WINTER – 2018 EXAMINATION
MODEL ANSWER

Subject: 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.	**A)**	**Attempt any three of the following:**	**12**
	i)	**Explain the necessity of modulation in Electronic Communication System.**	**4M**
	Ans.	**Necessity of Modulation:** **1.Reduction in height of antenna:** For transmission of radio signals, antenna height must be multiple of (λ/4). Minimum height required to transmit a baseband signal of f=10 KHz is calculated as Minimum height of antenna = λ/4=c/4f=7.5Km. The antenna of this height is practically impossible to install Minimum height required to transmit a baseband signal of f=1MHz is calculated as Minimum height of antenna = λ/4=c/4f=75m. Thus modulation is necessary to reduce the height of antenna. **2.Avoids mixing of signals:** If the baseband sound signals are transmitted without using the modulation through more than one transmitter, then all signals will be in frequency 0 to 20 KHz. Therefore all the signals get mixed together and a receiver cannot separate them from each other. So if the baseband signal is used to modulate different carrier then they will occupy different slots in	***Any four points 1M each***

		frequency domain. Thus modulation is necessary to avoid mixing of signals. **3.Increases range of communication:** The frequency of baseband signal is low and thus the low frequency signal cannot travel a long distance when they are transmitted they get heavily attenuated. The attenuation reduces with increase in frequency of the transmitted signal and they can travel longer distance. **4.Makes multiplexing possible:** Multiplexing is the process in which two or more signals can be transmitted over same communication channel simultaneously. This is possible only with modulation. Therefore many TV channel can use same frequency range without getting mixed with each other. **5.Improves quality of reception:** With FM and digital communication technique like PCM, the effect of noise is reduced to a great extent.	
	ii) **Ans.**	**Draw the block diagram for QPSK generation. State the function of each block.** 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 e 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)	**4M**

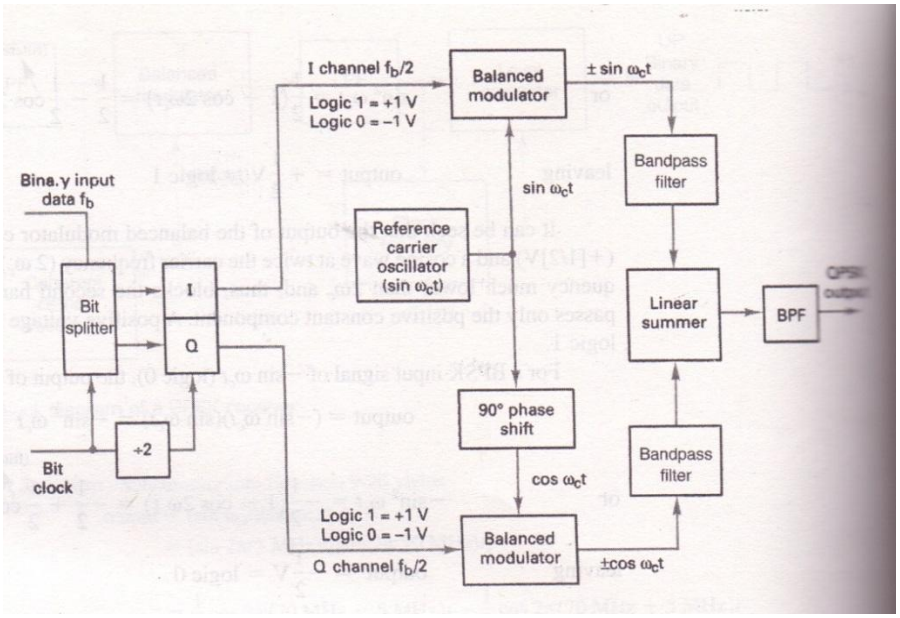


Diagram 2M

Functions of QPSK block:

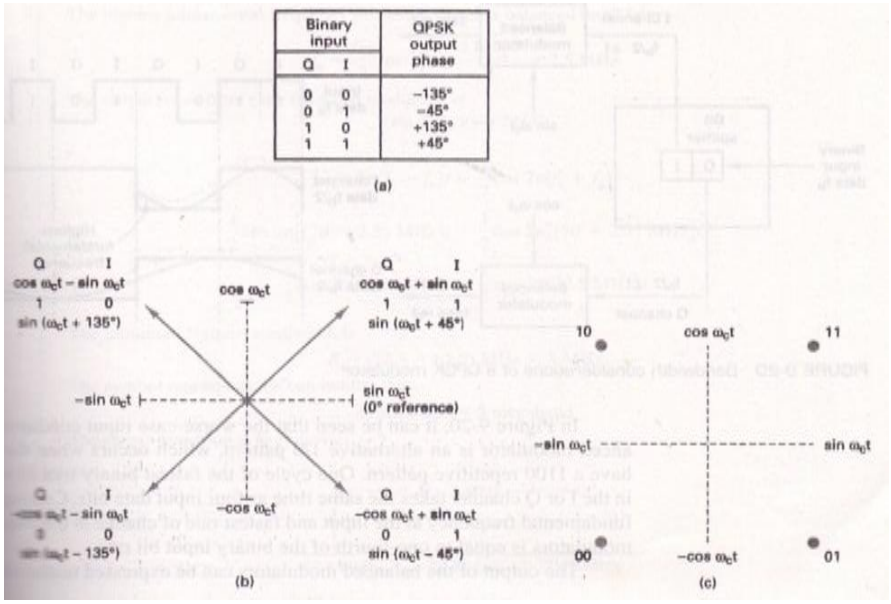
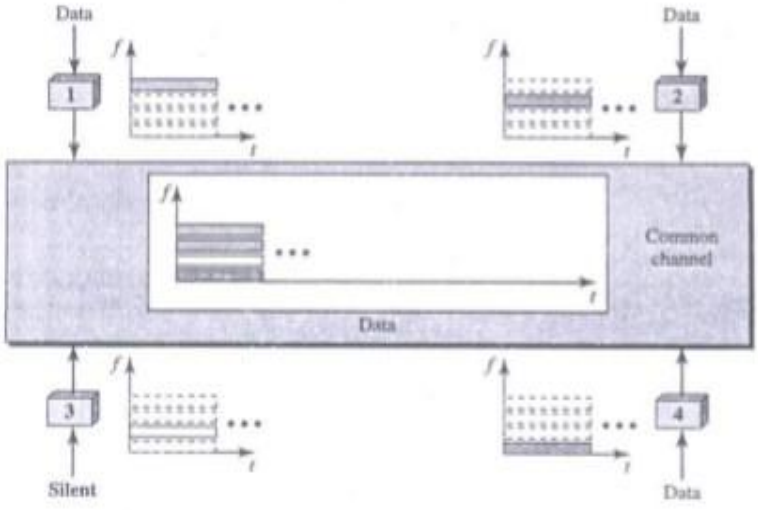
1. Two bits (a, dibit) are clocked into the bit splitter.
2. One bit is directed to the I channel and the other to Q channel.
3. The I bit modulates a carrier that is in phase reference oscillator (hence the name "I" for in phase channel).
4. The Q bit modulates a carrier that is 90^o out of phase OR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

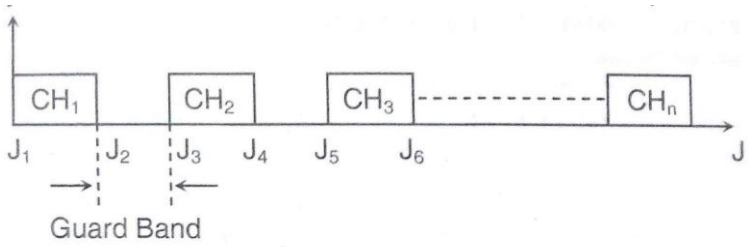
Logic 0 = - 1V

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:

