Important Instructions to examiners:

1) The Answer 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 Answer and model Answer.
6) In case of some questions credit may be given by judgment 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.1 a) Attempt any SIX of the following: **(12 Marks)**

i) State the sampling theorem.

Ans:- **(2 M)**

A continuous time signal x(t) can be completely represented in its sampled form and recovered back from the sampled form if the sampling frequency fs >= 2fm, where fm is the maximum frequency of the continuous signal.

ii) Give the frequency bands used in satellite communication.

Ans:- **(Any four bands ½ M each)**

Frequency bands used in satellite communication.

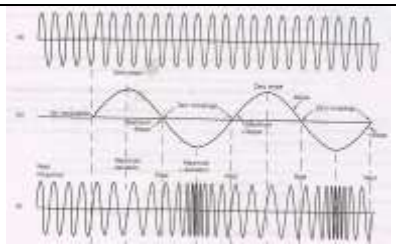
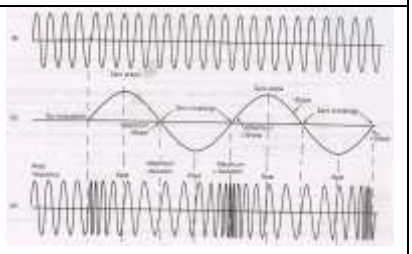
Band	**Frequency**
L	1.53 – 2.7 GHz
S	2.5 – 2.7 GHz
C	3.4 – 6.4 GHz
X	7.2 – 8.4 GHz
Ku	10.95 – 14.5 GHz

Ka	17.7 – 31 GHz
Q	36 – 46 GHz
V	46 – 56 GHz
W	56 – 100 GHz

iii) Compare FM and PM for

1) **Waveform**
2) **Modulation index**

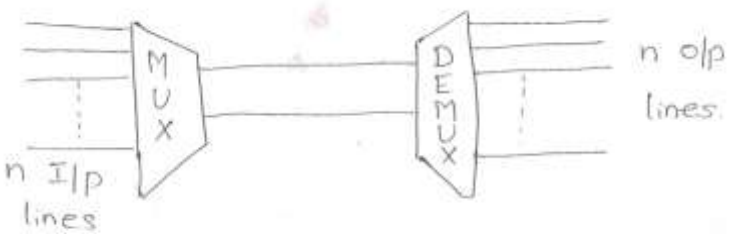
Ans:- **(1M for each point)**

Parameter	**FM**	**PM**
Wave form		
Modulation index	$m = \frac{fc}{fm}$ fc = frequency deviation fm = modulating signal frequency	M= KVm (radians) K= deviation sensitivity (radians / volts) Vm= peak modulating signal amplitude

iv) Define multiplexing. Give its classification.

Ans:- **(Definition – 1 M, Classification – 1 M)**

Multiplexing is a set of techniques that allows the simultaneous transmission of multiple signals across a signal data link.

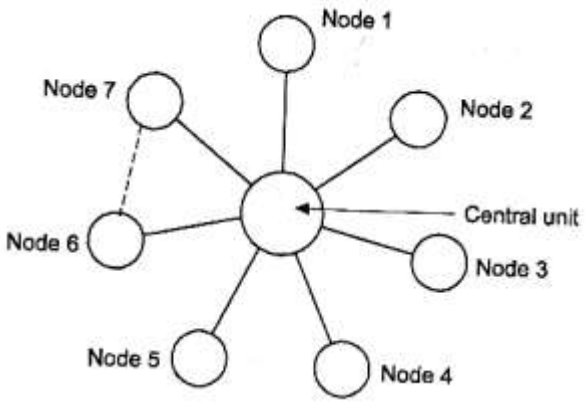


Classification of multiplexing:

1. Frequency division multiplexing (FDM)
2. Time division multiplexing (TDM)
3. Wavelength division multiplexing (WDM)

v) Write features of star topology.

Ans:- **(Diagram – 1 M, Any two features- ½ M each)**



- A large no. of users can be connected to the central node
- Each user on a star network communicates with a central hub that resends the message either to all the computers of a star network or only to the destination computer in a switched star network.
- The central node acts as a switch to direct the data from transmitter to the receiver.
- New number or nodes can be easily added without breaking path.

vi) What is dispersion? In which type of fiber it occurs?

Ans:- **(Definition 1M, Fiber type 1M)**

Definition of Dispersion: Dispersion is defined as the spreading and reduction in the amplitude of the pulse as it propagates down the optical fiber cable due to variation in refractive index.

- Dispersion occurs in **Multimode Step-index fiber.**

vii) Define signal to noise ratio and noise factor.

Ans:- **(signal to noise ratio 1M, Noise factor 1M)**

Signal to noise ratio: Signal-to- noise ratio is defined as the ratio of signal amplitude (voltage) to noise amplitude (voltage).

$$SNR = \frac{V_s}{V_n} \; OR \; SNR = \frac{P_s}{P_n}$$

Noise Factor: Noise factor is simply a ratio of input signal-to-noise power ratio to the output signal-to-noise power ratio. Mathematically noise factor is,

$$F = \frac{Input\ signal - to - noise\ power\ ratio}{output\ signal - to - noise\ power\ ratio}\ (Unitless)$$

b) Attempt any TWO of the following: (8 Marks)

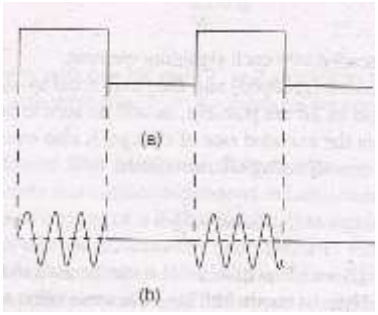
i) Define ASK and FSK. Draw their waveforms.

Ans:- (Definition of ASK,FSK 1M each, waveforms 1M each)

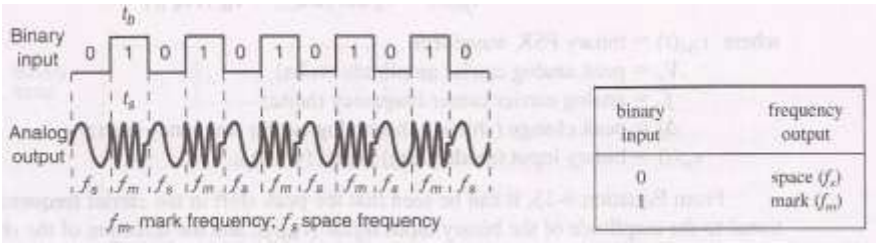
Definition of ASK : If the information signal is digital and the amplitude of the carrier is varied proportional to the information signal , a digitally modulated signal called amplitude shift keying is produced.

Modulating signal

ASK



Definition of FSK: If the information signal is digital and the frequency of the carrier is varied proportional to the information signal , a digitally modulated signal called frequency shift keying is produced.

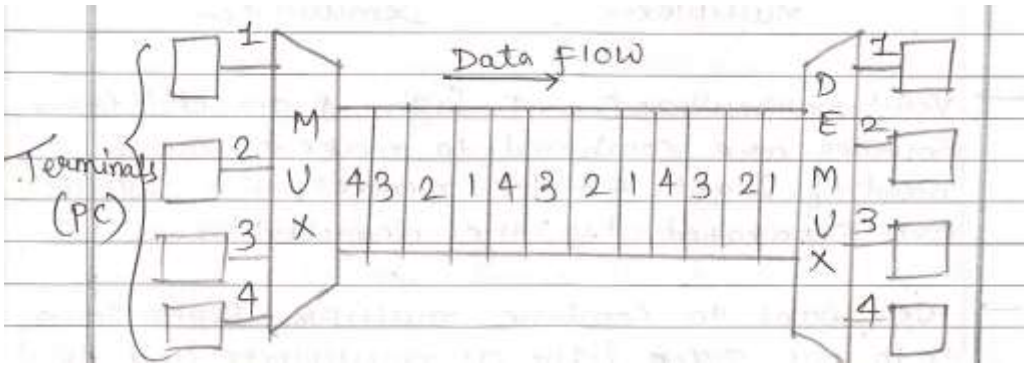


ii) Describe working principle of TDM. State its two applications.

