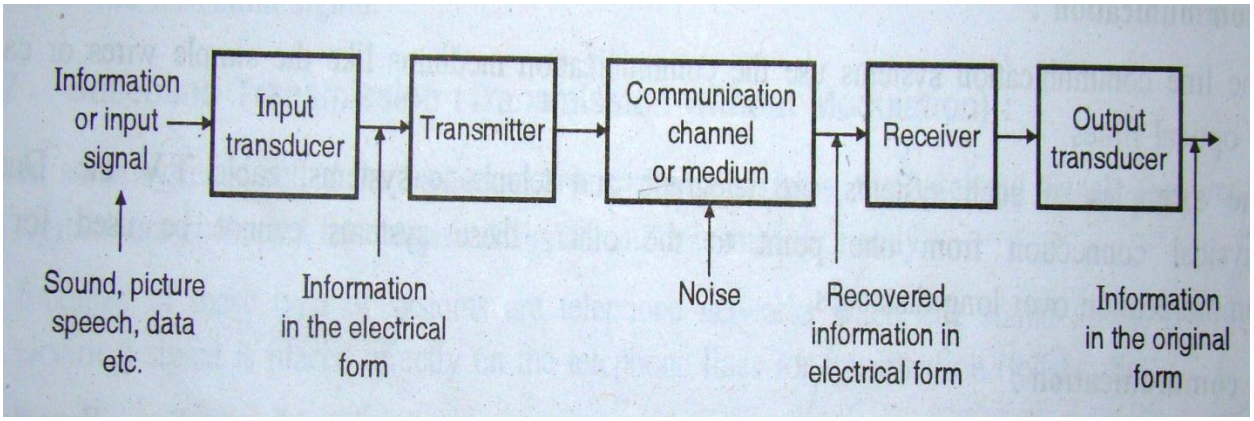
Q.1 (A) Attempt any three. (Marks 12)

a) Block diagram of communication system

(2 marks for block diagram, 2 marks for explanation)



1) The input transducer converts the information (sound, picture or data signal) to a suitable electrical form. Transmitter is a collection of one or more electronic devices or circuit that convents the electrical equivalent of the source information to a form suitable for transmission. It also increases the power level of the signal.
2) A transmission medium or communication channel provides a means of transporting the signal between or transmitter and receiver. E.g. copper wire, (telephone system), satellite, microwave or fiber optic network.
3) A receiver is collection of electronic devices and circuit that accepts the transmitted signals, amplifies, demodulates, and converts back to its original form. The output transducer converts the electrical signal at the output of the receiver back to the original form (sound, picture or data signal).
(System noise is any unwanted electronics signal that in refers with the information signals).

b) Sampling theorem and Nyquist criteria:

Sampling Theorem

1) Sampling Theorem states that "if the sampling rate in any pulse modulation system exceeds twice the signal frequency, the original signal can be reconstructed in the receiver with minimal distortion."

2) The sampling frequency is as per statement:

$$fs \geq 2\ fm$$

fs – Minimum Nyquist sampling rate (Hz)

fm – maximum analog i/p frequency (Hz)

Nyquist Criteria :

1) Nyquist rate is the minimum sampling rate required to represent the continuous signal x(t) in its sampled form i.e. fs = 2 fm.
2) Nyquist criteria : fs (min) = 2fm

$$Ts\ (max) = 1/fs\ (min) = 1/2fm$$

(If sampling frequency fs is less than Nyquist rate, then some of the original information is lost and not recovered . (i.e. aliasing error))

(2 mrks for each point - 2 marks for sampling th. & 2 marks for Nyquist crt)

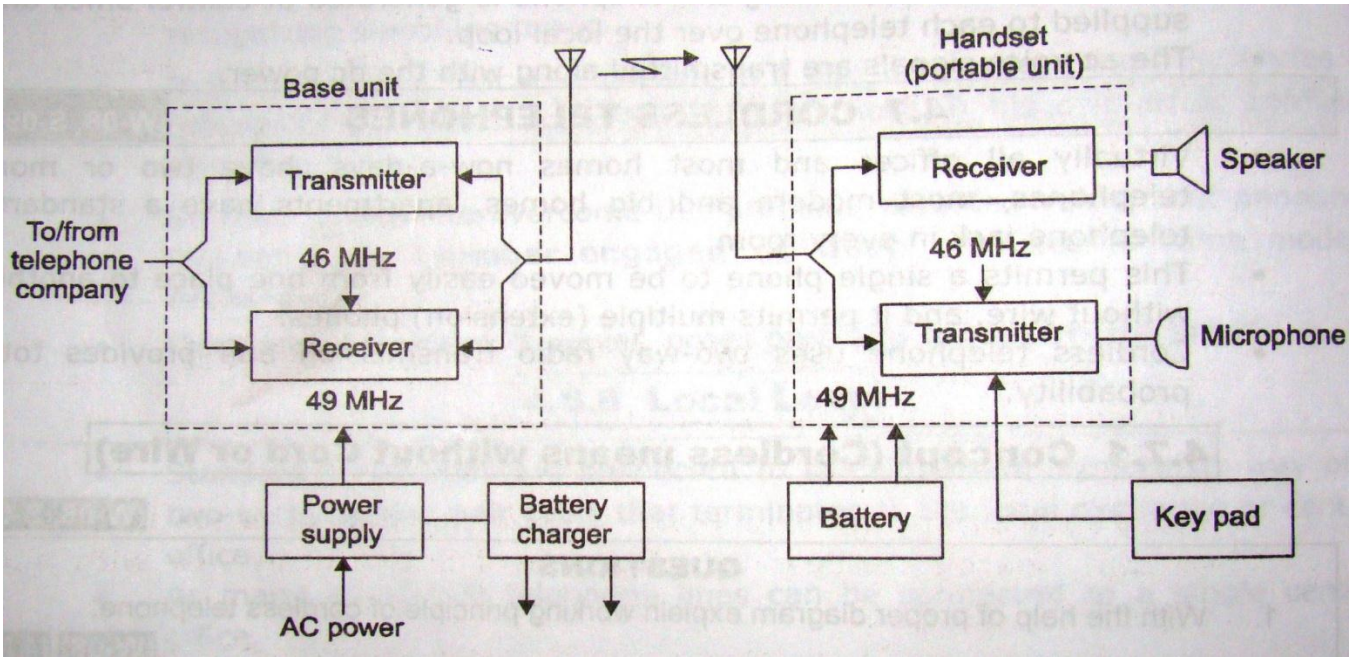
c) Different CCIR-B standard for monochrome TV **(any 4 points – 4 marks)**

1. Aspect ratio 4:3.
2. – ve modulation for video.
3. Interlaced scanning 2:1.
4. VSB modulation for video transmission .
5. 7 MHz - TV channel BW.

   5 MHz – video BW.

   5.5 MHz – IF carrier frequency.
6. Lines per frames – 625.
7. picture frames/sec - 25
8. Field frequency – 50 Hz.
9. Sound system – FM.
10. Max sound deviation – 50 KHz.
11. Line frequency – 15625 Hz.

d) Cordless Phone :



1) Cordless telephone systems are full duplex communication system that use radio waves to connect a portable handset to a dedicated base station which is the connected to the PSTN.

2) The portable unit communicates only to the dedicated base unit over few tons of meter.

3) The base unit is connected to the telephone line and an adaptor which produces dc supply for various electronic circuits inside the base unit.

4) The adaptor is also required to change the battery used for wireless handset.

5) The base station consistes of a ringer, an amplifier & all other circuits present inside the conventional telephone.

6) The base station consists of a transreceiver, it radiates & receives the signals from the handset using the same antennae which is omnidirectional

7) The handset also contains a transreceiver along with antennae, amplifer, microphone & loudspeaker.

8) The modulation technique used is FM.

9) Cordless telephone systems provide the user with limited range & mobility .

The base unit transmitter operates in the 43-46 Mhz range & receives in the 49 Mhz range.

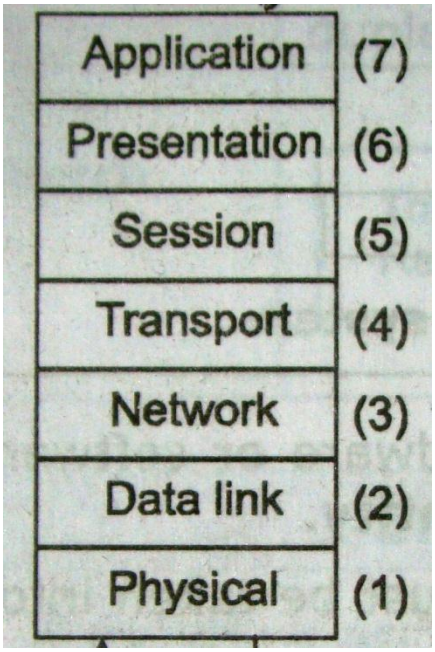
The portable unit has a receiver that operates in 43-46 Mhz range & a transmitter that operates in 49 Mhz.