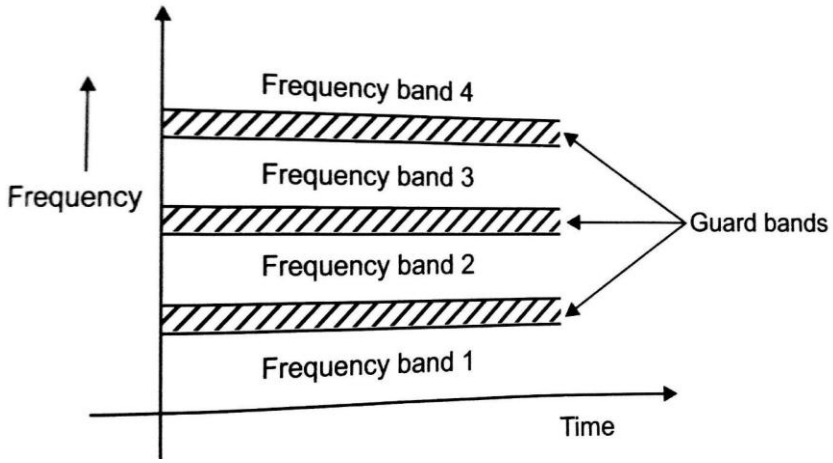
+ Sin $w_c t$ + Cos $w_c t$
+ Sin $w_c t$ - Cos $w_c t$
- Sin $w_c t$ + Cos $w_c t$
+ Sin $w_c t$ - Cos $w_c t$

Functions 2M

			
	iii) Ans.	**Draw the block diagram of FDMA and describe its working.**  **OR**	**4M** ***Diagram 2M***

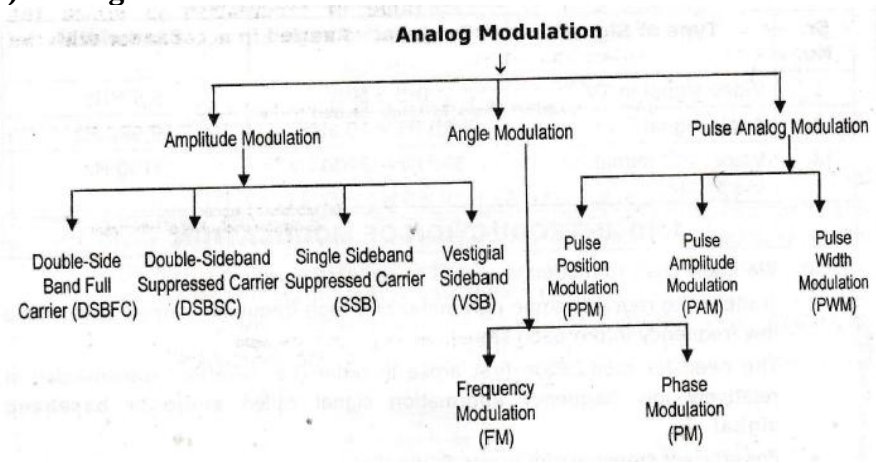
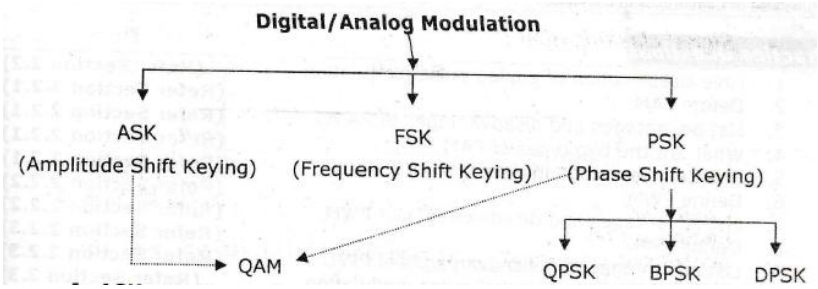


OR

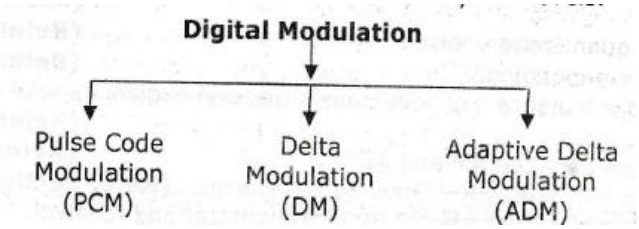


In frequency-division multiple access (FDMA) the available bandwidth is divided into frequency bands. Each station is allocated a band to send its data. In other word each band is reserved for a specific station, and it belongs to the station all the time. Each station also uses a bandpass filter to 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

Description 2M

		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.	
	iv) Ans.	**Define modulation. Give its classification.** **Definition of modulation:** It is a process in which the amplitude, frequency or phase of carrier signal is varied in accordance with the instantaneous amplitude of the modulating signal. OR It is a process in which the low frequency information signal is superimposed on a high frequency carrier signal. **Classification of modulation** (Any other method of classification may also be considered) **1) Analog Modulation:**  **2) Digital/ Analog Modulation:**  	**4M** ***Definition 1M*** ***Classification 3M***

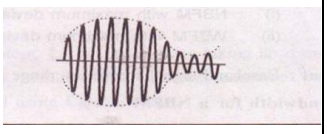
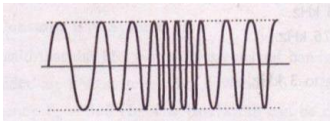
3) Digital Modulation:



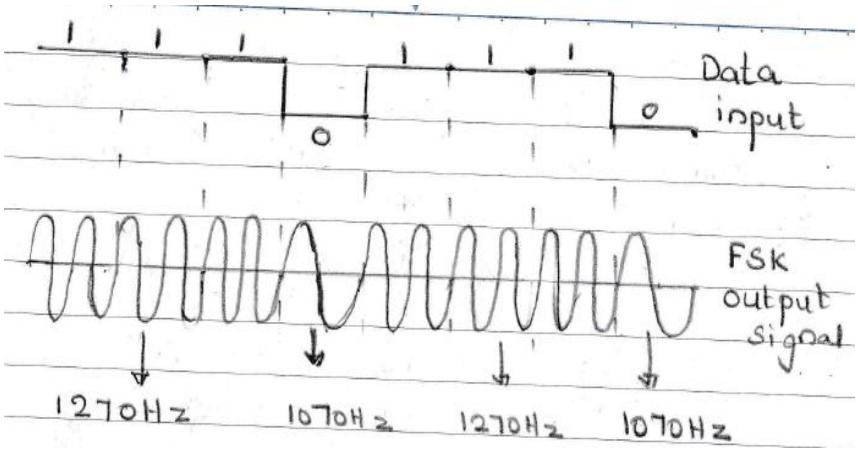
1. B) Attempt any one of the following: 6

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

Ans.

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	$m_f = \frac{\delta}{f_m}$ δ – frequency deviation

1M for each point

			modulating signal V_c- Amplitude of carrier signal	f_m - frequency of modulating signal
		Frequencies used for transmission	535 – 1700 KHz	88.1 – 108.1 MHz
	ii) **Ans.**	**Draw FSK waveform for a bit sequence 11101110. State advantages and disadvantages (any two).** **FSK Waveform:**  **Advantages of FSK:** 1. Easy to implement. 2. Better noise immunity than ASK. **Disadvantages of FSK:** 1. Not useful for high speed modems. 2. Preferred only for low speed modems.	**6M** ***FSK waveform 2M*** ***Advantages 2M*** ***Disadvantages 2M***
2.	**a)** **Ans.**	**Attempt any four:** **Draw the block diagram of Delta modulation transmitter. Describe its operation with waveform.**	**16** **4M**

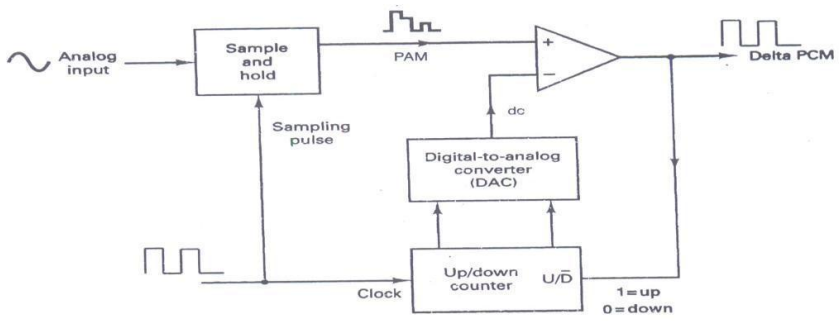
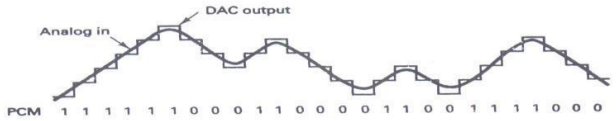