Ans:- (Diagram 1M,Working principle 2M, Applications (any 2) ½ M each)

- TDM is digital process that allows several connections to share the high bandwidth of a link. Time is shared in TDM. Each connection occupies a portion of time in the link as shown in figure below.

Diagram:



- The link is sectioned by time rather than by frequency. The portion of signals 1, 2, 3 and 4 occupy the link sequentially.
- All data in a message from source 1 always go to one specific destination be it 1, 2, 3 or 4. The delivery is fixed and unvarying unlike switching.
- In synchronous TDM, if we have 'n' connection, a frame is divided in to n time slots and one slot is allocated for each unit, one for each input line.
- The data rate of the output link must be 'n' times the data rate of a connection to guarantee the flow of data.

Applications:

- For multiplexing of digital data
- For digital telephony
- In the mobile phones

iii) Write the mathematical expression for a FM wave and define modulation Index of it.

Ans:- **(Mathematical expression 2M, definition 2M)**

The mathematical expression of FM wave is as follows:

$$e_{FM} = A \sin (\omega_c t + m_f \sin \omega_m t)$$

Where,

ω_m = Angular velocity = $2\pi f_m$ ω_c = Angular velocity = $2\pi f_c$ **m_f = modulation index of FM**

f_m = Modulating frequency

f_c = Carrier frequency

Definition of Modulation Index: The ratio of frequency deviation to the modulating frequency is known as modulation index. (m_f)

$$M.I. = \frac{\text{Frequency deviation}}{\text{Modulating frequency}}$$

$$\boxed{m_f = \frac{\delta}{f_m}}$$

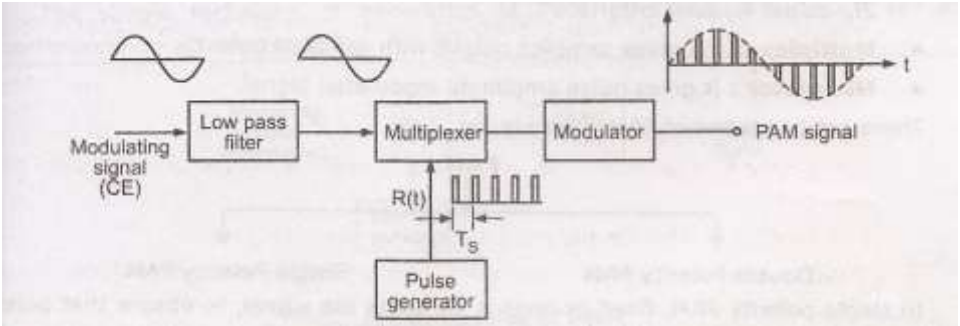
Modulation Index of FM decides –
(i) Bandwidth of the FM wave.
(ii) Number of sidebands in FM wave.

$\boxed{\text{In FM, } m_f > 1}$

Q. 2. Attempt any Four of the following.

a) Describe the generation of PAM with the help of block diagram.

Ans:- **(PAM block diagram 2M, Explanation 2M)**



When the amplitude of the pulse carrier varies in accordance with the instantaneous value of modulating signal, is called PAM where width and position remain constant.

Functions of the each block:

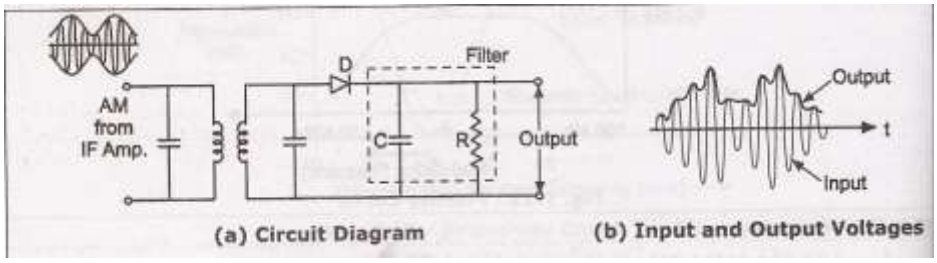
1. Low pass filter: it passes only modulating frequencies (f_m) and rejects higher frequencies than f_m.

2. Pulse generator: It generates pulse carrier with frequency f_s, where $f_s \geq 2f_m$ as per sampling theorem.

3. Multiplexer : It gives sampled output with sampled time T_s
4. Modulator: It gives pulse amplitude modulated signal.

b) Describe working of amplitude modulation by diode detector circuit.

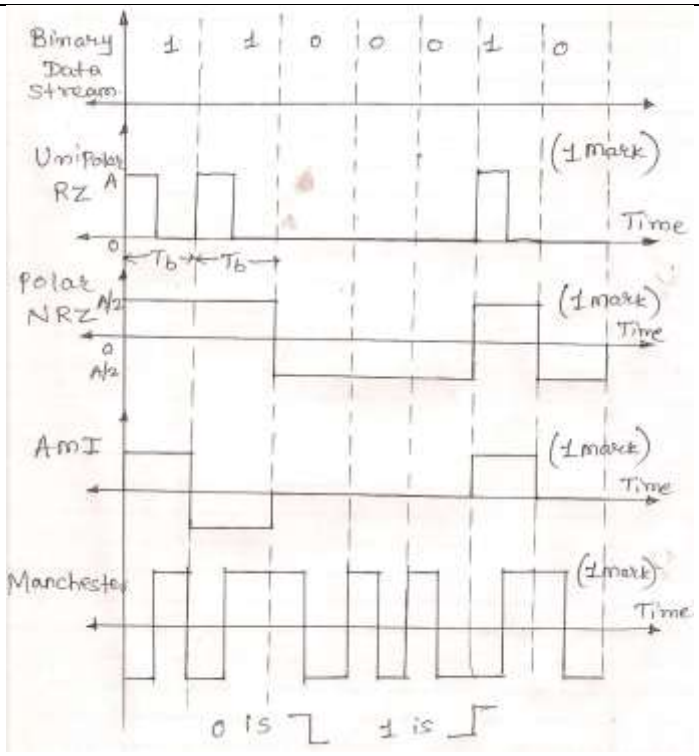
Ans:- **(2M for diagram, 2M for explanation)**



1. The diode is the most common device used for AM demodulation.
2. AM signal is applied to input of simple diode detector.
3. In every positive half cycle diode is forward biased so that capacitor charges to peak value of input voltage.
4. As soon as input voltage goes below peak point voltage , diode will reverse biased and capacitor discharges through R.
5. Charging and discharging of capacitor repeats for each cycle that result as positive envelope of AM as shown at output in figure (b).
6. This envelope is nothing but original modulating signal.

c) Encode the binary data stream 1 1 0 0 0 1 0 into Unipolar RZ, Polar NRZ, AMI, Manchester code.