(2 marks for diag, 2 marks for expln)

Q. 1. B) Attempt any One. (Marks – 6)

a) Explain OSI reference model:- (2 marks – diagram, 4 marks – explanation)

OSI seven layer protocol hierarchy.



- Layer 1 – the physical layer is the lowest level of the OSI hierarchy and is responsible for the actual propagation of the data bits 1 s & 0s . It specifies the type of transmission medium and transmission mode.

- Layer 2 – data link is responsible for frame formatting for transmitting data across a physical communication link.

- Layer 3 – the network layer provides details that enable data to be routed between devices in an environment using multiple networks, sub networks or both.

- Layer 4 – the transport layer tract the data as it moves through the network.

- Layer 5 – session layer is responsible for network availability e.g. data storage and process or capacity.

- Layer 6 – the presentation layer specifies how end user application should format the data.

- Layer 7 – the application layer is the highest layer in the hierarchy and provides distributed information service and control the sequence of activities within an application and also sequence of event between an computer application and user of another application

Q1) B)

b) GSM technique

GSM stands for Global system for mobile communication.

GSM uses :

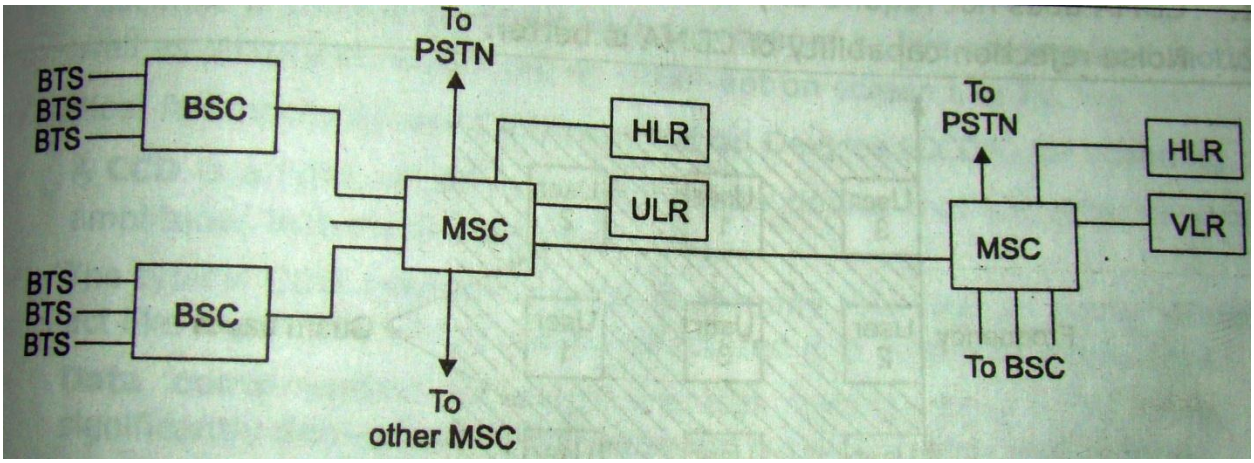
Up link frequency – 890 to 915 Mhz

Downlink frequency – 935 to 960 Mhz.

Guard band – 200 Khz

GSM uses TDMA and the type of modulation used is Gaussian Minimum Shift Keying.

GSM network



1) When a GSM mobile user initiates a call, his telephone will search for a free local base station system (BSS)

2) Every BSS consists of a Base Station Controller (BSC) and one or more Base Station Transreceiver (BST)

3) Each BST serves as a radio cell having one or more RF channels.

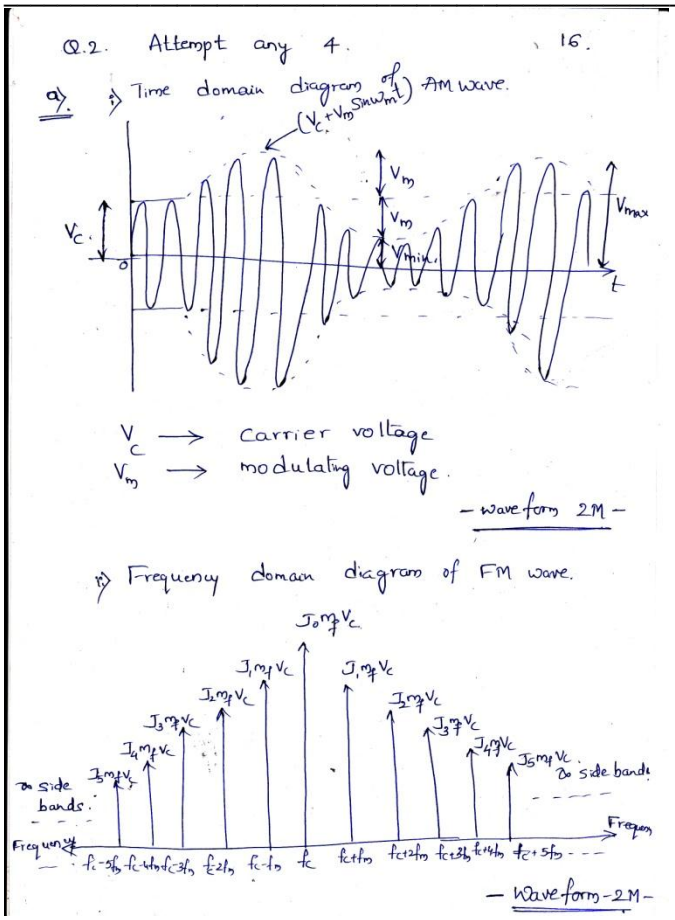
4) Once mobile has accessed and synchronized with a BSS, the BSC will allocate a dedicated bi-directional signaling channel and will set up a root to a mobile services switching centre (MSC)

5) MSC routes the traffic and the signaling data within the network and interconnects with the networks.

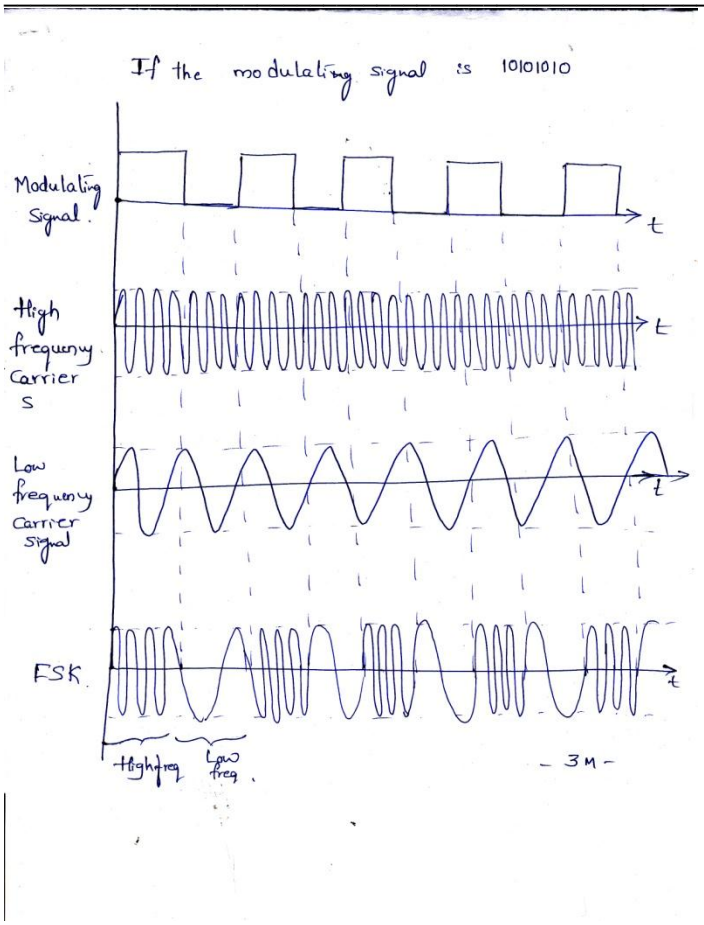
6) When a mobile requests access to the system, the mobile must supply International mobile subscribe identity (IMSI) number.

7) The network then check the caller's authority to use the network.