FIGURE 10-20 Delta modulation transmitter

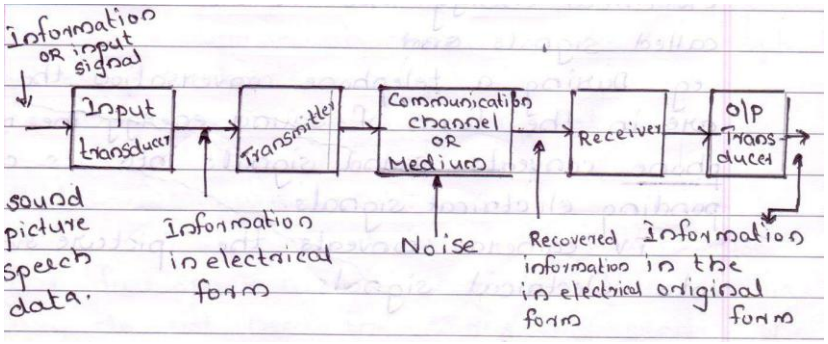


Ideal operation of a delta modulation encoder

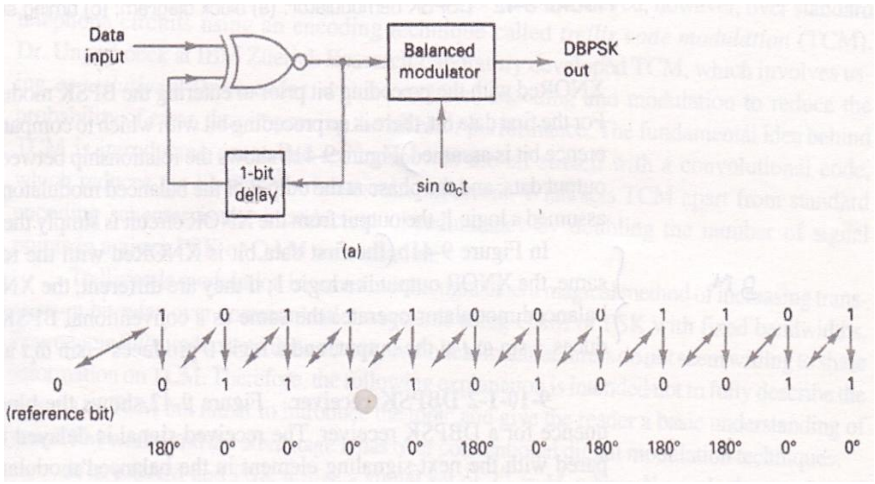
Block diagram -1M Waveform-1M

The above diagram shows a block diagram of a delta modulation transmitter. The analog input is sampled and converted to a PAM signal, which is compared with the output of the DAC. The output of DAC is a voltage equal to the regenerated magnitude of the previous sample, which was stored in the up-down counter as a binary number. The up-down counter is incremented or decremented depending on whether the previous sample is larger or smaller than the current sample. The up-down counter is clocked at a rate equal to sample rate. Therefore, the up-down counter is updated after each comparison. Initially, the up-down counter is zeroed, and the DAC is outputting 0V. The first sample is taken, converted to PAM signal, and compare with zero volts. The output of the comparator is a logic 1 condition (+V), indicating that the current sample is larger in amplitude than the previous sample. On the next clock pulse, the up-down counter is incremented to a count of 1. The DAC now outputs a voltage equal to the magnitude of the minimum step size (resolution). The steps change value at a rate equal to the clock frequency (sample rate). Consequently, with the input signal shown, the up-down counter follows the input analog signal up until the output of the DAC exceeds the analog sample; then the up-down counter will begin counting down until the output of the DAC drop below the sample amplitude. In the idealized situation, The DAC output follows the input signal. Each time the up-down counter is incremented, logic 1 is

Description 2M

		transmitted, and each time the up-down counter is decremented, logic 0 is transmitted.	
	b) Ans.	**Draw and explain the block diagram of communication system.**  **Fig: block diagram of communication system** **The main components of a basic communication system are:** 1. Information or input signal 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	**4M** ***Diagram 2M*** ***Explanation 2M***

		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 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.	
	c) **Ans.**	**Draw and explain block diagram of DPSK. Also give its advantages (any 2).**	**4M**



Block Diagram of DPSK generation

Block *Diagram 1M*

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.

Explanation 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.

Advantages of DPSK:

1) DPSK does not need carrier at its receiver. Hence the complicated circuitry for generation of local carrier is avoided.

2) The bandwidth requirement of DPSK is reduced compared to that of BPSK.