Ans:

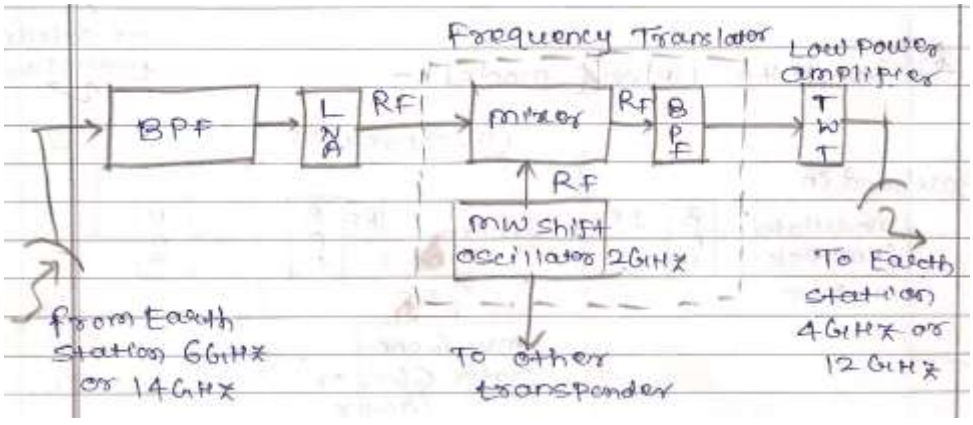


d) Describe the working principle of Transponder with block diagram.

Ans: **(Diagram 2M, Explanation 2M)**

- A typical satellite transponder consists of an input band limiting device (BPF), an input low-noise amplifier (LNA), a frequency translator, a low-level power amplifier, and an output BPF.

Diagram:

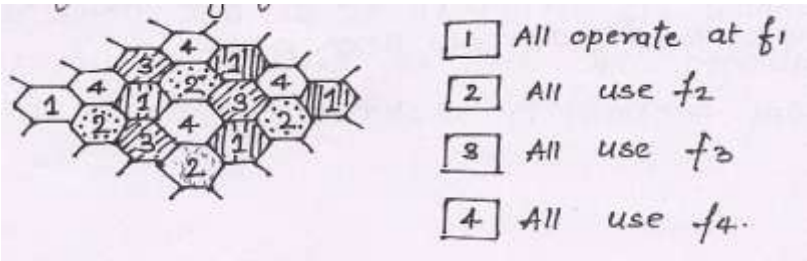


- The input BPF limits the total noise applied to the input of the LNA.
- The output of the LNA is fed to a frequency translator (a shift oscillator and a BPF), which converts the high-band uplink frequency to the low0band downlink frequency.

- The low-level power amplifier, which is commonly a travelling wave tube, amplifies the RF signal for transmission through downlink to earth station receivers. Each RF satellite channel requires separate transponders.

e) Describe the concept of frequency reused in mobile communication.

Ans:- **(2M for diagram, 2M for explanation)**

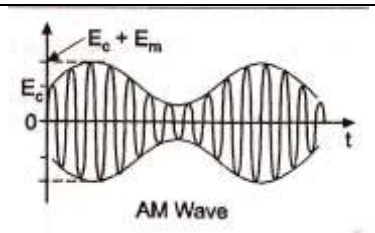
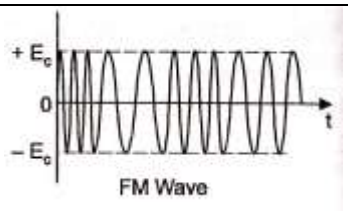


- The cellular system uses the concept of frequency reuse, which allows cells within the system to use the same frequency channel.
- Because the cells are physically small and low power transmitters are used, and the cells sites use directional antennas, the signal does not stray beyond the cell boundaries.
- This allows other cells within the system to share the same frequency channel without interference.
- Frequency reuse tremendously increases the number of available channels.
- But to prevent interference, adjacent cells are not permitted to use the same channel.

f) Compare AM and FM on the basis of the following parameters.

i) waveforms ii) noise immunity iii) bandwidth iv) Modulation index

Ans:- **(1M for each point)**

Parameters	**AM**	**FM**
Wave forms		
Noise Immunity	Less	More

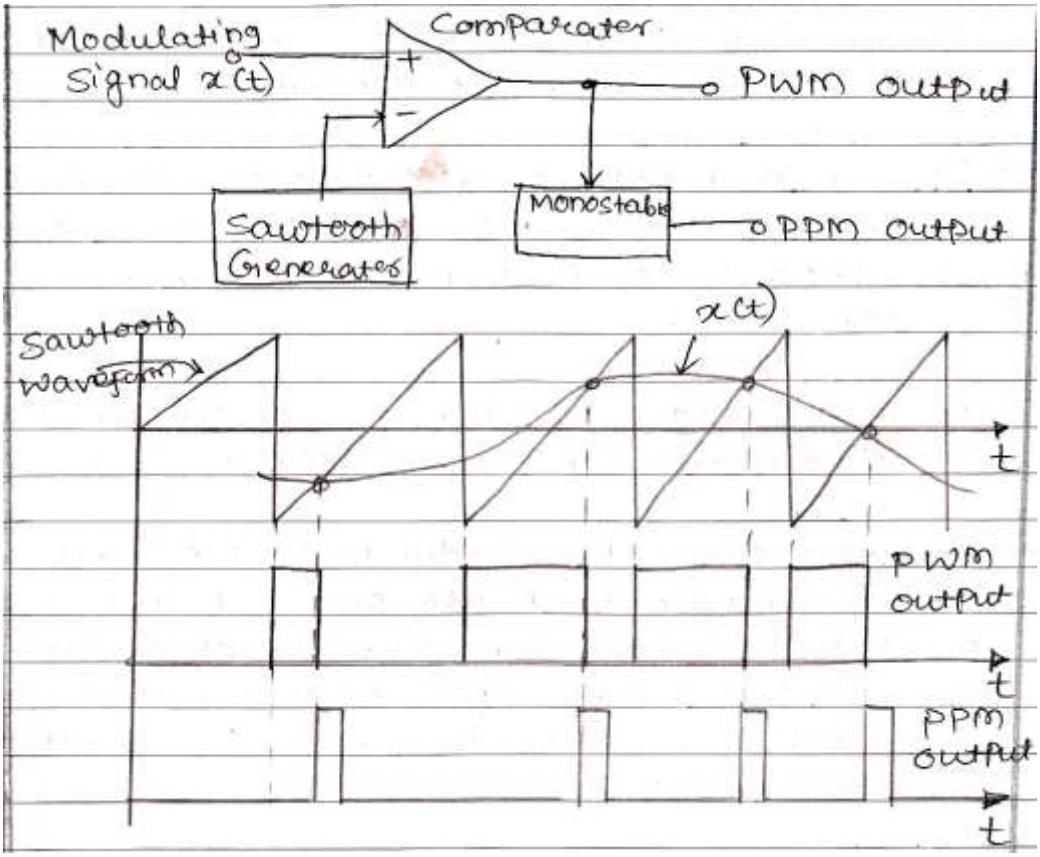
Band width	$2 f_m$	$2 f_m m_f$
Modulation Index	$m = V_m / V_c$	$m_f = \Delta f_c / f_m$

Q.3 Attempt any FOUR of the following: (16 Marks)

a) Illustrate how PPM is obtained from PWM?