(2 marks – diagram, 4 marks – explanation)



b) Definitions of FSK:- If the frequency of carrier signal is varied in accordance with the digital modulating signal is known as FSK.



(1 mark for def, 3 marks for waveforms)

c) (2marks for diag, 2 marks for labelings)

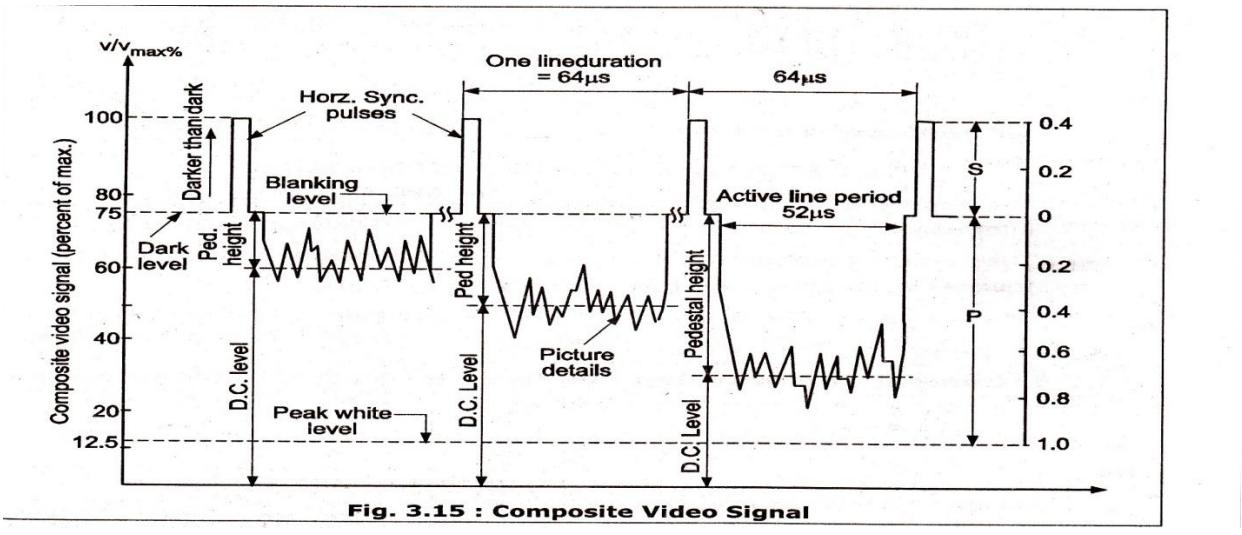


Fig. 3.15 : Composite Video Signal

d)

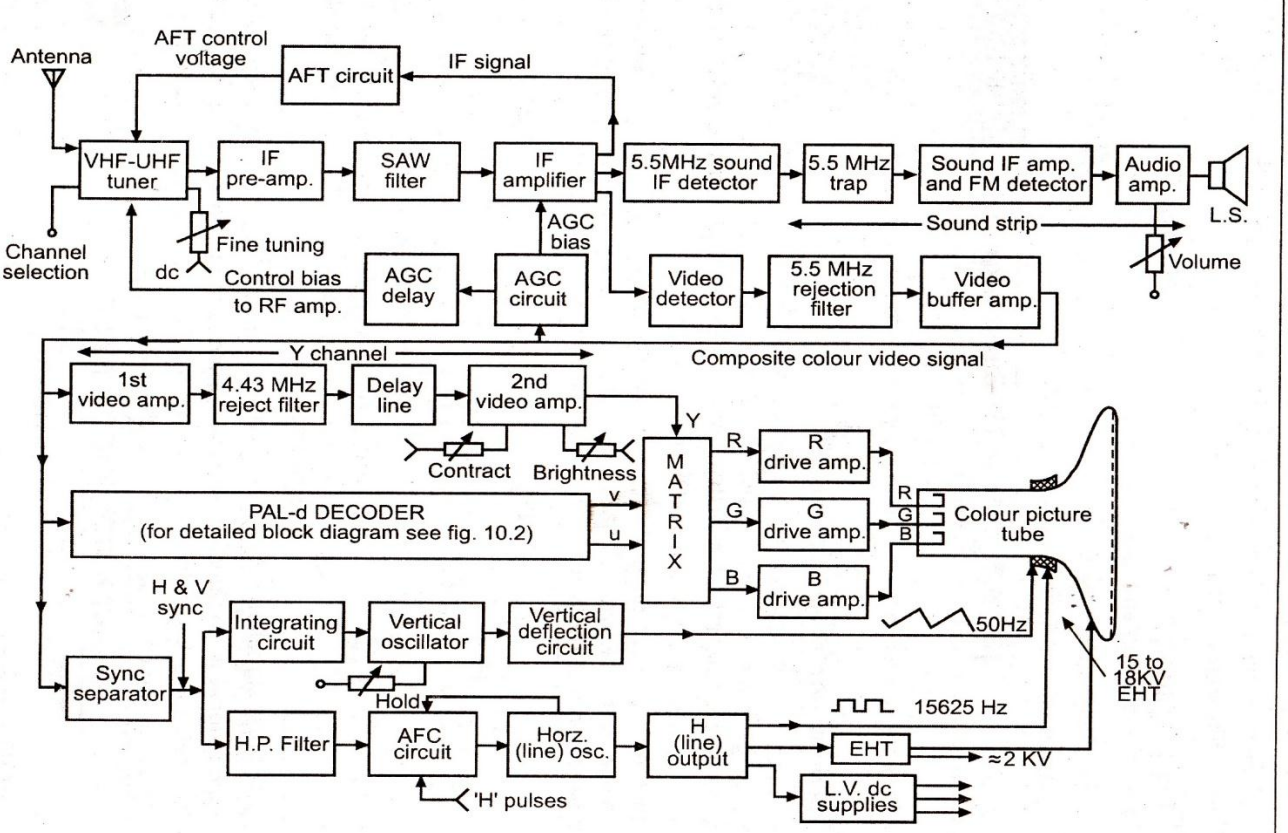


Fig. 3.26 : Block Diagram of a PAL-D Colour Receiver

(4 marks for diag)

e) (1 mark for each)

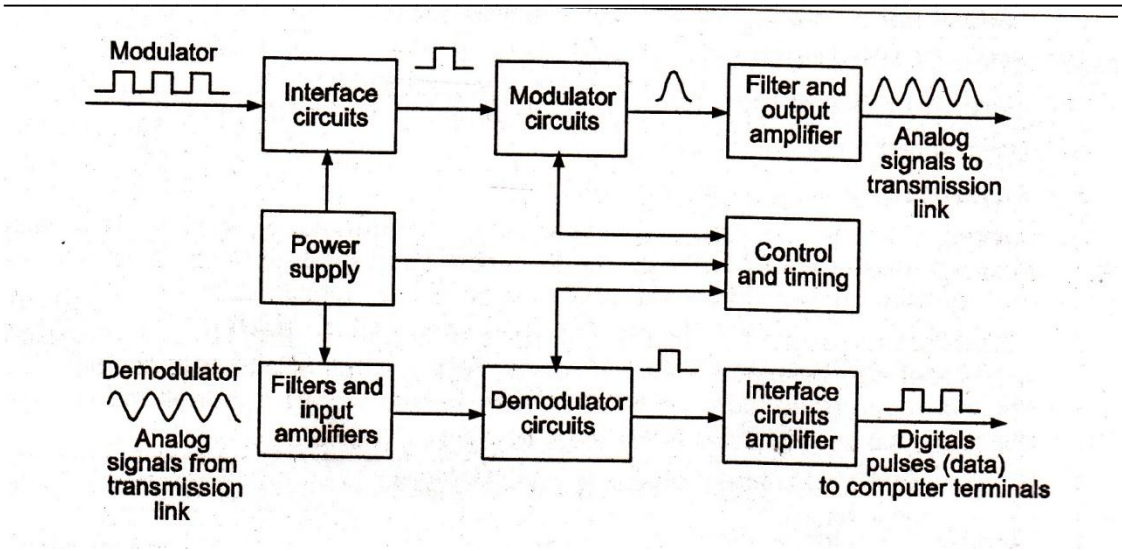
Network: - network is a broad term similar to system. Network is a communication system which supports many users.

Network topology: - Network topology is the geometric representation of the relationship of the links connection devices.

Protocol: - set of rules to be followed in data communication system.

Node:- each station is a communication network is called as a node.

f) MODEM (2 mark for diag 2 mark for expl)



Functions of each block:

Interfacing circuits: To transmit byte data,it is necessary to convert byte into eight serial bits. This parallel to serial conversion is done by interfacing circuits.UART8250 can be used to serve this purpose.

