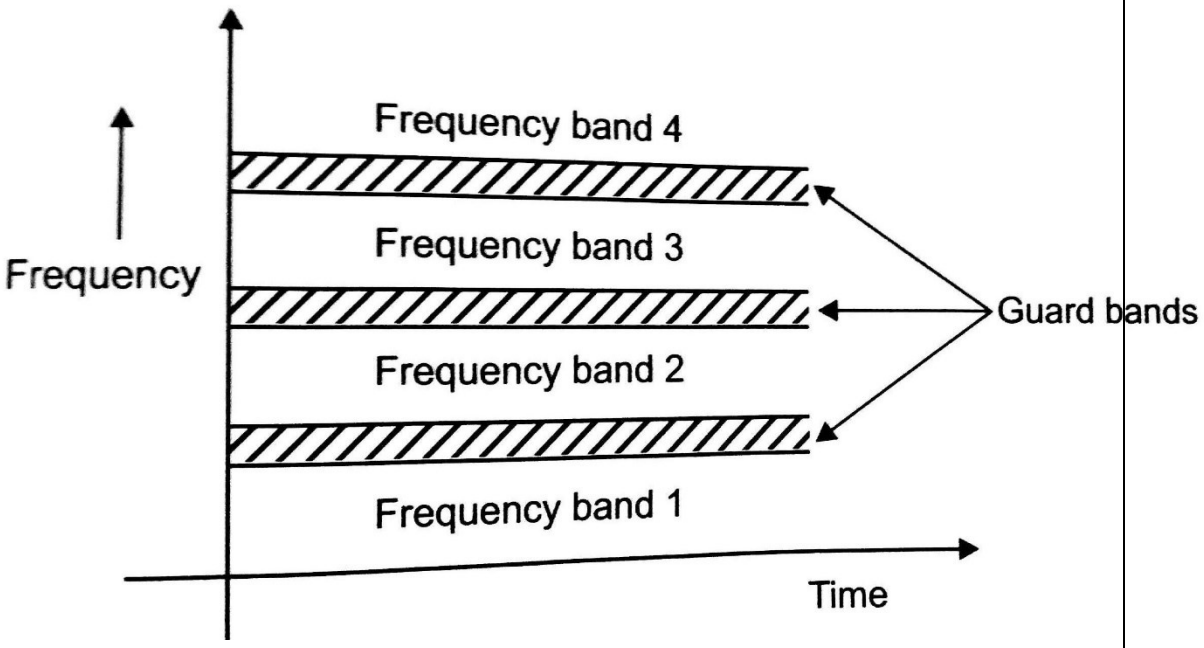
7. Mobile Assisted Handoff (MAHO): every mobile station measures the received power from surrounding base stations and continually reports the results of these measurements to the serving base station.

- A handoff is initiated, when the power received from the base station of a neighboring cell begins to exceed the power received from the current base station by a certain level or for a certain period of time.
- In MAHO method call handed over between base stations is much faster than first generation analog systems .As handoff measurements are made by each mobile. MSC no longer constantly monitors signal strengths. MAHO is particularly suited for microcellular environments where handoffs are more frequent. During the course of a call, if a mobile moves from one cellular system to a different cellular system controlled by a different MSC, an intersystem handoff becomes necessary.
- An MSC engages in an intersystem handoff when a mobile signal becomes weak in a given cell and the MSC cannot find another cell within its system to which it can transfer the call in progress.

	b)	**Attempt any one of the following:**	**6 Marks**
	i)	**Draw the block diagram of PCM and explain its working .State advantage and disadvantage.**	**6M**
	Ans;	 i. The analog signal x(t) is passed through a band limiting low pass filter, which has a cut-off frequency fc =W Hz. This will ensure that x(t) will not have any frequency component higher than "W". This will eliminate the possibility of aliasing. ii. The band limited analog signal is then applied to a sample and hold the circuit where it is sampled at adequately high sampling rate. Output of sample and hold block is a flat topped PAM signal. iii. These samples are then subjected to the operation called "Quantization" in the "Quantizer". The quantization is used to reduce the effect of noise. The combined effect of sampling and quantization produces the quantized PAM at the quantizer output. iv. The quantized PAM pulses are applied to an encoder which is basically an A to D converter. Each quantized level is converted into an N bit digital word by the A to D converter. The value of N can be 8,16,32,64 etc. v. The encoder output is converted into a stream of pulses by the parallel to serial converter block. thus at the PCM transmitter output we get a train of digital pulses **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 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	**(Block Diagram: 2 marks, Working: 2 marks, Advantage(Any one): 1 mark, Disadvantage(Any one): 1 mark)**