Answer: (2M for block diagram, 2M for waveforms)

Diagram:



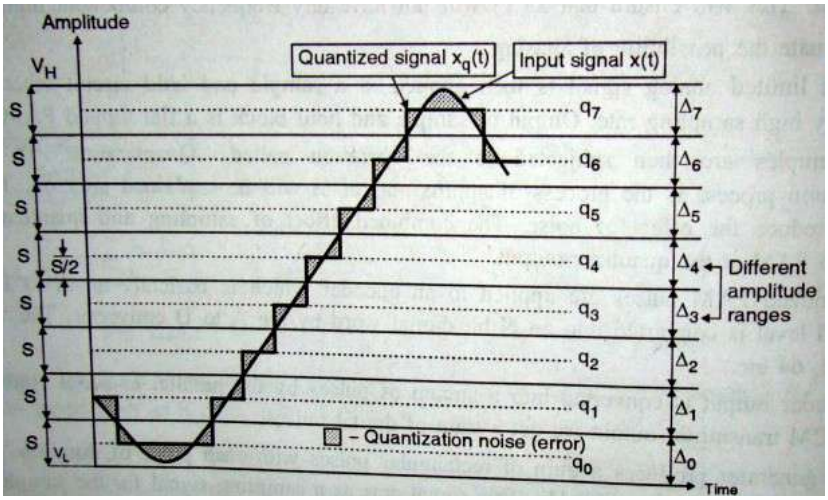
b) Describe Quantization and Quantization error in PCM.

Answer: (Quantization 2M, Quantization error 2M, Diagram is optional)

Quantization:

- Quantization is a process of approximation or rounding off. The sampled signal is applied to quantizer block.
- Quantizer converts the sampled signal into an approximate quantized signal which consists of only a finite number of predicted voltage levels.

- Each sampled value at the input of the quantizer is approximated or rounded off to nearest standard predicted voltage level.



Quantization error:

- The quantized signal $x_q(t)$ is approximation of x(t). The difference between them is called quantization error or quantization noise.
- This error should be as small as possible.
- To minimize the quantization error we need to reduce step size "S" by increasing the number of quantization levels Q.

$$E = Xq\ (t) - X\ (t)$$

c) State any four specification of LASER.

Answer: **(Any 4 specification 1M each)**

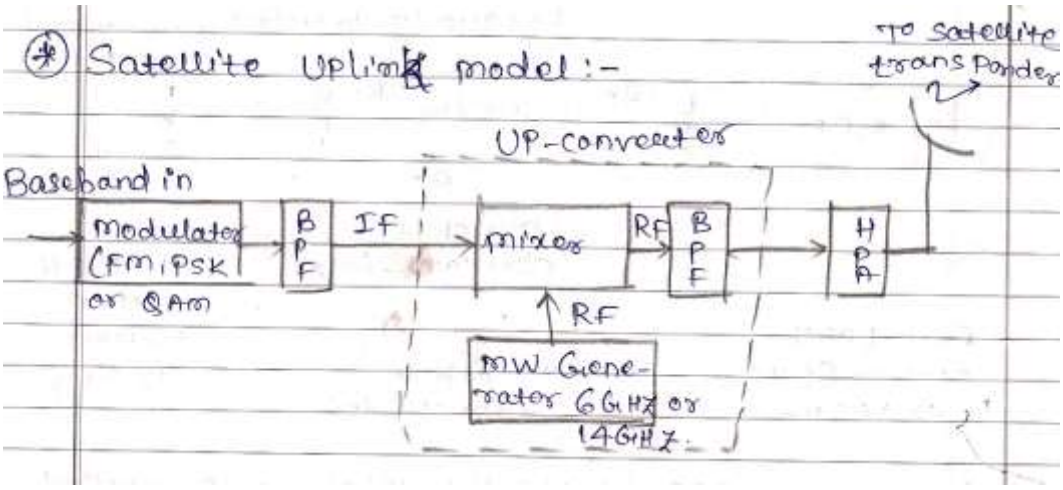
Parameters	Specifications
Wavelength	1300-1550nm
Spectral Width	1 to 6nm
Modulated frequency	>=5GHz
Power(dBm)	+1 to -3dBm
E/O conversion efficiency	30-70%
Directionality	Beam is directional and highly collimated
Reliability	Moderate
Coherence	Coherent

Temperature Dependence	Very temperature dependent
Drive and control circuit	Threshold and temperature compensation circuitry
Cost	Moderate to high
Harmonic distortion	Less
Receiving filter	Narrow-lower noise floor
Optical output power	High power

d) Describe uplink model for satellite communication and describe its working.

Answer: **(Diagram 2M, Explanation 2M)**

Diagram:



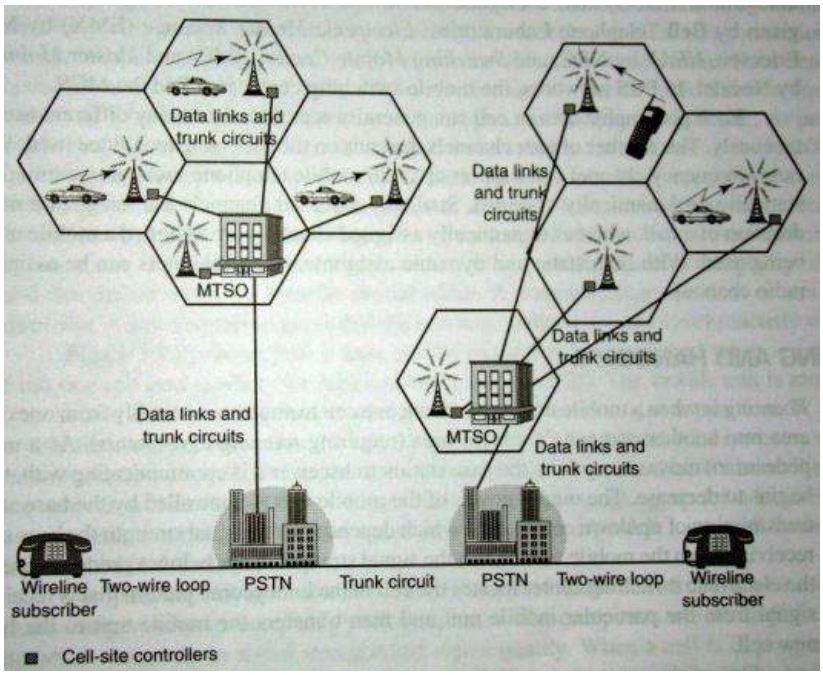
Explanation:

- The primary component of within the uplink section of a satellite system is earth station transmitter.
- A typical earth station transmitter consists of an IF modulator, an IF to RF microwave up-converter, a high power amplifier (HPA), and some means of band limiting the final output spectrum.
- The IF modulator converts the input baseband signal to either an FM, a PSK, or a QAM-modulated intermediate frequency,
- The up converter (mixer and band pass filter) converts the IF to an appropriate RF carrier frequency.
- The HPA provides adequate gain and output power to propagate the signal to the satellite transponder. HPAs commonly used are klystron and travelling wave tube.

e) Draw general block diagram of mobile phone system and explain its operation.