Any 2 advantages ½ M each

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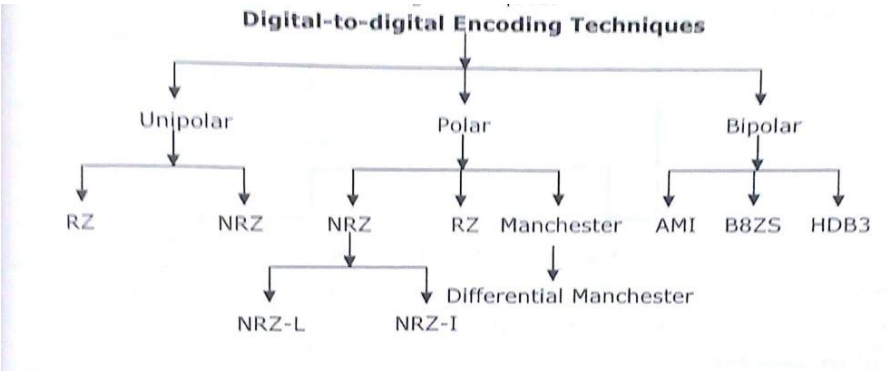
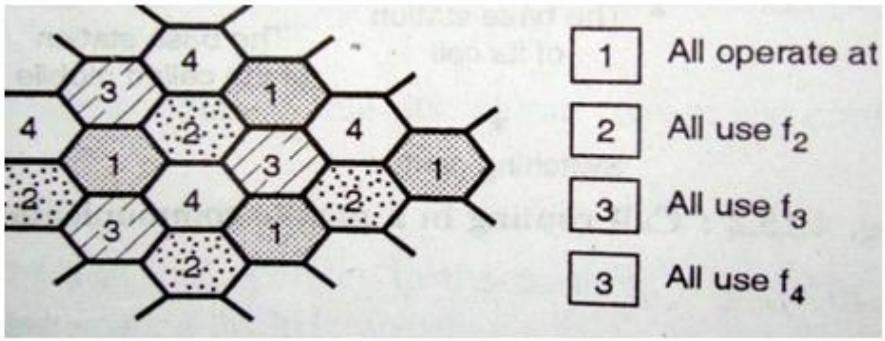
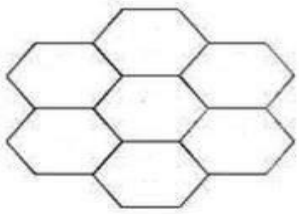
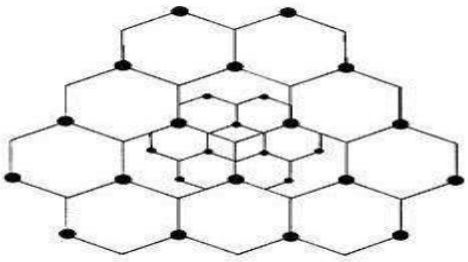
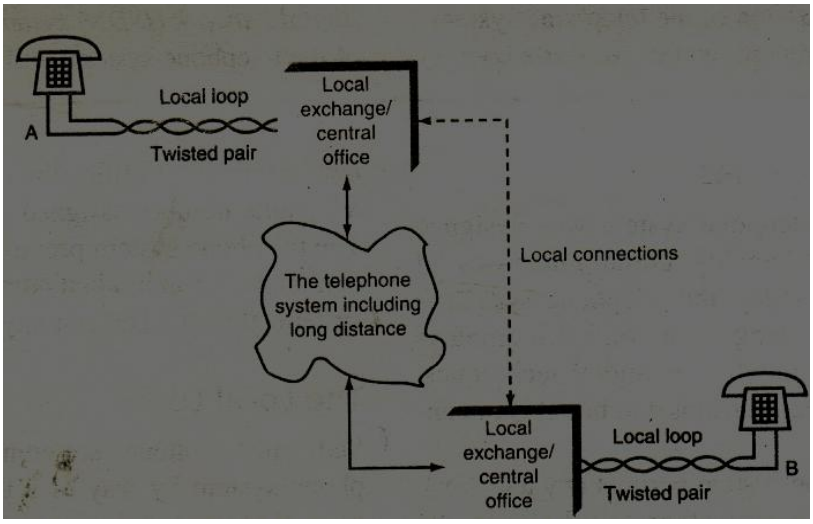
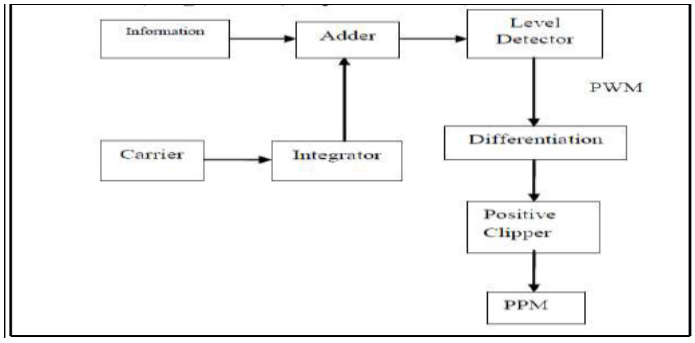
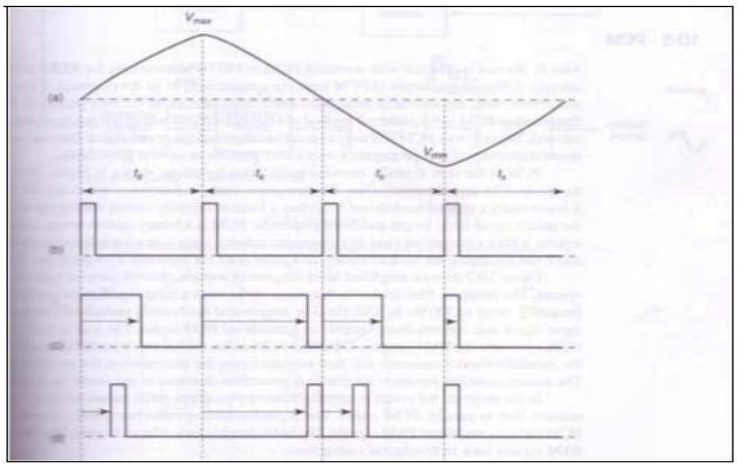
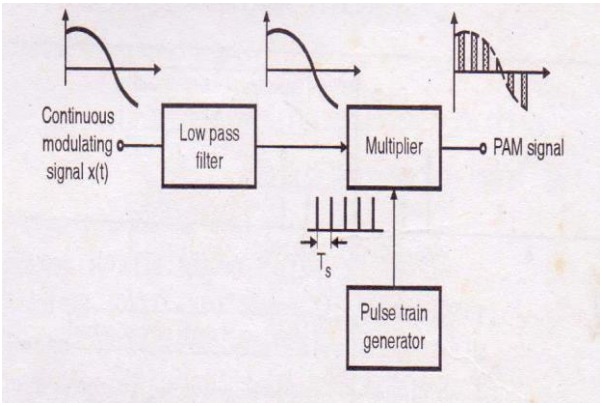
	d) **Ans.**	**Give the classification of encoding techniques. Give its advantages (any 2).** **Classification of encoding techniques:**  **Advantages of Encoding techniques** 1. DC component can be reduced thus reducing transmission power 2. Synchronization between bits transmitted and received can be obtained. 3. Bandwidth utilization can be reduced 4. Error detection and correction is possible 5. By encoding, the information is secure.	**4M** ***Classification 2M*** ***Any two advantages 1M each***
	e) **Ans.**	**Explain concept of frequency reuse and cell splitting in mobile communcation with neat diagram.** **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	**4M** ***Concept of frequency reuse With diagram 2M***

		are separated by sufficient distance reducing each cells coverage area. 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 may be used in different cells without interfering with each other. **Cell Splitting:** 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.  Each cell has its own BS. Each cell is connected to 100 different MS.  **Fig: Cell splitting**	***Concept of cell splitting With diagram 2M***

		As the number of users increase in the area, it is necessary to have more base stations and so the concept of cell splitting is used.	
	f) **Ans.**	**Draw the block diagram of telephone system. State function of each block.**  The original telephone system was designed for full-duplex analog communications of voice signals. 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 reorganizing each individual number and switching systems that can connect any two telephones. Standard telephones are connected to the telephone system by way of a two-wire, twisted pair cable that terminates at the local exchange or central office. The connections from the central office go to the 'telephone system' by the large cloud. 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 two-wire, twisted-pair connection between the telephone and the central office is referred to as the local loop or subscriber loop. The circuits in the telephone and at the central office from a complete	**4M** ***Block diagram 2M*** ***Functions 2M***

		electric circuit, or loop. This single circuit is analog in nature and carries both dc and ac signals. The dc power for operating the telephone is generated at the central office and supplied to each telephone over the local loop. The ac voice signals are transmitted along with the dc power. Despite the fact that only two wires are involved, full-duplex operation that is, simultaneous send and receive, is possible. All dialing and signaling operations are also carried on this single twisted pair.	
3.		**Attempt any four of the following:**	**16**
	a)	**Draw the block diagram for generation of PPM. Describe its operation.**	**4M**
	Ans.	**Block Diagram of generation of PPM from PWM** 	***2M for Diagram***
		Pulse position modulation (PPM) It is the process of modulation in which the position of the carrier is varied in accordance to the instantaneous voltage of the modulating signal keeping the carrier width and amplitude constant. PPM Signal is obtained from PWM signal. In PWM, the Positive or the leading edge appears after fixed interval of time. But the negative edge of the trailing edge does not appear after a fixed interval of time. It appears after time propagation to the width of the pulse. The width of the pulse is proportional to the modulating signal at that instance. Thus the position of the trailing edge is proportional to the instantaneous voltage of the modulating signal.	***2M for Explanation with waveform***
		To obtained PPM from PWM The trains of PWM pulses are given to the differentiator whose output is proportional to differential input which produces positive and negative spikes. The positive spikes are equidistant and negative spikes are position modulated. The positive spikes are removed by a	

		positive chipper and the negative spikes represent the PPM signal. 	
	b) **Ans.**	**Define PAM and describe the generation process of PAM with waveform.** **Definition of PAM:** Pulse amplitude modulation (**PAM**) is the transmission of data by varying the amplitude s (voltage or power levels) of the individual pulses in a regularly timed sequence of electrical or electromagnetic pulses.  **Fig: Generation of PAM** The continuous modulating signal x(t) is passed through the low pass filter. The low pass filter will bandlimit signal to f_m All the frequency	**4M** ***1M for definition*** ***2M for diagram***

components higher than f_m are removed.
The pulse train generator generates a pulse train at a frequency
The modulating signal x(t) and the sampling signal are multiplied in the sampled to produce pulse amplitude modulated (PAM) signal.
The PAM signal is a train of pulse of width t whose amplitudes are varying.