Modular circuit: Several data coming from interfacing circuit is converted into analog signal with two frequencies:1070 Hz for logic ‘0’ and 1270 Hz for logic ‘1’.

Filter and amplifier: The two frequencies are sent with amplified form through telephone line.

Control and Timing circuit: To establish the communication link between transmitting and receiving modem, control circuit is used.

Demodulator converts signals back to original form to feed it to computer terminal.

Q 3.

a) carrier power = 10 kW = Pc
total power to be transmitted = 14 kW = Pt
fc carrier freq = 680 kHz
fm modulating freq = 7500 Hz

→ $P_t = P_c \left(1 + \frac{m^2}{2}\right)$ ... (1m formula)

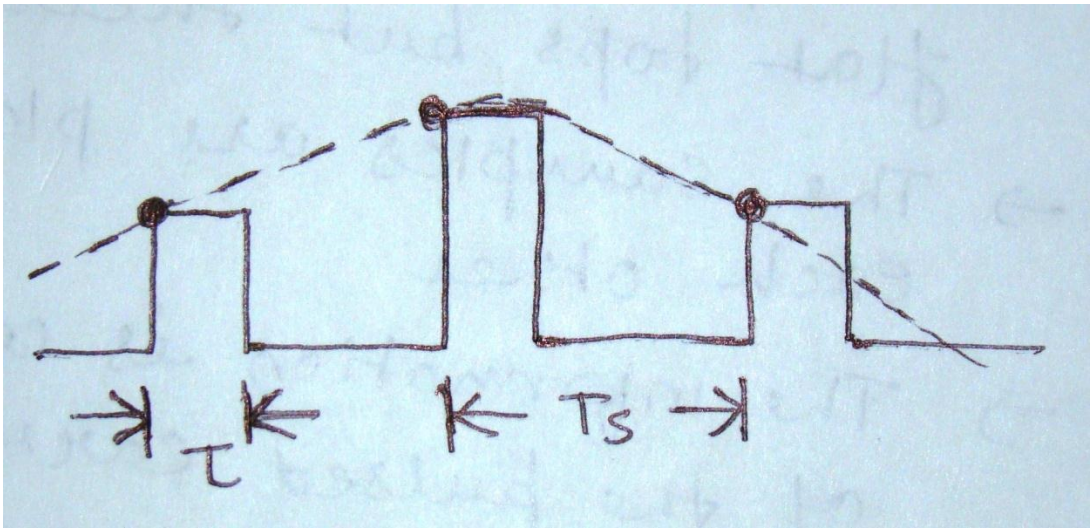
$14 \times 10^3 = 10 \times 10^3 \left(1 + \frac{m^2}{2}\right)$

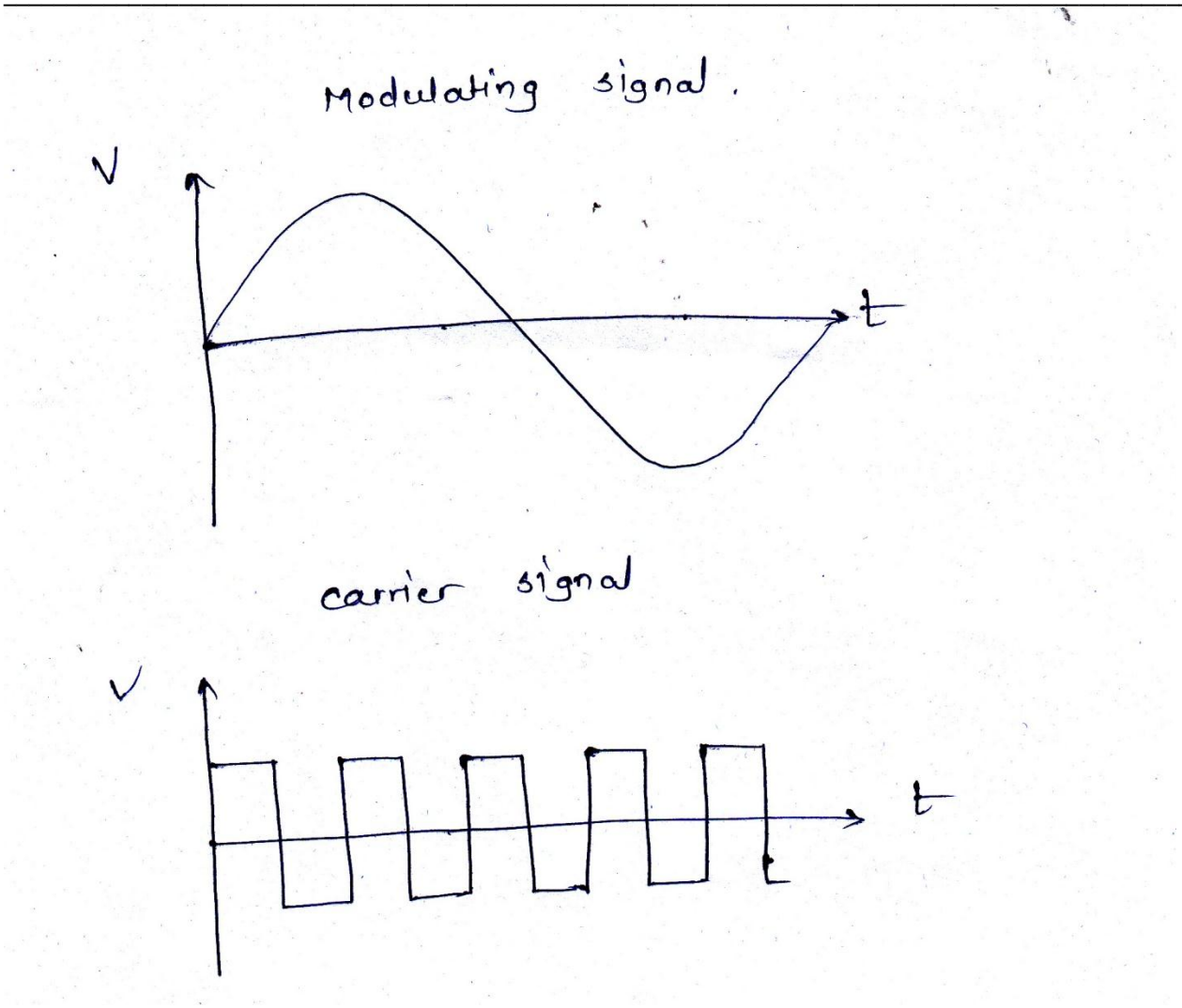
$\frac{m^2}{2} + 1 = 1.4$

$m = 0.894$ // ... (1m ans)

Bandwidth = 2 fm ... (1m formula)
= 2 × 7500
= 15 kHz // ... (1m. ans)

b) Advantages of PAM: Generation of PAM is simple (1 mark for adv)





(1 mark for modulating signal, 1 mark for carrier, 1 mark for the PAM signal)

c) (4 marks for the diagram)