Answer: **(2M for diagram and 2M for explanation)**

Diagram:



Explanation:

- A radio network is defined by a set of radio-frequency transceivers located within each of the cells. The locations of these radio-frequencies transceivers are called **base stations.**
- A base station serves as central control for all users within that cell.
- **Mobile Telephone Switching Office(MTSO):** An MTSO controls channel assignment, call processing, call setup and call termination, which includes signalling, switching, supervision, and allocating radio frequency channels.
- The MTSO provides a centralized administration and maintenance point for the entire network over wire line voice trunks and data links.
- Base stations are distributed over the area of system coverage and are managed and controlled by an on-site computerized cell-site controller that handles all cell-site control and switching functions.
- The BS consists of a low-power radio transceiver, power amplifier, a control unit (computer) and other hardware, depending on the system configuration.

f) Define the following terms (i) Hand off (ii) Cell splitting

Answer: **(Hand off 2M, Cell splitting 2M)**

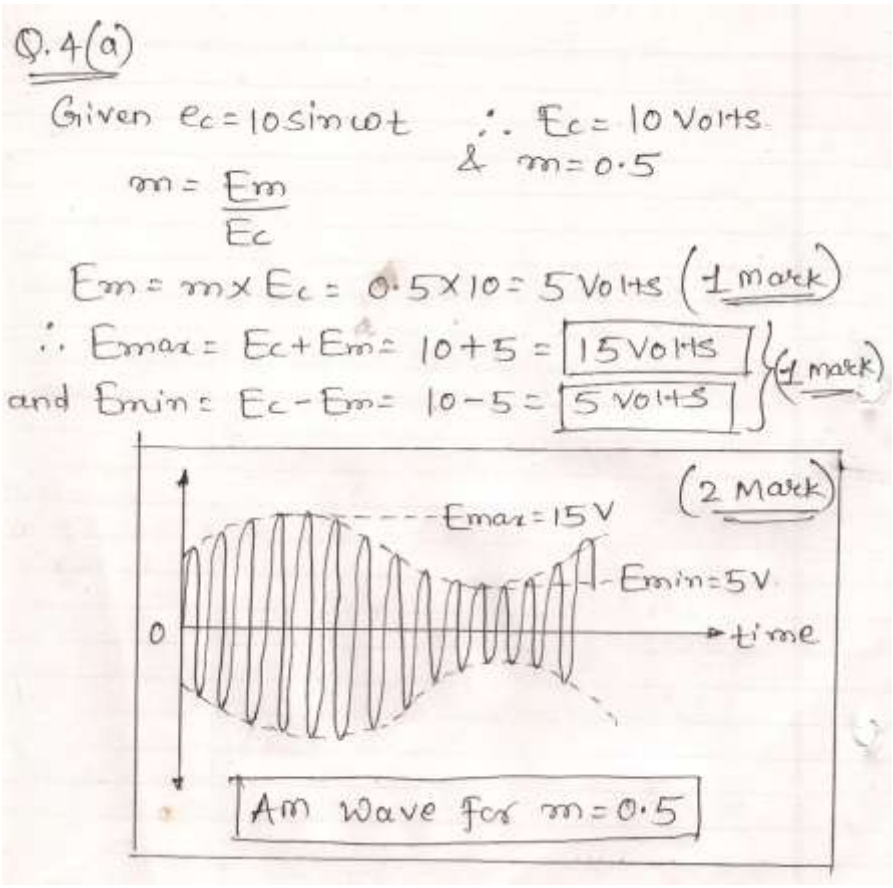
Hand off: The transfer of mobile unit from one base station's control to another base station control is called a **hand off (or handover)**

Cell splitting: Cell splitting is the resizing or redistribution of cell areas. In essence, cell splitting is the process of subdividing highly congested cells into smaller cells each with their own BS and set of channel frequencies.

Q.4 Attempt any FOUR of the following: **16 Marks**

a) A carrier wave is represented by the equation $e_c(t)=10 \sin \omega t$. Draw the waveform of a AM wave for m=0.5

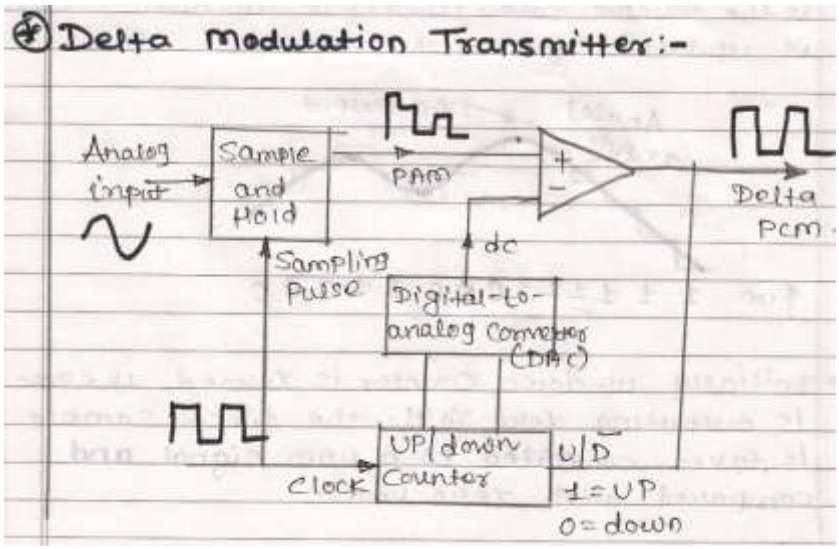
Answer: **(Analysis of Emax and Emin 2M, Diagram 2M)**



b) Describe the working principle of Delta modulation. State its disadvantages.

Answer: (Diagram of delta modulation 1.5M, Working principle 1.5M, disadvantages (any two) ½ M each)

Diagram:



Working principle:

- Delta modulation uses a single-bit PCM code to achieve digital transmission of analog signals. With delta modulation, rather than transmit a coded representation of the sample only a single bit is transmitted, which simply indicates weather the sample is larger or smaller than the previous sample.
- If the current sample is smaller than the previous sample, logic '0' is transmitted.
- If the current sample is larger than the previous sample, logic '1' is transmitted.
- The input analog signal is sampled and converted to PAM signal, which is compared with the output of DAC.
- The output of a 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 weather the previous sample is larger or smaller than the current sample.

Disadvantages:

- The two distortion i.e. slope overload error and granular noise are present.
- Practically the signaling rate with no slope overload will be much higher than that of PCM.

c) Define following terms related to satellite communication:

(i) Azimuth angle (ii) station keeping.

Answer: (Azimuth angle 2M, Station keeping 2M)

Azimuth Angle: Azimuth refers to the direction where north is equal to 0^o. The azimuth angle is measured clockwise with respect to north.

Station keeping: The process of firing rockets underground control to maintain or adjust the orbit periodically is known as station keeping.

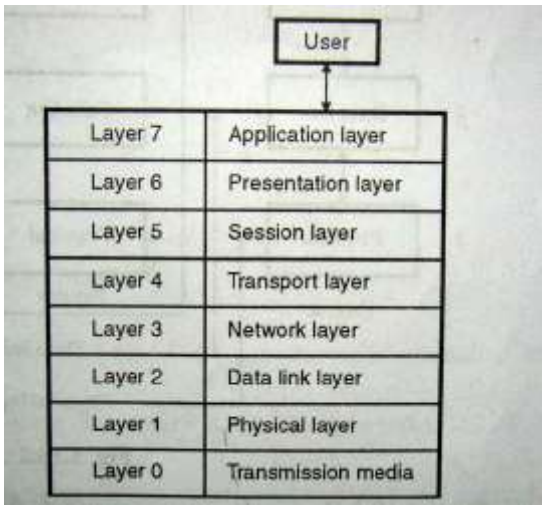
d) State any four advantages of optical fibre cable.

Answer: (Any four points, 1M each)

- Enormous potential bandwidth
- Small size and weight
- Electrical isolation
- Immunity to interference and crosstalk
- Signal security
- Low transmission loss
- Ruggedness and flexibility
- System reliability and maintenance
- Potential low cost

e) Draw architecture of OSI model.