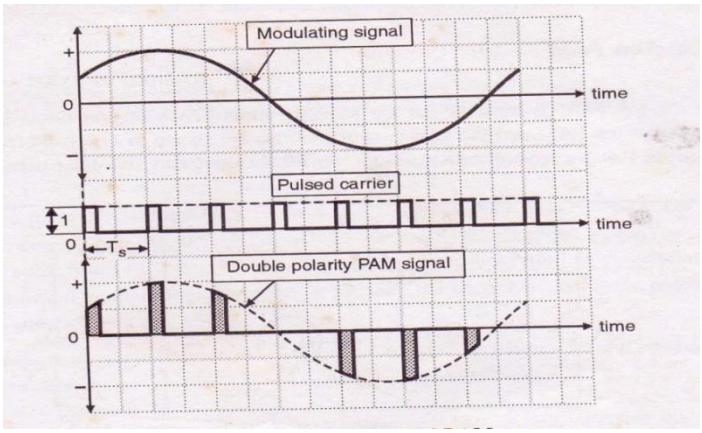


Fig: Waveform of PAM

1M for waveform

c) Ans. **Define channel capacity and describe its significance.** **4M**

Definition of channel capacity:
Data rate
$R=n f_s$
Where n=Number of bits/sample
f_s=Number of sample/sec
Channel capacity is defined as maximum possible data rate is with which information can be conveyed on channel with minimum error.
The channel capacity of a white, band limited Gaussian channel is given by,

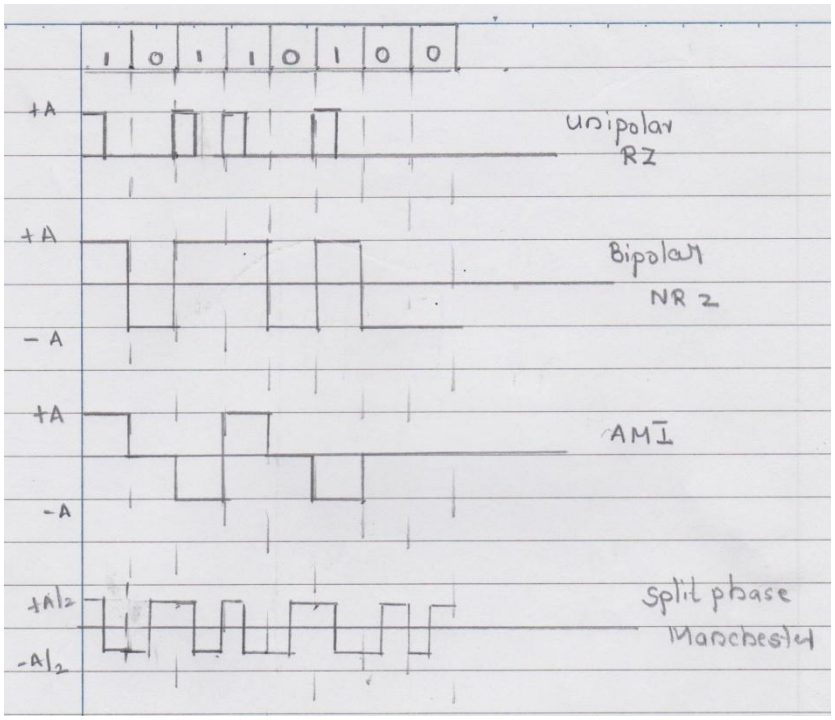
$$C = B \log_2 (1 + \frac{S}{N}) \quad \text{bit/sec}$$

Where, B = Channel Bandwidth
S = Signal Power
N = Noise within the channel bandwidth

2M for definition

Significance of Channel capacity:
The Implications of the Shannon Hartley Theorem is as follows,
1. It gives us an upper limit that can be reached in the way of reliable data transmission rate over Gaussian channels. Thus, a system designer always tries to optimize his system to have data rate as close

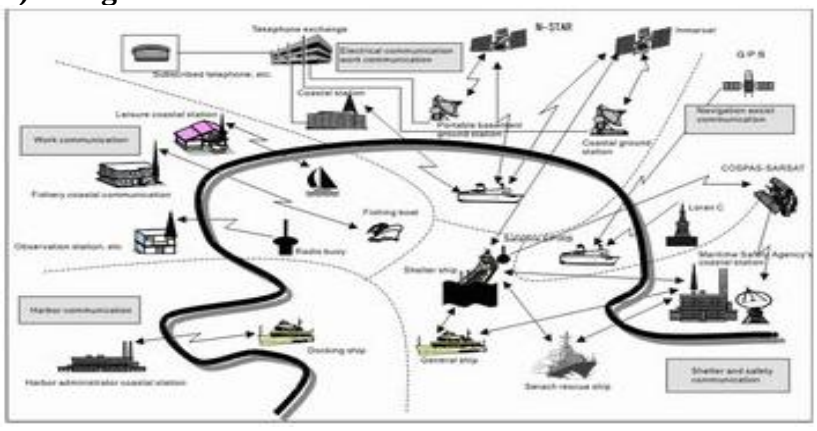
2M for significa

		to channel capacity *C*, given in the equation, as possible with an acceptable error rate. 2.The second implication of the Shannon-Hartley theorem has to do with the exchange of signal-to-noise ratio *(S/N)* for bandwidth i.e. tradeoff between *S/N* and Bandwidth *B*	***nce***
	d) **Ans.**	**Draw the following data formats for bit stream 10110100.** **a) Unipolar RZ** **b) Bipolar NRZ** **c) AMI** **d) Manchester**  	**4M** ***1M each for correct waveform***
	e) **Ans.**	**Describe the application of satellite communication:** **a) Surveillance** **b) Navigation.** **a) Earth Observation or Surveillance:**	**4M**

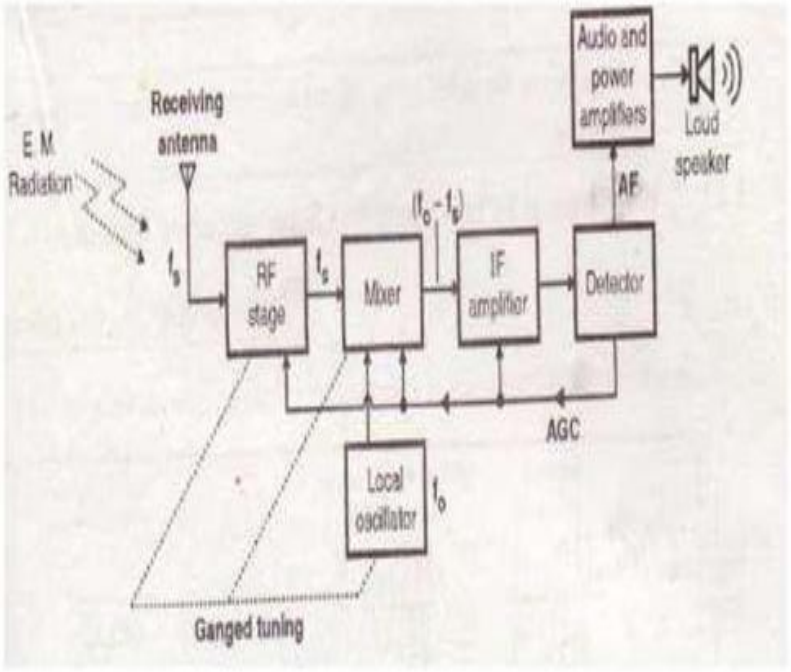
Understand and analyzing global environmental conditions is an essential element of guaranteeing our safety and quality of life. Among other things, we need to be able to spot environmental disasters in a timely manner, and to monitor and manage the Earth's natural resources. For this purpose, a number of Earth Observation satellites are in orbit for Earth observations. Data collected by these satellites allow us to understand the processes and interactions among land masses, oceans, and atmosphere. The utility of different data sets for different applications are agriculture, forestry, geology, risk management, cartography, environment, and defence.

2M each for description of application

b) Navigation:



Navigation satellite is an artificial satellite stationed in space for the

		purposes of navigation. Satellite navigation is a space-based radio positioning system that includes one or more satellite constellations, augmented as necessary to support the intended operation, and that provides 24-hour three-dimensional position, velocity and time information to suitably equipped users anywhere on, or near, the surface of Earth. A satellite navigation system provides users with sufficient accuracy and integrity of information to be useable for critical navigation applications. The GPS system is the first core element of the satellite navigation system widely available to civilian users.	
4.	**A)** **i)** **Ans.**	**Attempt any three of the following:** **Draw the block diagram of 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	**12** **4M** ***2M for diagram*** ***2M for explanat***

		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 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.	***ion***