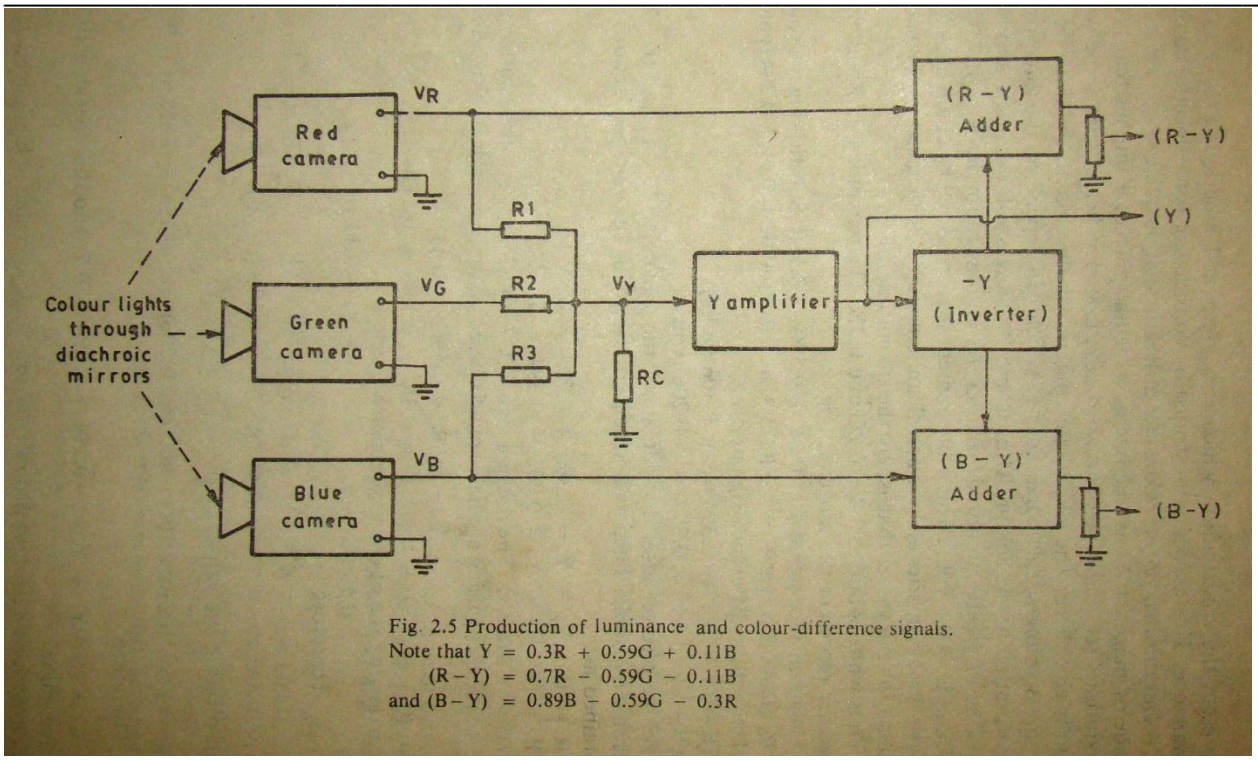
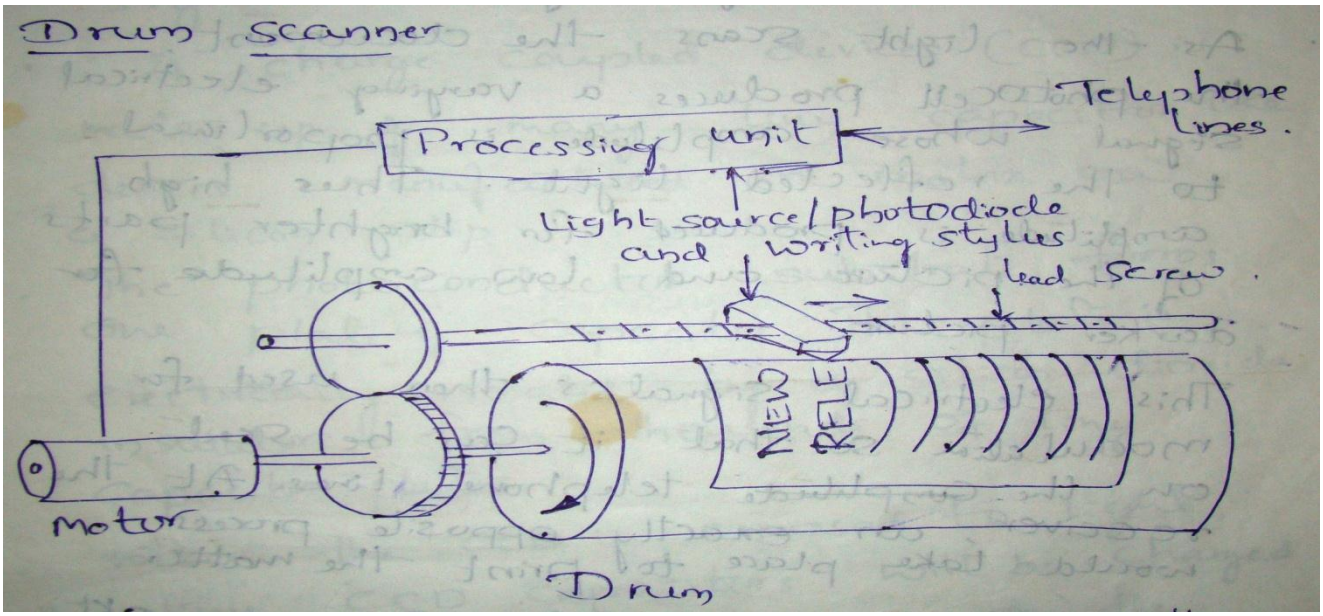


Fig. 2.5 Production of luminance and colour-difference signals.
Note that Y = 0.3R + 0.59G + 0.11B
(R – Y) = 0.7R – 0.59G – 0.11B
and (B – Y) = 0.89B – 0.59G – 0.3R

d) There are two scanning mechanisms:-

(1 mark for the diff method, 1 mark for the diag, 2 marks for the expln)

Drum scanner:- The drum scanners were used in the early facsimile machines which were electro-magnetic devices



-The document to be transmitted is wrapped around and tightly affixed to the drum.

-An electric motor is used to rotate this drum through a gear train mechanism. The motor is designed to operate at an accurate sped so that the scanning rate is precise and constant.

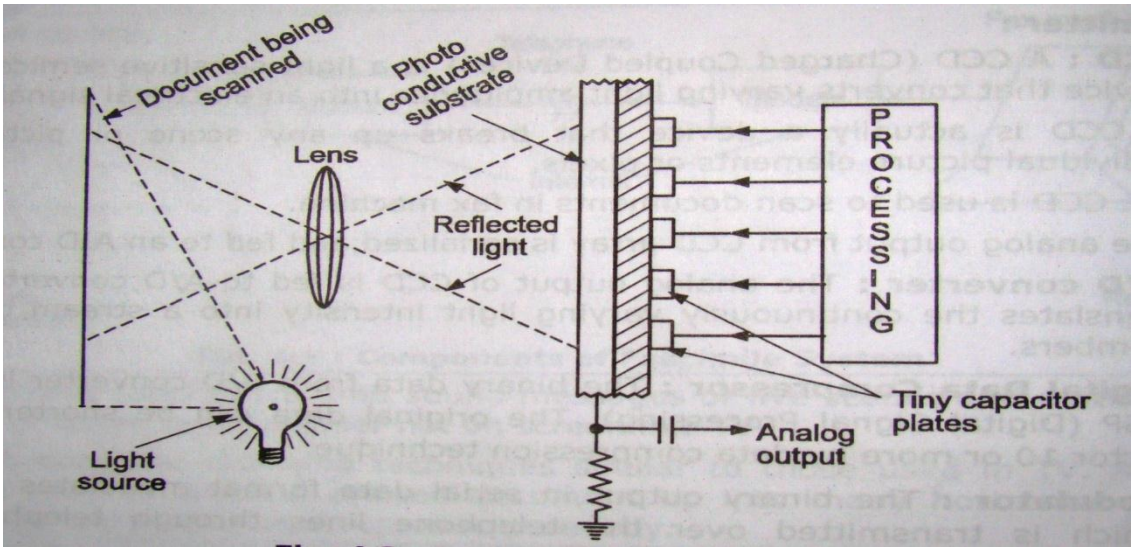
-Scanning of the document is done with a light and photocell arrangement. A lead screw driven by the gear train moves a scanning head consisting of a light source and a photo cell. The lens is used to focus the reflected light from the document onto the photocell.

-Photocell produces a varying electronic signal whose output amplitude is proportional to the amount of reflected light.(High voltage for white, Low voltage for black)

-this baseband signal is then modulated and then sent on telephone line.

OR

CCD Scanner:-



-Most fax machines uses CCD charge coupled devices for scanning.

-CCD is a light sensitive intensity into a proportional electrical signal.

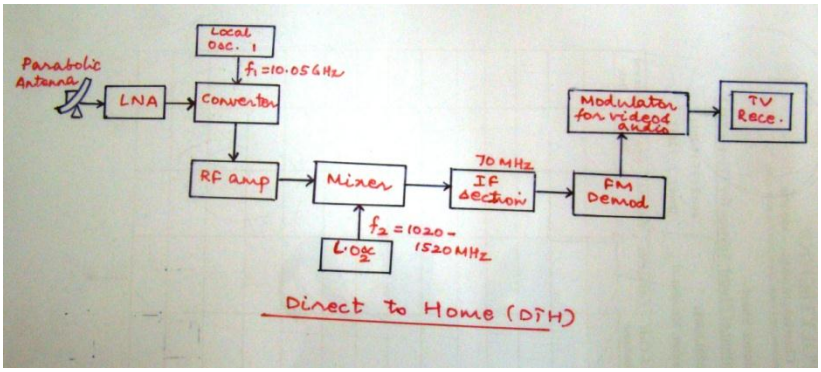
-A typical CCD is made up of many reverse biased diodes that act like capacitors which are manufactured in a matrix on a silicon chip.