Answer: (4M for any one correct diagram)



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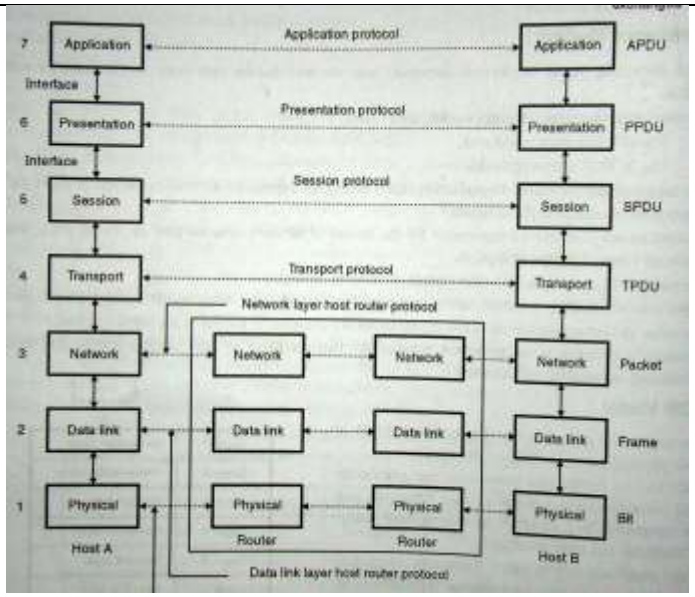


f) State the sequential steps for wire line (PSTN) to mobile (cellular) call procedure.

Answer: **(4M for correct answer)**

- User inputs the mobile unit's telephone number.
- Telephone number is transferred from PSTN to cellular network switch MTSO.
- MTSO receives incoming call from PSTN, and locates the BS nearest the mobile unit.
- If the mobile unit is available, a positive page response is sent over a reverse control channel to cell site controller which is forwarded to MTSO.
- The cell-site controller assigns an idle user channel to the mobile unit and then instructs the mobile unit to tune to the selected channel.
- The cell-site controller sends an audible call progress tone to the subscriber's mobile unit.
- Mobile answers, the switch terminates the call progress tones, and conversation begins.

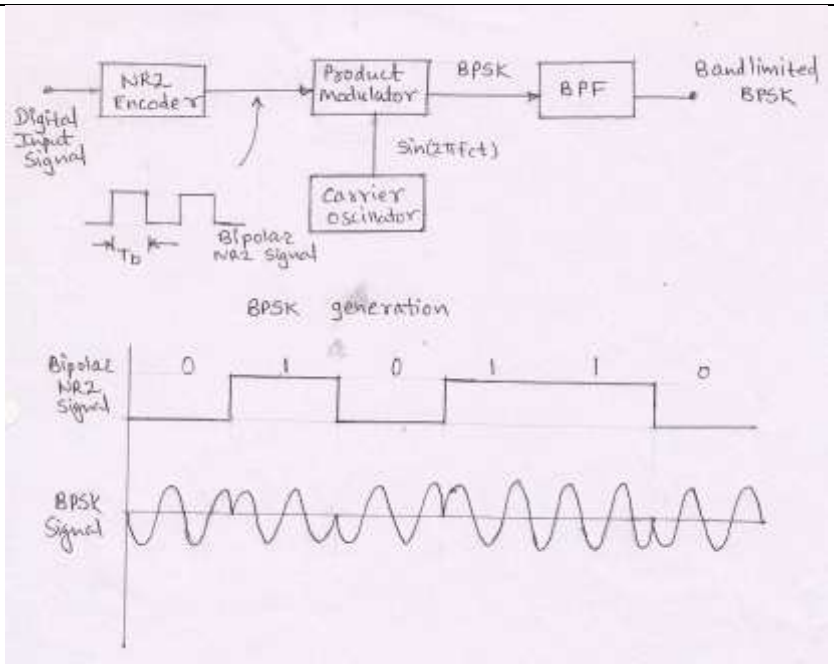
Q.5. Attempt any FOUR of the following: **(16 Marks)**

a) Describe working of BPSK generation with block diagram.

Ans :- **(Block Diagram – 2M, Explanation- 2 M)**

Binary phase shift keying is used for high bit rates. In PSK , phase of Sinusoidal carrier is changed according to the data bit to be transmitted.

In BPSK, carrier phase is changed between 0^0 and 180^0 by the bipolar digital signal. The BPSK signal generation is shown in following block diagram.



The binary data signal (OS & IS) is converted into NRZ bipolar signal by an NRZ, encoder. This is then applied to a multiplier / balanced modulator. The other input to the multiplier is the carrier signal (2π fct)

The data bits OS & IS are converted into a bipolar NRZ signal "d" as shown in following table.

Digital Signal	Bipolar NRZ Signal	BPSK Output
Binary 0	d=1	$V_{BPSK}(t) = \sin(2\pi fct)$
Binary 1	d= -1	$V_{BPSK}(t) = -\sin(2\pi fct)$

b) Compare ASK, FSK and PSK on the basis of :

i) Variable parameter

ii) Bandwidth

iii) Noise immunity

iv) Error probability

Ans :- **(1 M for Each point)**

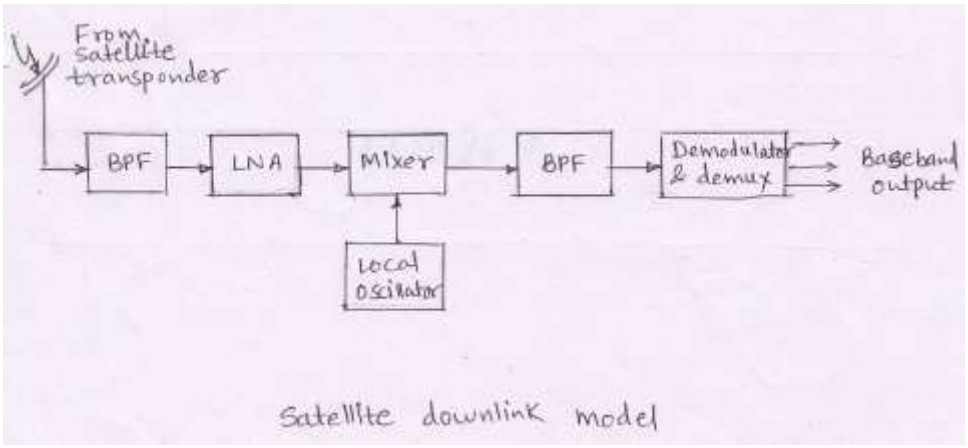
Parameter	**ASK**	**FSK**	**PSK**
i) Variable Parameter	Amplitude	Frequency	Phase

ii) Bandwidth	Less	High	Less
iii) Noise immunity	Low	High	High
iv) Error probability	High	Low	Low
v) Bit rate	Suitable upto 100 bits /sec.	Suitable upto 1200 bits / sec.	Suitable for high bit rates.

c) Describe the downlink model used by satellite communication with block diagram.

Ans :- **(Block Diagram – 2 M , Description – 2 M)**

Downlink model is basically the receiver section of the earth station.



- A parabolic reflector horn type antenna is used for transmitting as well as receiving the signals. Thus it can receive the downlink signals from the satellite or can send uplink signals to the satellite.
- The received signal is routed to the receiver via a special microwave device called diplexer. It couples the antenna output signals only to the receiver input and isolates the receiver into from the transmitter output.
- The received signal is then passed through a band pass filter which allows only the downlink frequency signal to pass through to LNA.
- A low noise amplifier (LNA) is a specially designed amplifier that produces a very low noise voltage. It operates at extremely low temperatures to minimize thermal noise generation.

- The amplified signal is then passed through a down convertor or mixer. The frequency of signal at the mixer output is equal to the difference between oscillator frequency and signal frequency.
- The BPF only selects IF frequencies to pass through it.
- The IF is then applied to a demodulator which demodulates it and then to de multiplexer which separates it from the remaining multiplexed signals.

d) State the functions of following devices :

i) Hub

ii) Repeater

iii) Gateway

iv) Router

Ans :- **(1 M for Each)**

Hub: - A Hub is a connecting device. It is actually a multiport repeater. It is normally used to create connections between terminals in a physical star topology.