		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	
	ii)	**Explain FDMA with Uplink and Downlink frequency range. Also list any two frequency band used in satellite.**	**6M**
	Ans:	 **OR** 	**(FDMA Diagram: 2 marks, Explanation: 2 marks, List satellite frequency bands(any two): 2 marks)**

OR



In frequency-division multiple access (FDMA) the available bandwidth is divided into frequency bands. Each station is allocated a band to send its data. In other word each band is reserved for a specific station, and it belongs to the station all the time. Each station also uses a bandpass filter to confine the transmitter frequencies. To prevent station interferences, the allocated bands are separated from one another by small guard bands. FDMA specifies a predetermined frequency band for the entire period of communication. This means that stream data) a continuous flow of data that may not be packetized) can easily be used with FDMA. FDMA is an access method in the data link layer of OSI layer. The data link layer in each station tells its physical layer to make a bandpass signal from the data passed to it. The signal must be created in the allocated band. There is no physical multiplexer at the physical layer. The signals created at each station are automatically bandpass-filtered. They are mixed when they are sent to the common channel.

Satellite:
Uplink frequency range- 5.9 GHz to 6.4 GHz
Downlink frequency range- 3.7 GHz to 4.2 GHz

Satellite frequency Bands:

Band	Downlink, GHz	Uplink, GHz	Bandwidth, MHz
L	1.5	1.6	15
S	1.9	2.2	70
C	4	6	500
Ku	11	14	500
Ka	20	30	3500

5. **Attempt any four of the following :** **16 Marks**

a) **State advantage and disadvantage of digital communication.** **4M**

Ans:

1) Advantages of digital communication: **(Any Two Advantages : 2 marks, Any Two Disadvantages : 2 marks)**

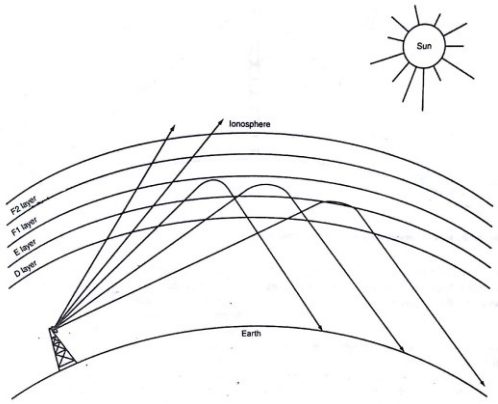
Some of the advantages of digital communication are as follows :

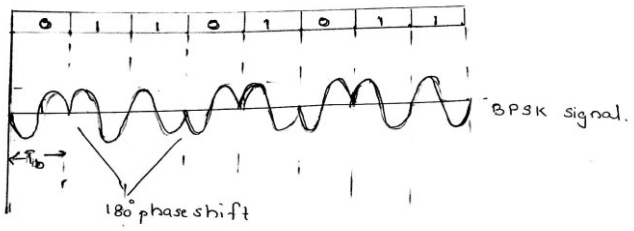
i. Due to digital nature of the transmitted signal, the interference of additive noise does not introduce many errors .so digital communication has a better noisy immunity.
ii. Due to the channel coding techniques used in digital communication, it is possible to detect and correct the errors introduced during the data transmission.
iii. Repeaters can be used between transmitter and receiver to regenerate the digital signal. This improves the noise immunity further.
iv. Due to the nature of the signal, it is possible to use the advanced data processing techniques such as digital signal processing, image processing, data compression etc.
v. TDM (Time Division Multiplexing) technique can be used to transmit many voice channels over a single common transmission channel.
vi. Digital communication is useful in military applications were only a few permitted receivers can receive the transmitted signal.
vii. Digital communication is becoming simpler and cheaper as compared to the analog communication due to the invention of high speed computers and integrated circuits (ICs) .