-When CCD is exposed to light, the CCD capacitors charge to value proportional to the light intensity.

-The capacitors are then scanned or sampled electronically to determine their charge. This creats an analog output signal that accurately depicts the image focusedon the CCD.

e) The system used in individual homes for direct reception of TV from a satellite is DTH system. Direct home broadcasting of TV signal is possible due to direct broadcast satellite. DBS operates on same principle as that

of conventional communication satellite, but DBS is expected to cover a large area and hence it has to transmit large power compared to conventional satellite.



I. Outdoor unit

The receiving antenna is a parabolic reflector with active element as a horn antenna which is directly connected to the reflector.

The low noise amplifier LNA consists of a low noise wideband amplifier. Therefore amplifies all the frequencies.

The convertor gives a signal of UHF frequency ranging from 950-1450MHz(500MHz bandwidth)

Advantages of using UHF frequency are that low cost coaxial cable can be used as feeder from outdoor unit to indoor unit.

II. Indoor unit

RF amplifier is tuned to UHF frequency

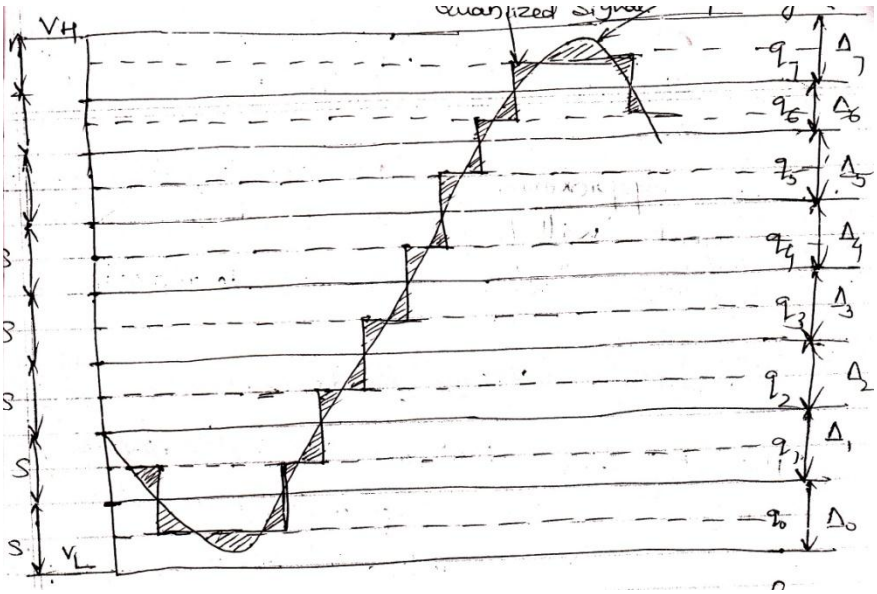
To achieve IF as 70MHz local oscillator 2 and mixer down convert RF UHF frequency(or selected channel)

FM detector recovers original baseband signal consisting of composite video and audio signal. Video part of baseband signal modulates RF carrier using AMVSB technique

Audio part modulates another RF carrier using FM. Further these modulated signals are given to normal TV receiver. **(2 mark for diagram, 2 marks for expl.)**

Q.4 (A) Attempt any THREE **12**

(a)



1 Mark

3 Mark

The input signal x (t) is increased to have a peak to peak swing of V_L to V_H volts. This entire voltage range has been divided into "Q" equal intervals each of size "S".

S is called as the step size and its value is given as

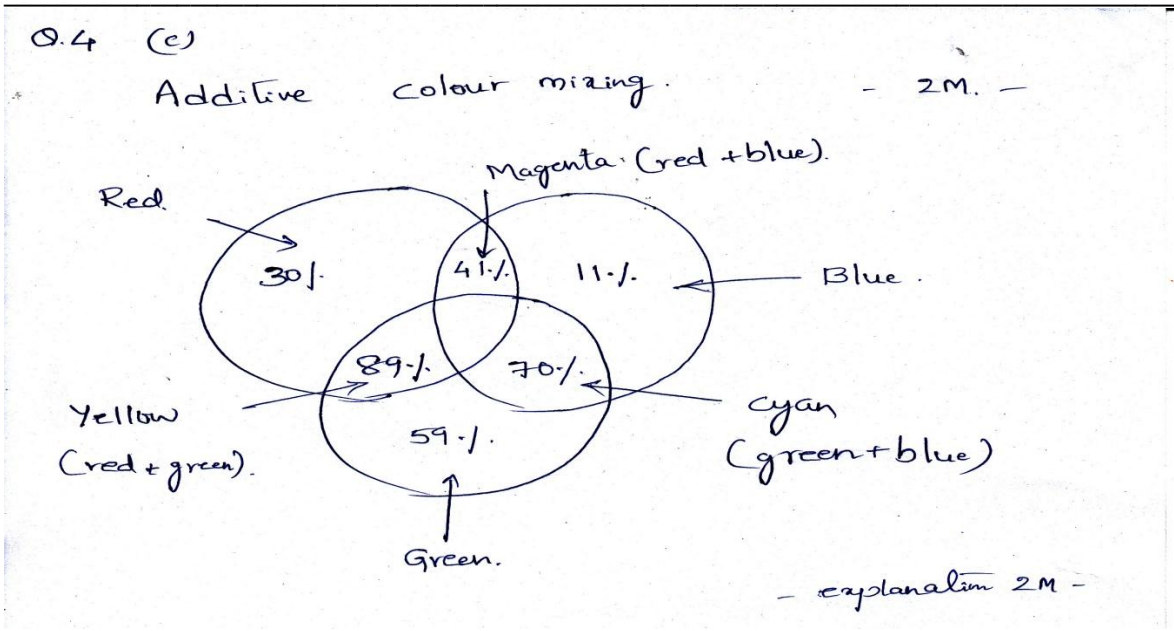
$$S = \frac{V_H - V_L}{Q}$$

At the Centre of each steps, the quantization levels q_0, q1, q 2 , …….q_7 are located.
Whenever x (t) in the Δ_0 , the quantized signal $x_q(t)$ maintains a constant level "q0".Similarly whenever x(t) is in the range Δ1,the quantized signal is produced.
The approximation between input signal and quantized signal will be better and better as the step size "S" is decreased.

(b) Each Definition 1 mark

i) Aspect Ratio: The width to height ratio of TV screen is called aspect ratio.
ii) Scanning: It is a process by means of which the optical image of the televised scene falling on the target plate of the camera is broken in a series of horizontal lines by an electron beam.
iii) Vertical Resolution : The ability of the system to resolve vertical picture details in the vertical direction is called vertical resolution.
iv) Horizontal Resolution : The ability to resolve maximum number of picture elements along horizontal direction is called Horizontal Resolution.

(c) diagram 2 mark



Additive colour mixing theory:

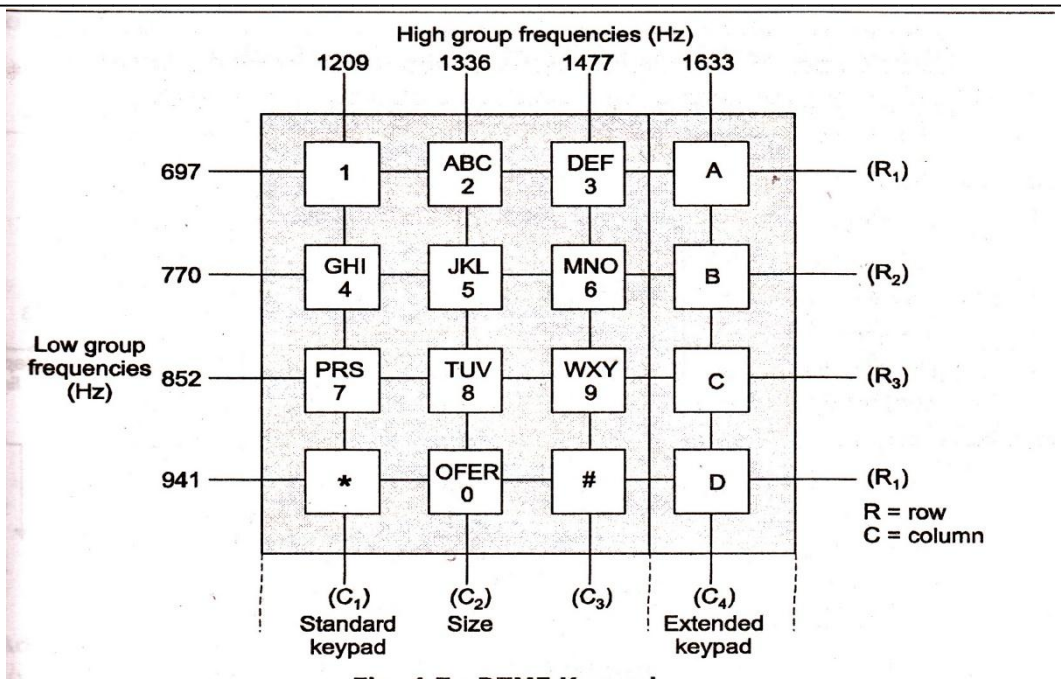
2 mark

Additive colour mixing is the basis for colour television,light from two or more colours obtained either from independent sources or through filters can create a combined sensation of a different colour.Thus different colours are created by mixing pure colours and not by substracting parts of white.