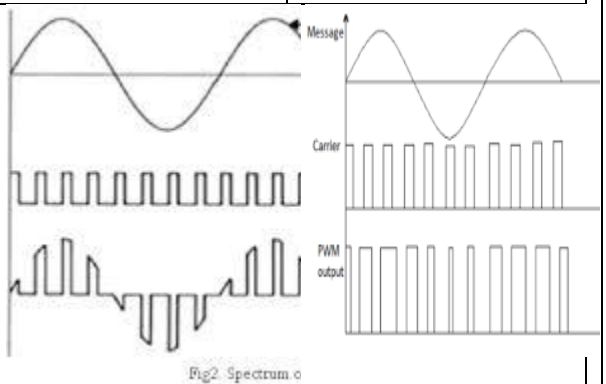
		The amplitude of this dc voltage is proportional to the detector output.	
	ii) **Ans.**	**Define bit rate. In digital to analog modulation system signal carries 4 bits per signal element. If number of signal elements per second are 1000, calculate bit rate.** **Bit rate:** Bit rate is the number of bits transmitted per second. Data rate is also known as bit rate. Bit rate = 1 /Bit interval **Given:** Number of signal element /sec=1000 Bit rate is the no. of bit transmitted in 1 second. The no .of bits in 1 signal element is 4 Therefore bit rate= 1000signal element X 4=4000bps.	**4M** ***2M for definition & 2M for numerical***
	iii) **Ans.**	**State the bandwidth requirement of :** **a) ASK** **b) FSK** **c) DPSK** **d) QPSK** F_b = input bit rate, ΔF = frequency deviation a) ASK = F_b b) FSK = $2(\Delta F + 2F_b)$ c) DPSK = F_b d) QPSK = $F_b/2$	**4M** ***1M each for correct Bandwidth***
	iv) **Ans.**	**State the sequential steps for handset to landline call procedure.** 1) 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 mobile units identification number over a reverse control channel to the base station switch. 2) If the mobile units ID number is valid, the cell site controller routes the called number over a wireline trunk circuit to the MTSO. 3) The MTSO uses standard call progress signals to locate the switching path through the PSTN to the destination party	**4M** ***Steps for handset to landline call procedu***

		4) 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 5) 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 6) If a suitable switching path is available to the wireline telephone number, the call is completed when the wireline party answers the telephone.	***re 4M***
4.	**B)** **i)** **Ans.**	**Attempt any one of the following:** **Define:** **a) Sampling theorem** **b) Nyquist rate** **a) 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. $f_s \geq 2\ f_m$ **b) Nyquist rate:** 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, $f_s = 2f_m$	**6** **6M** ***3M each for correct definition***
	ii) **Ans.**	**State applications of satellite communication system. (any four)** ***(Note: Any other relevant applications may also be considered)*** **Applications of satellite communication system** 1) Major application of satellite is surveillance or observation 2) It is used in Navigation (Global Positioning system). 3) It is used in TV distribution(TV signal is transmitted through satellite) 4) Satellite telephone 5) Entertainment - Broadcasting via satellite offers a variety of programming to the avid viewer including local and foreign programs. 6) Do serve civilian in rural area where terrestrial communication	**6M** ***Any four applications $1^{1/2}$M each***

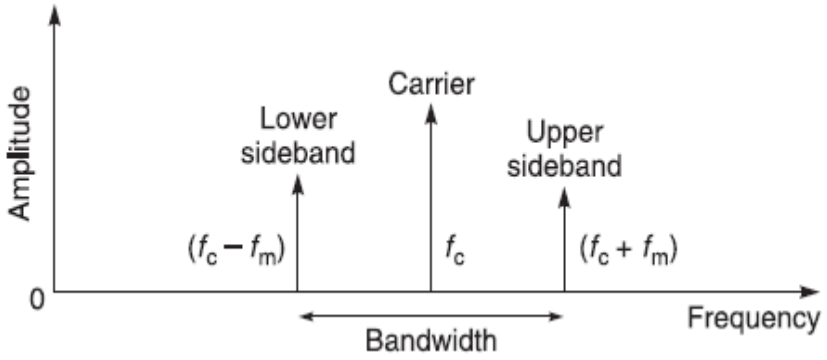
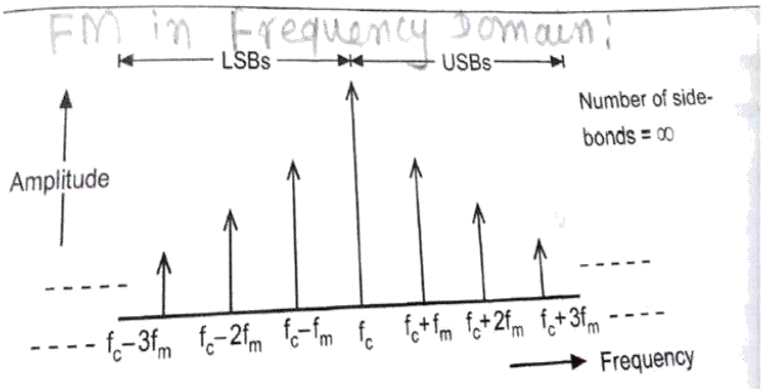
network does not exist by providing telephony service.
7) In military sector, providing robust and sophisticated secure communications network.
8) To provide communication when the terrestrial systems fail due to disaster such as earthquake, volcanic eruption floods, drought, cyclones, landslides and epidemics.
9) Tele-medicine.

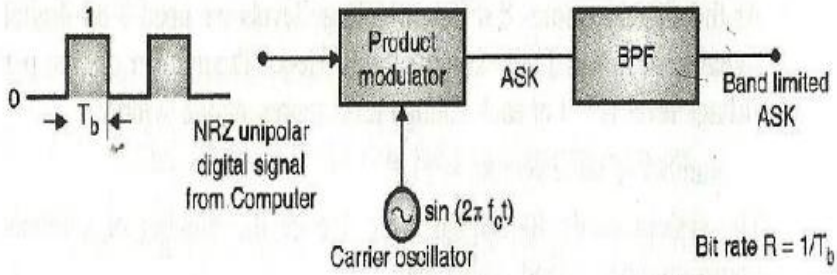
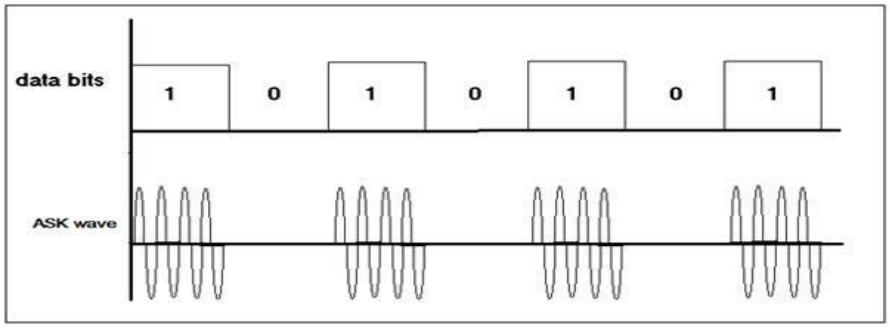
5. **a) Ans.** **Attempt any four of the following:** **16**

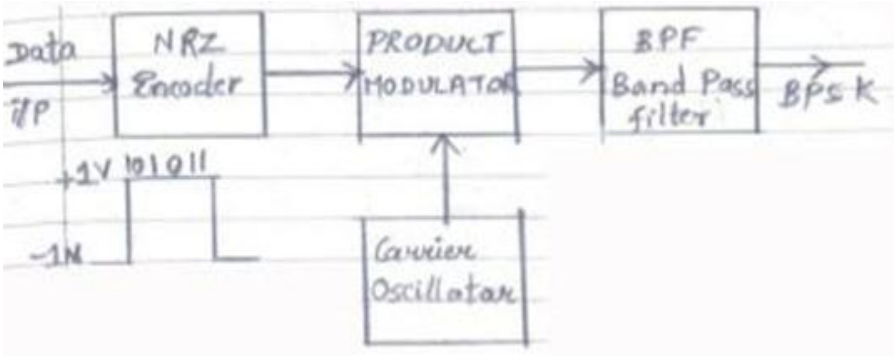
Compare PAM and PWM on the basis of any four parameters. **4M**

Parameter	**PAM**	**PWM**
Type of Carrier	Train of pulses	Train of pulses
Bandwidth requirement	Low	High
Transmitted Power	Varies with amplitude of pulses	Varies with variation in width
Noise immunity	Low	High
Definition	Changing the amplitude of the pulse in accordance to the instantaneous voltage of the modulating signal	Changing the width of the pulse in accordance to the instantaneous voltage of the modulating signal
Variable characteristics of the pulsed carrier	Amplitude	Width
Waveforms	 Fig2 Spectrum o	

Any four parameter 1M each

	b) **Ans.**	**Draw AM and FM signal in frequency domain. Give the bandwidth equation for both.**  Bandwidth of AM =$2f_m$ **FM:**  Bandwidth of FM Bandwidth = $2f_m$ X Number of significant sidebands	**4M** ***Diagram of AM 1M*** ***Bandwidth formula of AM 1M*** ***Diagram of FM 1M*** ***Any one Bandwidth formula***