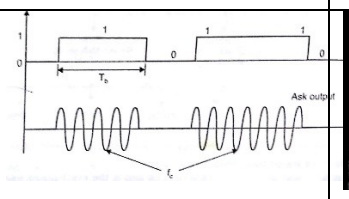
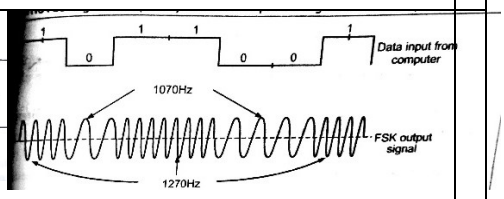
Disadvantages:

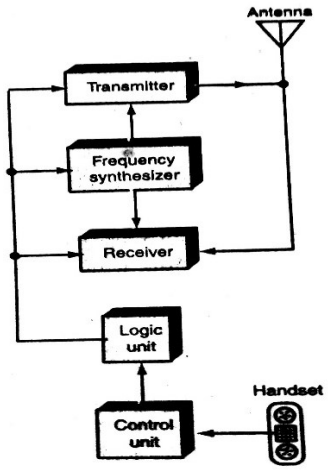
Some of the important disadvantages of digital communication are:

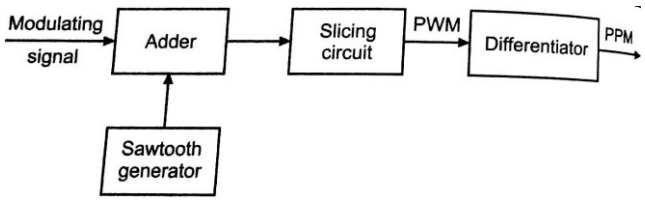
i. The bit rates of digital systems are high. Therefore they require a larger channel bandwidth as compared to analog systems.
ii. Digital modulation needs synchronization in case of synchronous modulation.

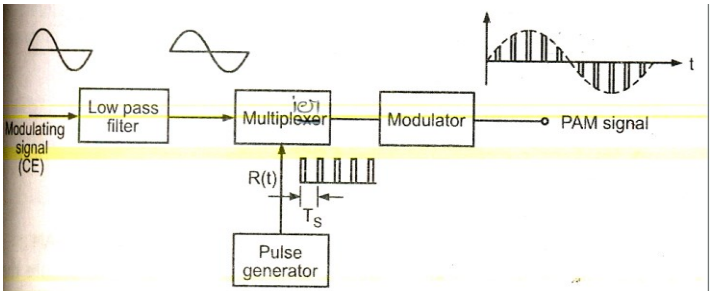
	b)	**Explain operating principle of sky wave propagation.**	**4M**
	Ans:	 i. A sky wave signal is one that is radiated by the antenna into the upper atmosphere where it is bent or reflected back to the earth. This bending of the signal is caused by a region in the upper atmosphere known as ionosphere. ii. The ionosphere is generally considered to be divided into three basic layers designated the D layer, the E layer, the F layer. iii. The primary layer of F layer is to cause refraction of the radio signal. iv. When a signal goes into the ionosphere, the different layers of ionization will cause the radio waves to be gradually bent. The direction of bending depends upon the angle at which the radio waves enters. v. When the angle is large with respect to the earth, the radio signals are bent slightly and pass on through the ionosphere and are lost in space. If the angle of entry is smaller, the radio wave will actually be bent and sent back to earth .Because of this effect, it actually appears as though the radio wave has been reflected by the ionosphere. vi. By using sky wave propagation signal can be send almost anywhere on earth surface It is not affected by curvature of earth .The quality of reception of sky wave is not uniform & constant to all locations & it gets affected by environmental factors	**(Explanation : 2 marks, Diagram: 2 marks)**

	c)	**Draw BPSK waveform for given bit sequence 01101011. Also, state advantage and disadvantage of BPSK.**	**4M**
	Ans:	**BPSK waveform:**  **Advantages:** i) Bandwidth less than FSK signal. ii) Good noise immunity. iii) Used for high bit rate greater than 1800 bits /sec . **Disadvantages:** i) Generation and detection of BPSK is not easy.	**(Waveform: 2 marks, Advantages: 1 mark, Disadvantages: 1 mark)**
	d)	**Compare ASK and FSK on the bases of** **1) Noise immunity 2) Bit Rate** **3) Waveform 4) Application**	**4M**
	Ans:		**(1 mark Each)**