The additive mixing of three primary colours-red,green and blue in adjustable intensities can create most of the colours encountered in daily life.

Red+green=yellow
Red+blue=magenta
Blue+green=cyan

d) diagram 2 mark

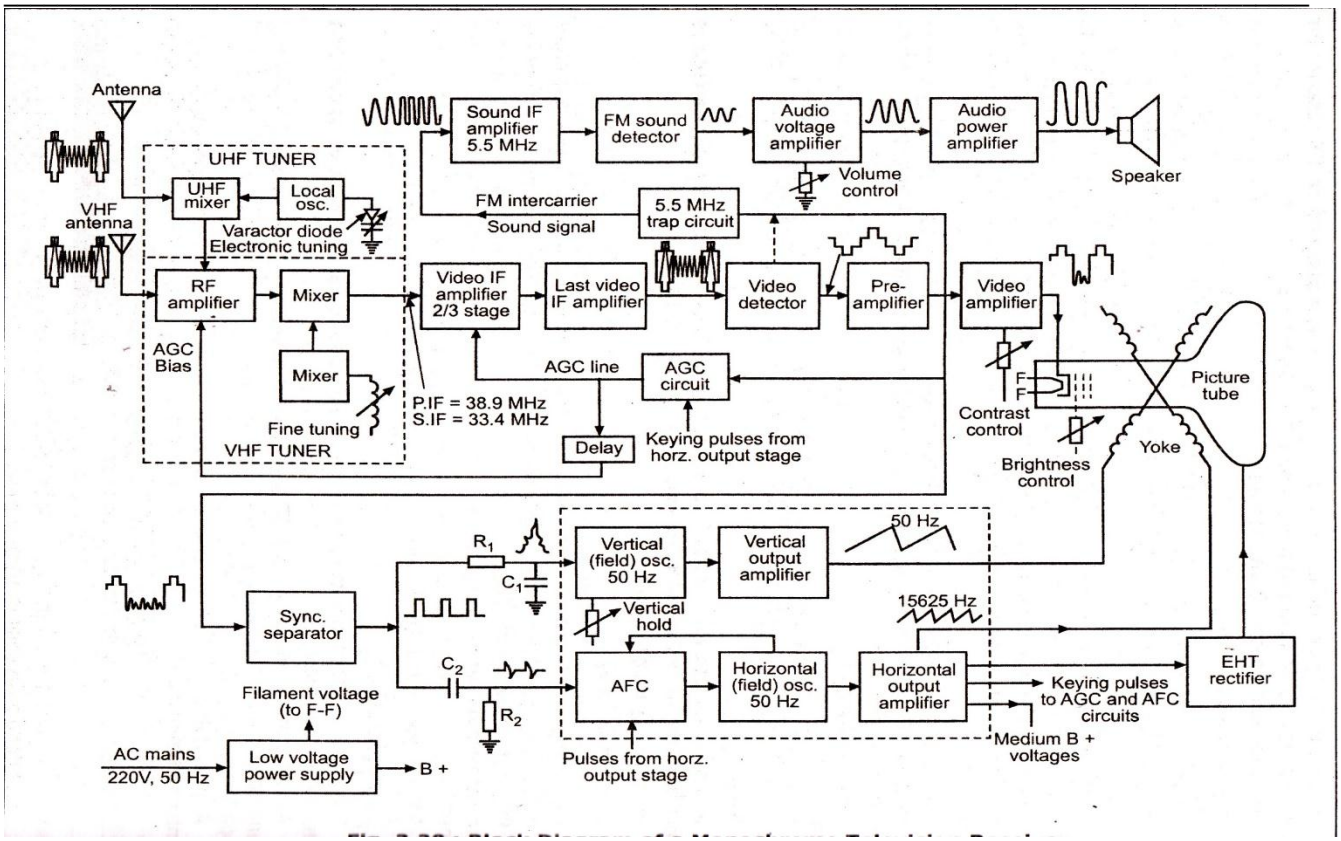


Explanation 2 mark

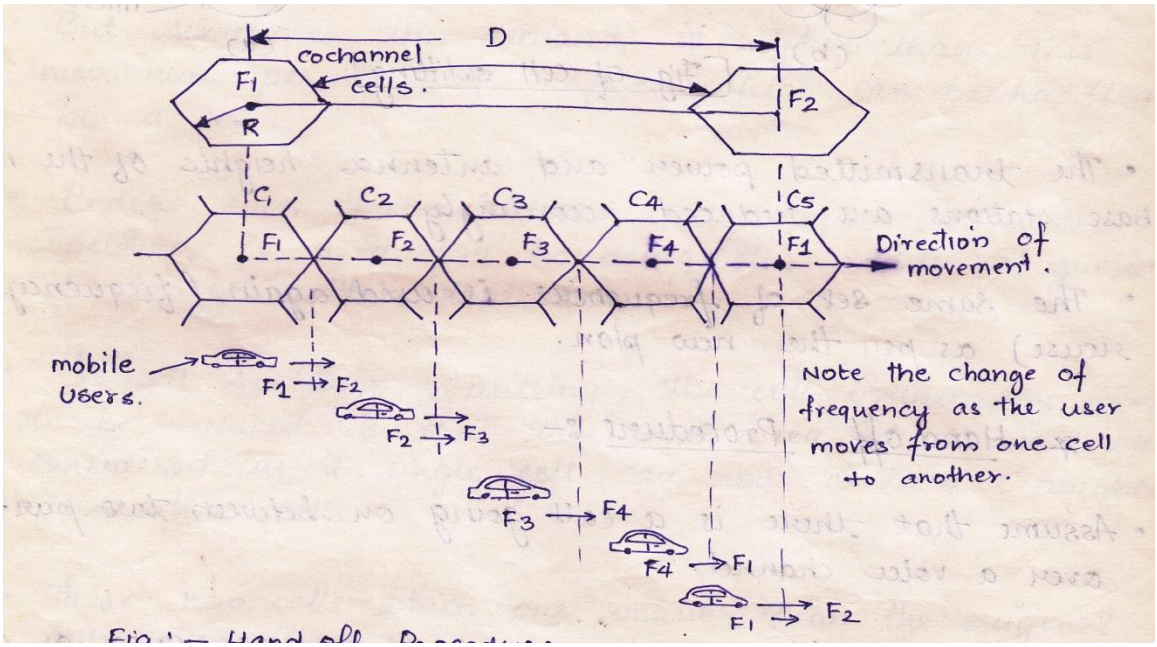
In DTMF Tone dialing technique a keypad of 12 push buttons arranged in four rows with three keys per row is used.
As we touch a push button on the keypad a voice frequency “tone” is used.
This tone is unique for each push button. It is generated by a combination of two frequencies, one from the lower band and the other from upper band.
Therefore the dialing is also known as the dual tone multi frequency dialing (DTMF).
If the”8” is pressed, the tone that is produced and sent to the exchange is a combination of 852Hz from the lower band and 1336 Hz from the upper band.
DTMF is much faster than the pulsed dialing. The time required to recognize any digit tone is only 50msec.