Repeater: - It is a networking device also called regenerator. It works at the physical layer of OSI protocol. Signal travelling across a physical wire travel some distance before they become weak or get corrupted. A repeater receives such a signal and regenerates it.

Gate way: - A gateway operates at all seven layers of OSI model. It is connecting device used for internetworking. Unlike router at higher level a gate way can forward packets across different networks that may also use different protocols. That is if network A is token ring network using TCP / IP protocol and network B is Novell netware network a gate way can relay friends between the two.

Router: - A Router operates at the physical, data link and network layer of OSI model. A router is useful for interconnecting two or more networks. These networks can be heterogeneous. Which means that they can differ in their physical characteristics such as frame size, transmission rates, topologies, addressing etc?

e) Describe the concept of digital signature. State the basic difference between message authentication and entity authentication.

Ans :- **(Concept of digital signature- 2 M, Difference – 2 M)**

Digital Signature :- It is signing of a document electronically. When we send a document electronically , we can also sign it. There are two choices.

i) one can sign entire document.

ii) One can sign a digest. (condensed version of document)

In the digital signature a private key is used for encryption and the public key is used for decryption. The sender uses private key to encrypt (sign) the message just as person uses own signature to sign a paper document. The receiver on the other hand uses the public key of the sender to decrypt the message just as the person verifies from memory another person's signature. This is possible because the encryption and decryption algorithm are used. eg. RSA

In Message authentication the receiver needs to be sure of sender's identity and that an imposter has not send the message.

Entity authentication is a technique designed to let one party prove the identity of another party. Entity can be a person , process or server.

There are two basic differences between message authentication and entity authentication.

First message authentication may not happen in real time. Entity authentication does. e.g. Alice sends the message to Bob. When Bob authenticates message Alice may or may not be present in the communication process. On the other hand in entity authentication alice needs to be online and take part in the process.

Second message authentication simply authenticates one message the process needs to be repeated for each new message.

Entity authentication authenticates the claimant for the entire duration of a session.

f) Describe synchronous and asynchronous data transmission.

Ans:- **(2 M Each)**

There are two types of serial data transmission.

i) Synchronous data transmission:-

- It is carried out under the control of a common master clock. Here the bits which are being transmitted are synchronized to a reference clock.
- No start and stop bits are used instead the bytes are transmitted as a block in a continuous stream of bits.
- The receiver operates at exactly same clock frequency as that of transmitter.
- There is no gap between the frames.

ii) Asynchronous data transmission :-

- In asynchronous transmission the transmitter commences transmission of data bytes at any instant of time.

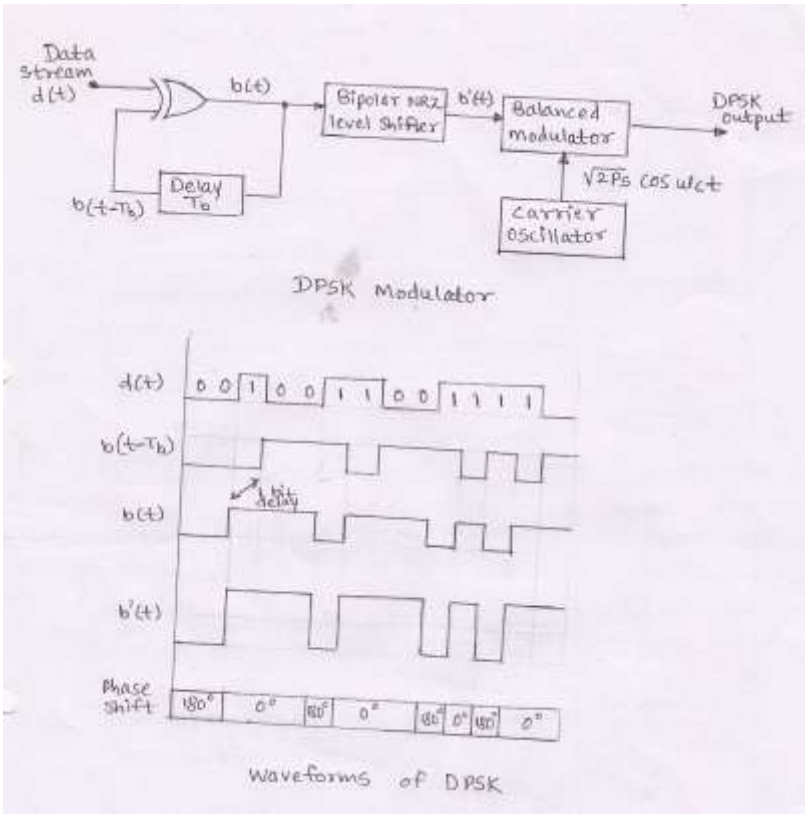
- Only one byte is sent at a time. After sending one byte, the next byte can be sent after an ordinary time delay.
- The transmitter and receiver operate at different clock frequencies.
- Start and stop bits are used along with each data byte.
- There are gap between two data bytes.

Q.6. Attempt any FOUR of the following: (16 Marks)

a) With the help of block diagram explain DPSK modulator.

Ans :(Block diagram – 2 M, Description – 2 M (Wave Forms and formula) optional)

The differential phase shift keying can be treated as the non coherent version of PSK. It combines two basic operations. i) Differential encoding ii) Phase shift keying. The block diagram of DPSK modulator is shown as follows.



Operation of DPSK modulator :-

- d(t) represents the data stream which is to be transmitted. It is applied to one input of EX-OR logic gate.
- The EX-OR gate output b(t) is delayed by one bit period T_b and applied to other input of EX-OR bit. The delayed output is represented by b(t-T_b)

- Depending on the value of d(t) and b(t-T_b) EX-OR gate produces the output sequence b(t).
- The output of EX-OR gate is then applied to a bipolar NRZ level shifter which converts b(t) to a bipolar level signal b '(t).

b(t)	b'(t)
0	-1
1	+1

- These bipolar NRZ signal is then multiplied with the carrier signal in balanced modulator to produce DPSK signal.
- The DPSK output signal is mathematically expressed as

$$V_{DPSK}(t) = b'(t)X\sqrt{2PS}\cos\omega ct$$

When b(t) = 1 , b'(t) = 1 hence

$$V_{DPSK}(t) = \sqrt{2PS}\cos\omega ct$$

That means no phase shift has been introduced.

- But when b(t) = 0, b'(t) = -1 hence

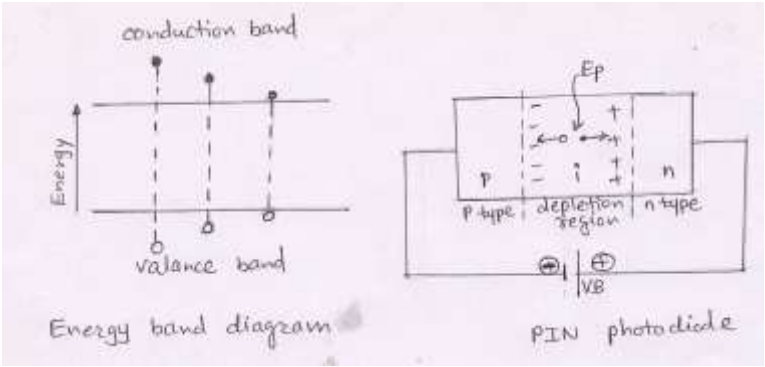
$$V_{DPSK}(t) = -\sqrt{2PS}\cos\omega ct$$

Thus 180 ^{0} phase shift introduced to represent b(t)=0

b) Describe the operating principle of PIN photodiode.

Ans :- **(Operating principle - 3 M, Diagram – 1 M)**

A PIN photodiode is photo detector capable of converting incident light into voltage or current. It has intrinsic 'i' layer between P-type and N- type regions.