Sr no	parameter	ASK	FSK
1	Noise immunity	low	high
2	Bit rate	Suitable upto 100 bits/sec	Suitable upto 1200 bits/sec
3.	WaveForm	 	
4	Application	Low speed modem	Medium speed modem

	e)	**Define: i) Baud Rate ii) Bit Rate.** **In Digital to Analog system signal carries 6 bit/sec. If no. of signal per second are 1000. Calculate Bit Rate.**	**4M**
	Ans:	**Baud rate:** the number of signal elements transmitted per second. A signal elements consists of one or more bits. **Bit rate:** The number of bits transmitted per second. **No of** bits transmitted per signal=6 bits/sec No of signals per second=1000 Bit Rate= No of Bits Transmitted per second =1000x 6 = 6000 bits/sec	**(Definition: 1 mark Each, Sum: 2 marks)**
	f)	**Explain the working of cellular mobile phone system.**	**4M**
	Ans;	 The five major parts of this system are: 1.Control unit 2.Logic unit 3.Transmitter 4.Receiver 5.Frequency synthesizer i) The transmitter and receiver share the same antenna .The same antenna acts as transmitting as well as receiving antenna.	**(Diagram: 2 marks, Explanation: 2 marks)**

		ii) The important feature of the transmitter is that its output power is controlled by the cell site and MTSO. Typically the output power is 3 watt iii)Transmitter is a low power FM unit and operates in the frequency range of 825 to 845 MHz iv) The transmitter uses a unit called duplexer which isolates the transmitter output from the receiver input. v) The transmit and receive frequencies are spaced 45MHz apart in order to minimize the interference. vi)The receiver is a dual conversion super heterodyne type receiver vii) The frequency synthesizer develops all the signals which are used by the transmitter and receiver. **(**Note: Any other relevant diagram should be considered**)**	
6.		**Attempt any four of the following:**	**16 Marks**
	a)	**Draw the block diagram of PPM. Also state merits and demerits of PPM.**	**4M**
	Ans:	 **(a) Block diagram of PPM** **Merits of PPM :** 1. Due to constant amplitude of PPM pulses, the information is not contained in the amplitude . hence the noise added to PPM signal does not distort the information. Thus it has good noise immunity . 2. It is possible to reconstruct PPM signal from the noise contaminated PPM signal. This is also possible in PWM but not possible in PAM. 3. Due to constant amplitude of pulses ,the transmitted power always remain constant. It does not change as it used to, in PWM. **Demerits of PPM:** 1. As the position of the PPM pulses is varied with respect to a reference pulse, a transmitter has to send syncronising pulses to operate the timing circuits in the receiver. Without them the demodulation won't be possible to achieve. 2. Large bandwidth is required to ensure transmission of undistorted pulses.	**(Diagram : 2 marks, Merits: 1 mark, Demerits: 1 mark)**

	b)	**Define Transmission Bandwidth. State the Bandwidth and Frequency range for 1) Video signal in T.V 2) Audio signal**	**4M**
	Ans:	**Transmission Bandwidth:** It is the range of frequencies constituting a band within which a signal can be transmitted without distortion **1) Video signal in T.V:** **Bandwidth:** 5MHz **Frequency range:** 5-6 MHz **2) Audio signal:** **Bandwidth:** 200 KHz **Frequency range:** 50 Hz to 15 KHz	**(Definition: 2 marks, Video Signal: 1 mark, Audio signal: 1 mark)**
	c)	**Explain the working of PAM with block diagram and also draw its waveform.**	**4M**
	Ans:	**Block diagram:**  **Fig:Generation of PAM** **Working:** • The continuous modulating signal x(t) is passed through a low pass filter. The low pass filter bandlimited the signal to f_m. All the frequency components higher than the frequency fm are removed. • The pulse generator generate a pulse train at a frequency fs such **that fs>2fm**. Thus, nyquist criteria is satisfied. • The modulating signal x(t) and the sampling signal are multiplied in the sampler to produce the pulse amplitude modulated(PAM) signal. • The PAM signal is a train of pulse of width τ whose amplitude are varying. • The information in the modulating signal is contained in the "Amplitude variation" of the pulsed carrier.	**(Block Diagram: 1 mark, Explanation: 2 marks, Waveform: 1 mark)**