		OR Bandwidth = $2[\delta + f_{m(max)}]$	***of FM 1M***
	c) **Ans.**	**Explain working principle of Amplitude Shift Keying (ASK) with waveform.** **Working Principle:** In ASK binary information signal directly modulates amplitude of analog carrier. **Block Diagram of ASK Generation:**  **Carrier Oscillator** – Generates carrier i.e. sinewave of frequency fc **Digital Signal** –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:**  	**4M** ***Blok Diagram 2M*** ***Explanation 1M*** ***Waveform 1M***
	d) **Ans.**	**Draw and explain block diagram of Phase Shift Keying (PSK).** NRZ encoder counters binary data into NRZ bipolar signal. Consider, the NRZ bipolar signal to be having amplitude +1V corresponding to	**4M**

		binary 1 and -1V corresponding to binary 0. The carrier oscillator generates line wave carrier signal ($\sin w_c t$). The product modulator multiplies the i/p encoded signal with the carrier signal producing +1 ($\sin w_c t$) signal and -1 ($\sin w_c t$). 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. **Diagram:** 	***Explanation 2M*** ***Block Diagram 2M***
	e) **Ans.**	**Compare unipolar RZ and unipolar NRZ encoding methods (any four points).** **Sr. No.** | **unipolar RZ** | **unipolar NRZ** 1. | In this format each "0" is represented by an off pulse (0) & each "1" by an on pulse With amplitude A & duration $T_b/2$. | In this format each "0" is represented by an off pulse (0) & each "1" by an on pulse With amplitude A & duration T_b. 2. | During the on time, the pulse return to zero after half bit period. | During the on time, the pulse does not return to zero after half bit period. 3. | Unipolar RZ pulses carry less energy. | Unipolar NRZ pulses carry more energy. 4. | Clock recovery is Poor. | Clock recovery is Good. 5. | Synchronization is not | Synchronization is essential	**4M** ***Any four points 1M each***

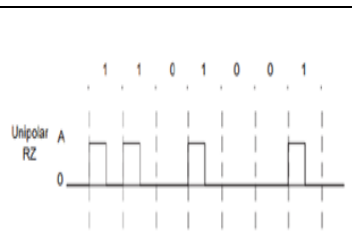
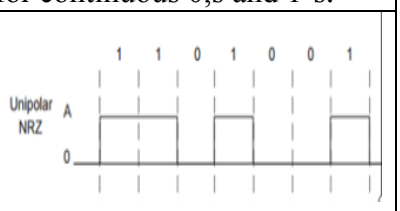
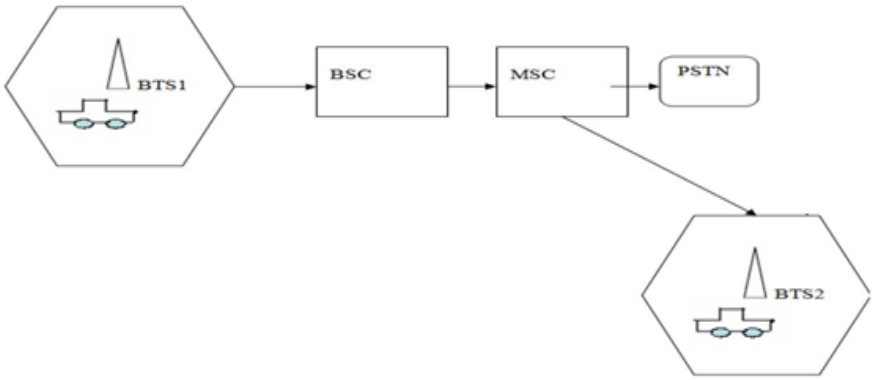
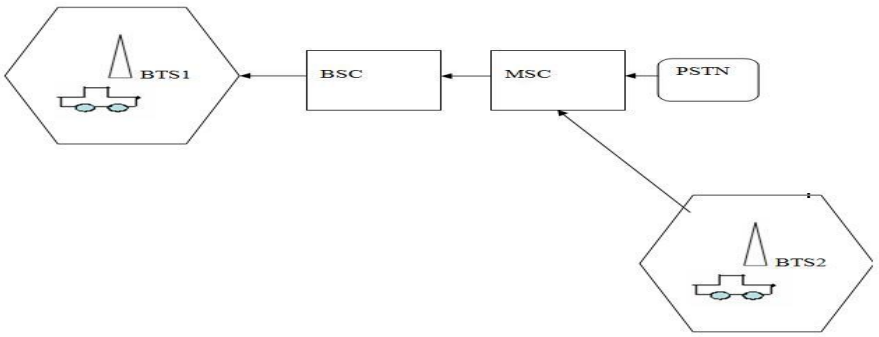
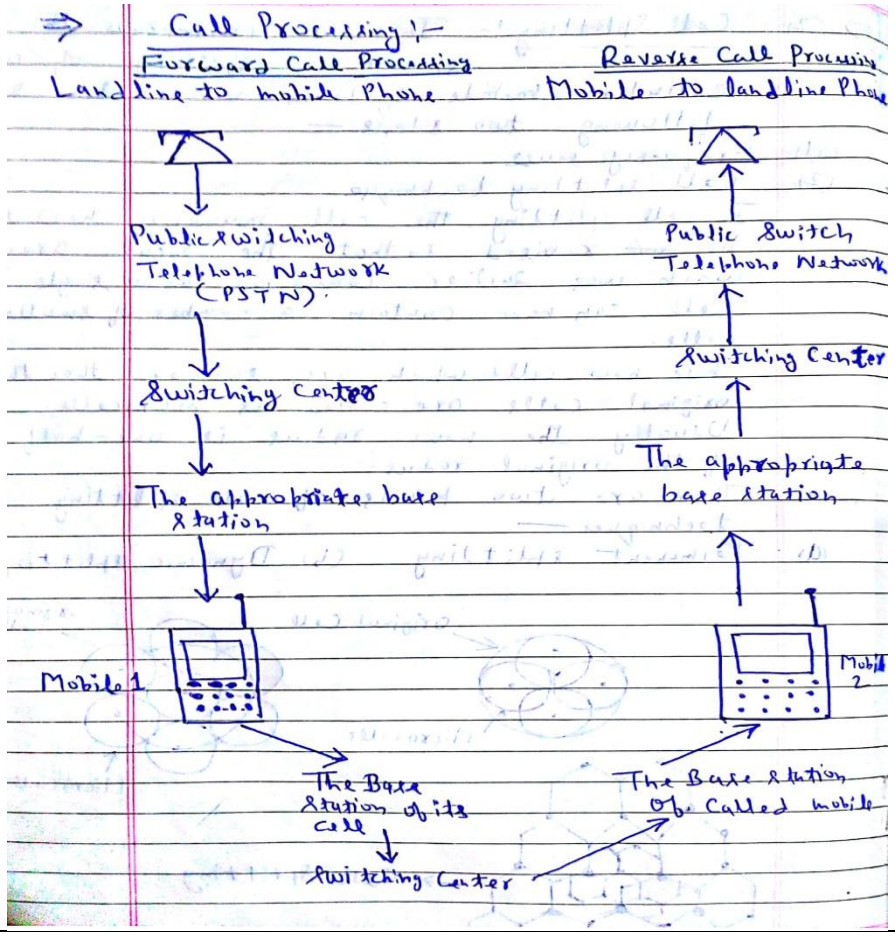
		essential	for continuous 0,s and 1's.
		6. 	
	f) Ans.	**Explain forward and reverse call processing with neat diagram.** **Forward call processing:** Mobile originated calls go to BTS first and then BSC .The BSC forwards this call to MSC .The MSC does the authentication and call routing as per the dialed 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. **Diagram:**  **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.	**4M** ***Forward call processing 2M*** ***Reverse call processing 2M***

Diagram:

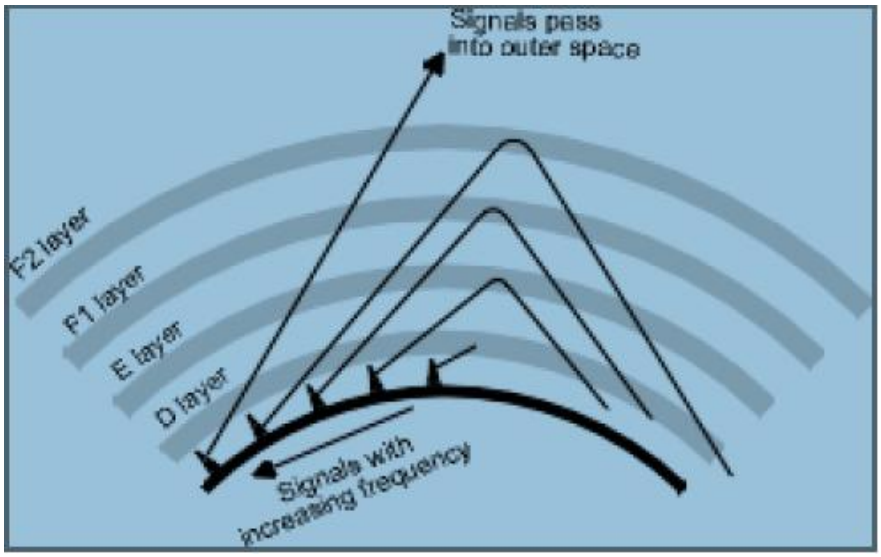

BTS1
BSC
MSC
PSTN
BTS2

OR


Call Processing :-
Forward Call Processing
Landline to mobile Phone
Reverse Call Processing
Mobile to landline Phone
Public Switching Telephone Network (PSTN).
Switching Center
The appropriate base station
Mobile 1
The Base Station of its call
Switching Center
Public Switch Telephone Network
Switching Center
The appropriate base station
Mobile 2
The Base Station of Called mobile

WINTER – 2018 EXAMINATION
MODEL ANSWER

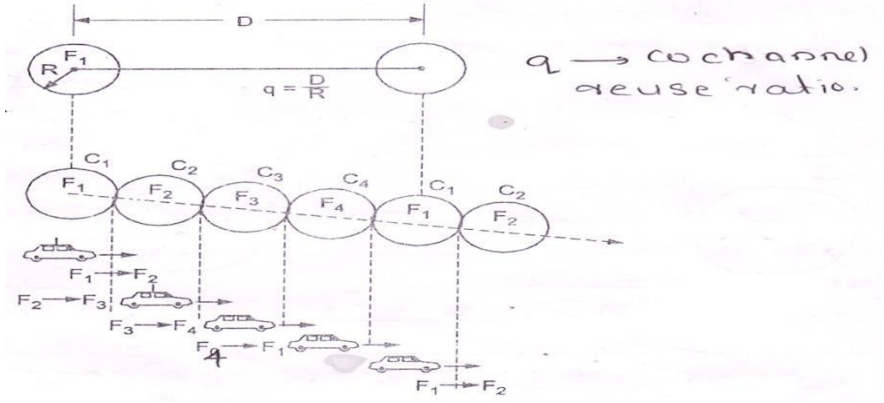
Subject: Communication Technology **Subject Code:** **17519**

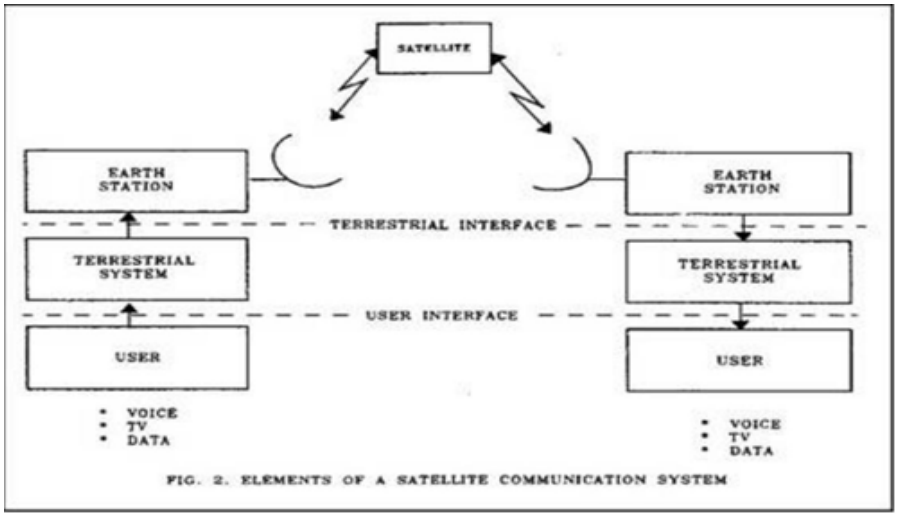
6.	**a) Ans.**	**Attempt any four:** **Define PWM. List its advantages and disadvantages (any two).** **Definition PWM:** When the width of pulsed carrier varies in accordance with instantaneous values of modulating signal where amplitude and position of the pulse remains constant. **Advantages of PWM:** 1) More immune to noise. 2) Synchronization between transmitter and receiver is not required 3) Possible to separate out signal from noise. 4) Can easily set the used duty cycle. **Disadvantages of PWM:** 1) Due to variable pulse width the pulse have variable power contents. The transmitter must be powerful to handle maximum width of pulses. 2) Bandwidth requirement is large as as compared to PAM. 3) Cost and complexity of the circuit. 4) Higher switching losses.	**16** **4M** ***Definition 2M*** ***Any two Advantage 1M*** ***Any two disadvantages 1M***
	b) Ans.	**With neat sketch and explain ionospheric propagation.**  **Explanation:**	**4M** ***Diagram 2M***

		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. 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 2M***
	c) **Ans.**	**Compare pulse modulation with continuous wave modulation for four points.**	**4M** ***Any four comparison 1M each***

Sr. No.	Parameter	Compare Pulse modulation	Continuous wave modulation
1.	Carrier	Train of rectangular pulses	Sinusoidal
2.	Types of modulation system	PAM,,PWM,PPM ,PCM,DM	AM,FM,PM
3.	Digital modulation	Possible	Not possible
4.	Principal of operation	Amplitude, width or position of pulsed carrier signal is changed in accordance with instantaneous value of modulating signal.	Amplitude, frequency or phase of carrier signal is changed in accordance with instantaneous value of modulating signal.
5.	Performance in presence of noise	PWM and PPM perform well but PAM does not.	FM and PM perform well but AM does not.
6.	Application	Satellite communication,	Broadcasting (radio and TV)

				communication between spaceship and earth station.	
		7.	Cost and Simplicity	Costly and complex	Simpler and less costly
		8.	Sampling Technique	used	Not used

	d) Ans.	**Explain the hand-off procedure and state hand-offs are needed.** **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.  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 vehicle 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.	**4M** ***Hand-off procedure 2M*** ***Diagram 1M***

		• The receiver in each cell station continuously 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 from the mobile unit is stronger. • The computer at the MTSO causes the transmission from the vehicle to be switched from the weaker cell to the stronger cell. It is called "Hand off" Mechanism. **Need of hand-off:** The hand-off process is of major importance within any cellular telecommunications network. It is necessary to ensure it can be performed reliably and without disruption to any calls. Failure for it to perform reliably can result in dropped calls, and this is one of the key factors that can lead to customer dissatisfaction, which in turn may lead to them changing to another cellular network provider. Accordingly handoff is one of the key performance indicators monitored so that a robust cellular handoff regime is maintained on the cellular network.	***Need of Hand-off 1M***
	e) **Ans.**	**Draw the block diagram of satellite communication system and explain how it works.**  FIG. 2. ELEMENTS OF A SATELLITE COMMUNICATION SYSTEM A satellite is any natural or artificial object located in space, capable of receiving and Retransmitting electromagnetic waves.	**4M** ***Block Diagram 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 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. An earth station transmit information signal to the satellite using a highly directional dish antenna. **Receiver** The satellite receive this signal, processes it and transmits it back at reduced frequency. The receiving earth stations will receive this signal using parabolic dish antennas pointed towards satellite. The signal which is being transmitted upward to the satellite is called at the "uplink" and it is normally at a frequency of 6 GHz. The signal which is transmitted back to the receiving earth station is called as "downlink" and it is normally at a frequency of 4GHz. Thus a satellite has to receive process and transmit the signal. All these functions are performed by a unit called satellite transponder.	***Explanation 2*M**