Operating Principle :- when incident light of sufficient energy strikes the junction, an electron is excited, this electron is called free electron. Along with this electron a positively charged electron hole is also created. When light absorption occur in the depletion region of the junction, these carriers are swept from the junction by the built in electric field of the region. This results in production of photo current due to the moment of holes towards anode and electrons towards cathode.

PIN diode must be reversed biased. The reverse biased increases the depletion region allowing a larger volume for electron hole pair production and reduces capacitance thereby increasing the bandwidth.

Apart from photo current some amount of dark current is generated from the flow of electrons without light.

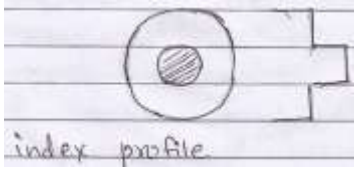
A PIN photodiode thicker intrinsic layer. It allows a more efficient collection of carriers and thus larger quantum efficiency. It has band width of order of tens of Giga Hertz for wavelength up to 1.7 µm. InGaAs PIN diodes are used.

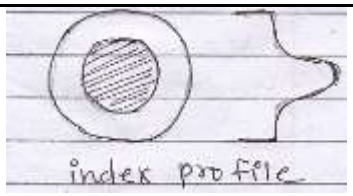
c) Differentiate between multimode step index and multimode graded index fiber.

Ans :- **(Any four points 1M for Each Point)**

Multi mode Step Index Fibers	Multi mode Graded index Fibers
1. The refractive index changes in steps or abruptly.	The refractive index changes gradually.
2. The light rays travel in straight line through step index fiber.	The light rays follows sinusoidal path down the fiber.
3. Acceptance cone of these fibers is smaller than that of graded index fiber.	Acceptance cone of these fiber is larger than that of step index fiber.
4. Modal dispersion is more.	Considerable decrease in modal dispersion.
5. Bandwidth is limited. E.g. for 50 µm core, it is 20 MHz – Km	Bandwidth is large for 50 µm core, it is 1 GHz – Km.
6. More sensitive to microbending and macrobending losses.	Less sensitive to microbending and macrobending losses.

7.



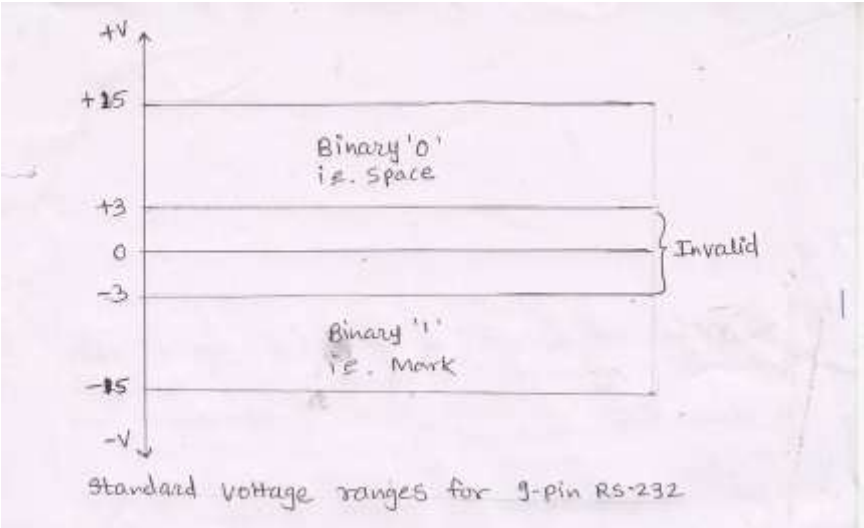


d) Write electrical characteristics of RS-232 (9-Pin) standard.

Ans :- **(Electrical Characteristics - 3 M , Diagram – 1M)**

Electrical characteristics of 9 Pin RS -232 standard.

- The binary data can be represented by two different voltage values . A binary "1" is called as mark and binary "0" is called as space. As per RS-232 standards , the voltage ranges for representing mark and space are well defined.
- The mark i.e. binary "1" is represented by any voltage between -3 volts to -15 volts.
- A space i.e. binary "0" is represented by any voltage between -3 volts to +25 volts.
- The voltage between -3 Volts and +3 volts is treated as invalid range.
- To reduce the effect of noise and ensure error free performance the largest possible value of voltage must be used for mark and space.
- Thus to send a mark selected voltage level should be closed to – 15 volts and to send a space selected voltage level should be closed to + 15 volts.
- The voltages sent using RS-232 standard are sent respect to a common ground or "0" volt point between the systems.

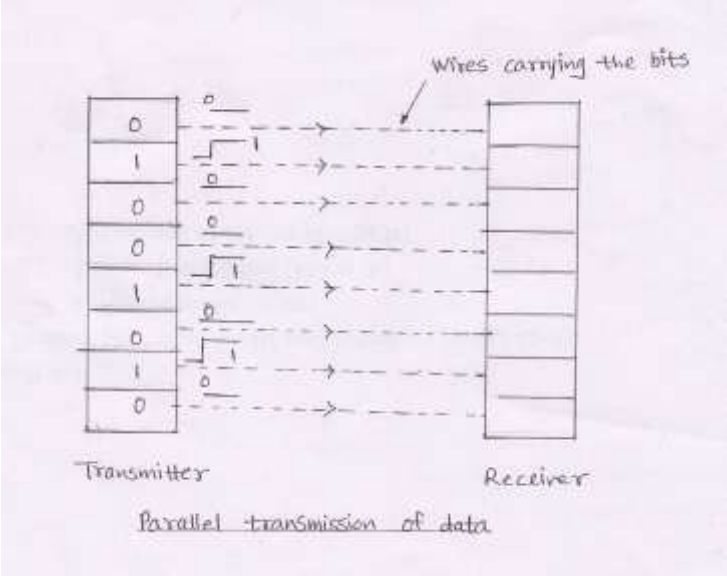


e) Describe parallel mode of data transmission.

Ans :- **(Description - 3 M, Diagram – 1 M)**

Describe parallel mode of data transmission.

- In parallel transmission of data, all the bits of a byte are transmitted simultaneously on separate wires.
- This type of transmission requires multiple circuits for interconnecting two devices.
- Parallel transmission is possible practically if the two devices are close to each other.
- The advantage of parallel transmission is that all the data bits will be transmitted simultaneously. Therefore the time required for the transmission of N-bit word is only one clock cycle. Due to this the clock frequency can be kept low without affecting the speed of operation.
- It has one disadvantage that , to transmit an N bit word, we need N number of wires. With increase in the number of users, these wires will be two many to handle.



f) Compare FDMA, TDMA and CDMA (any four points).

Ans :- **(1 M for Each point)**

Comparison between FDMA, TDMA, CDMA

Sr. No.	Parameter	FDMA	TDMA	CDMA
1.	Technique	Sharing of overall bandwidth of	Sharing of time of the satellite	Sharing of bandwidth

		satellite transponder.	transponder.	and time both.
2.	Interference effect	Adjacent frequency band interference generated because of nonlinearity of satellite transponder amplifier.	Interference between the user of adjacent time slots. Generated because of incorrect synchronization.	Performance is affected because of adjacent time and frequency slots. But due to frequency hopping the effect is less.
3.	Synchronization	No synchronization is required.	Time synchronization is essential.	No synchronization is required.
4.	Code word	No code word is required.	No code is required.	Code words are required by group stations.
5.	Power efficiency	Power efficiency is reduced.	Full power efficiency is possible.	Full power efficiency is possible.
6.	Guard time and bands	Guard bands are required.	Guard times are required.	Guard times and bands both are required