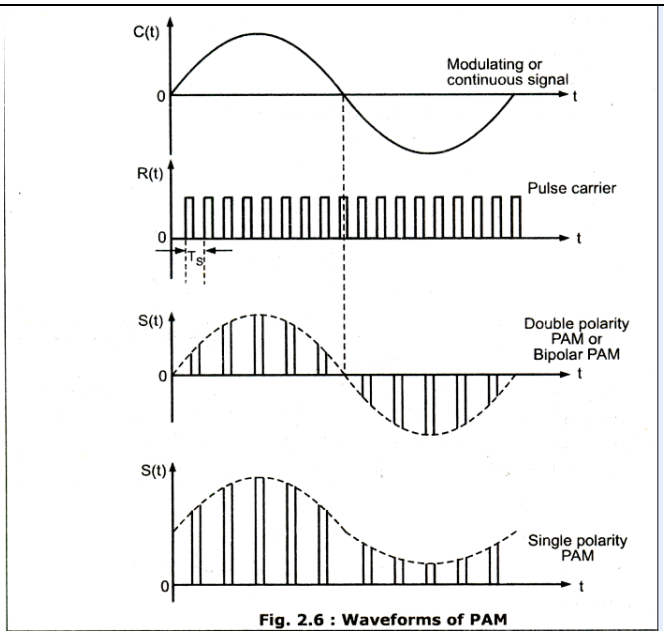
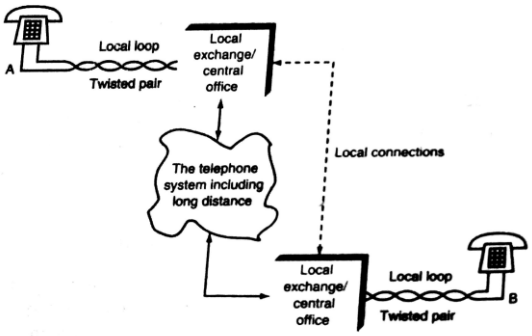


Fig. 2.6 : Waveforms of PAM

	d)	**Describe the working of basic telephone system with block diagram.**	**4M**
	Ans:	 **Fig: Basic telephone system** The telephone system permits any telephone to connect with any other telephone in the world. This means that each telephone must have a unique identification code- **the 10** digit telephone number assigned to each telephone, the telephone system provides a means of recognizing each individual number and switching system that can connect any switching systems that can connect any two telephones. The local loop Standard telephones are connected to then telephone system by way of a two-wire, twisted pair cable that terminates at the local exchange or central office. As many as 10000 telephone line can be connected to single central office. Then connections from then central office go to then "telephone system'. A call originating at telephone A will pass through the central office and then into the main system where it is transmitted via one of many different routes to the central office connected to the desired location designated as B. The connection between nearby local exchange is direct rather than long distance. The two wire twisted pair connection between the telephones and the central office is referred to as the local loop or subscriber loop. All dialing and signaling operations are	**(Diagram: 2 marks, Explanation: 2 marks)**

		also carried on this single twisted pair. A basic telephones or telephone set is an analog baseband transceiver. It has a handset which contains a microphone and a speaker, better known as a transmitter and a receiver. It also contains a ringer and a dialing mechanism.	
	e)	**State the working principle of handset to handset call processing.**	**4M**
	Ans:	**Handset to Handset call processing:** 1. The mobile subscriber enters the mobile telephone number into the unit's memory using a standard touch-tone keypad. 2. The subscriber then press a send key which transmits the called number as well as the mobile unit's identification number. 3. The cell site controller receives the caller identification number and the destination telephone number through a reverse control channel which are then forwarded to the MTSO. The MTSO sends a page command to all cell site controller to locate the destination party (which may be anywhere in our out of the services area). 4. Once the destination mobile unit is located the destination cell site controller sends a page request through a control channel to the destination party to determine if the unit is on or off hook. 5. After receiving a positive response to the page, the idle user channels are assigned to both mobile units. 6. Call progress tones are applied in both direction (ring and ring back) 7. When the system noticed that the called party has answered the telephone, the switches terminate the call progress tones and the conversation begins.	**(Correct Answer: 4 marks)**