(B) Attempt any one **6 marks**

(a) Monochrome TV receiver (6 marks for diagram)



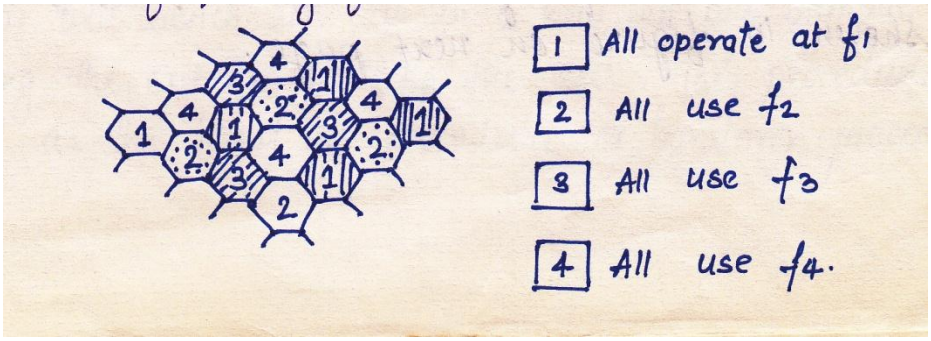
(b) hand off mechanism: diagram 1 mark



Explanation 2 marks

Assume that there is a call going on between two parties over a voice channel.
When the mobile unit moves out of coverage area of a particular cell site,the reception becomes weak.
Then present cell will request a hand off.
The system will switch the cell to a new cell site without interrupting the cell or changing the user.This procedure is called as the hand-off procedure or handover procedure.
The user can continue talking without even noticing that the handoff procedure has taken place.It increases the effectiveness of mobile system.

Frequency Reuse Technique: diagram 1 mark

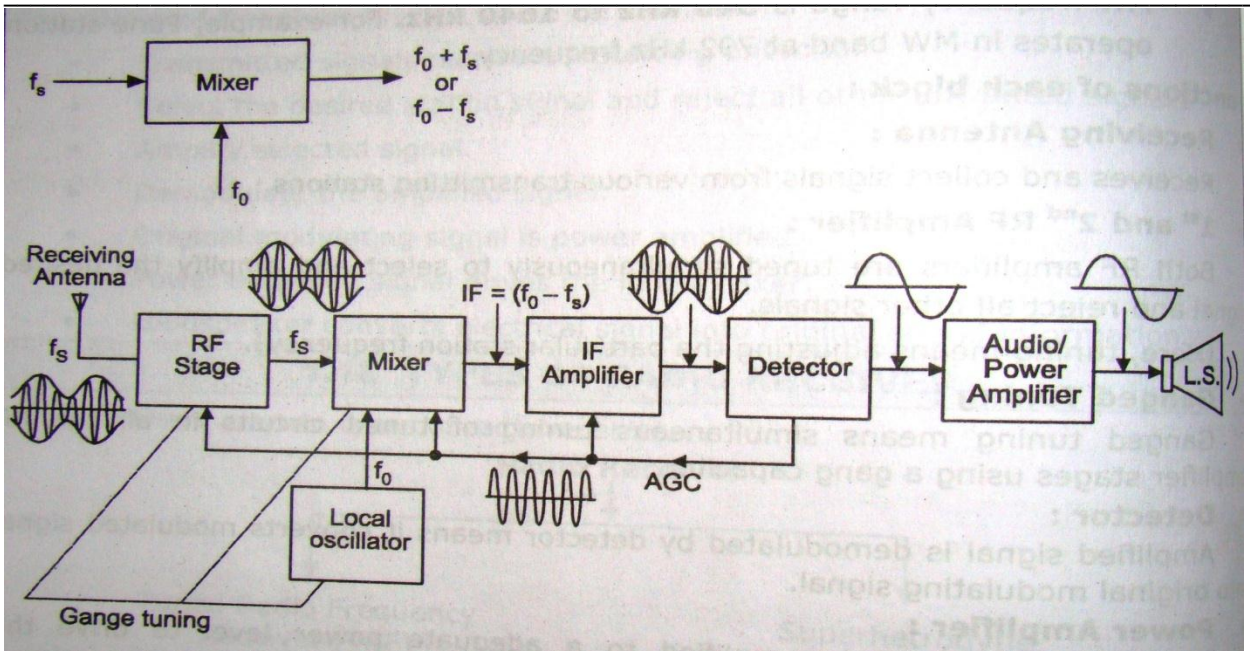


Explanation 2 mark

Same frequency is assigned in two different geographical areas.
To use the same frequency repeatedly in a same general area in one system.This scheme is popularly used in cellular system.
The total frequency spectrum allocation is divided into 4 co-channel cells in the system as shown in figure.The cells marked-1 will use the same frequency say f1,the cells marked-2 will use same frequency f2 and so on.

Q. 5. Attempt any Four (16 marks)

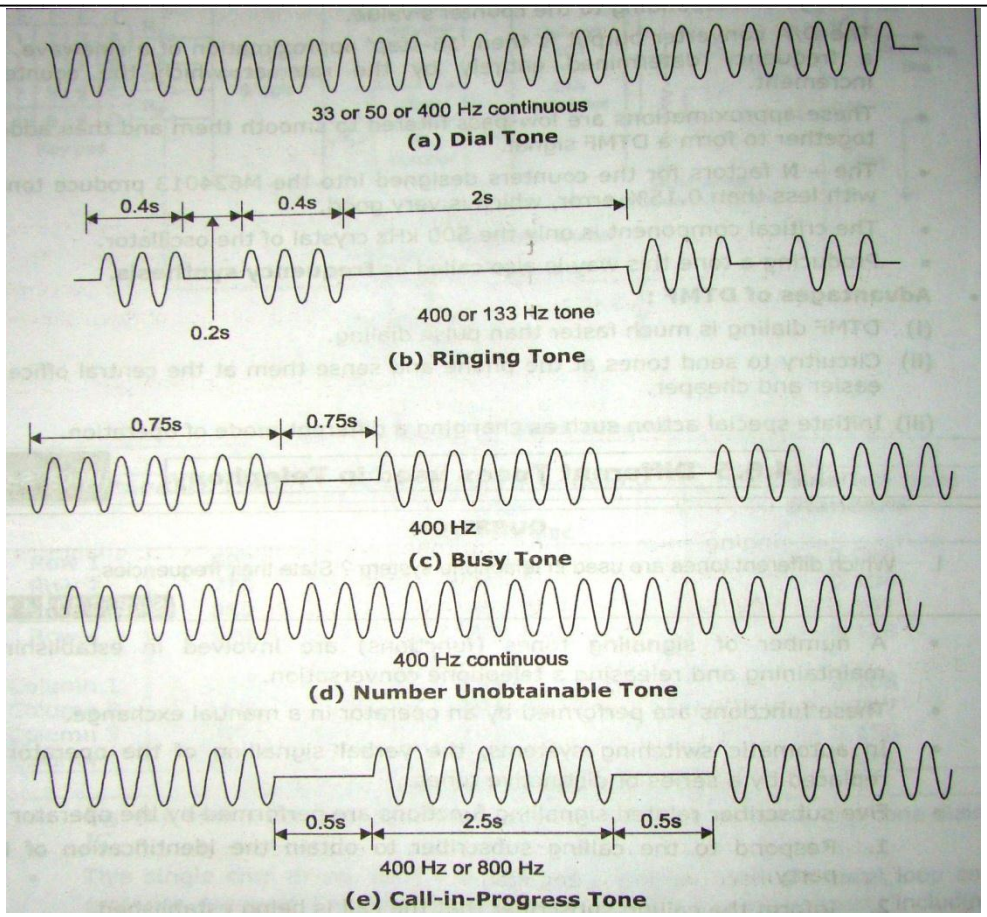
a) Superhetrodyne radio receiver (2 marks – diagram, 2 marks – explanation)



A super heterodyne receiver is a practical radio & TV receiver used now days. It does frequency translation or conversion

1) RF amplifier – they provide front end selectivity and amplification. They provide high gain, sensitivity, improved S/N ratio. It also helps in precise hand pass filtering. At the output of RF amplifier we get (f_s).
   The local oscillator (f_o) has its own LC elements by varying C it produces the IF.
2) Frequency conversion or mixer - it is the process of frequency conversion e.g. RF signal and Lo is mixed to produce different o/ps. The desired frequency is obtained by filtering.
3) IF Amplifier – IF is not a suitable frequency neither to high nor low to suit the modulation technique. The mixer receives signals from the RF amplifier and local oscillator, mix these signals to produce various frequencies. IF is selected and others are rejected ie IF = (f_o- f_s) .Eg. For AM it is 455 KHz.
4) Detector or demodulator – it separate the original AF signal out of IF o/p which contains signal as well as the carrier. It is a rectifier circuit with LPF.
   The amplified signal is sent to the loud speaker.
   (AGC is automatic gain control controls the gain of the amplifier to maintain or constant o/p voltage level).

b) Different tones used in telephony (2 marks for diagram 2 marks for expl.)



1) Dial tone : This tone indicates that the exchange is ready to accept dialed digits from the subscriber. The subscriber should start dialing only after hearing the dial tone. The 400 Hz signal is usually modulated with 25 Hz or 50 Hz.

2) Ringing tone : When the called party line is obtained, the exchange control equipment send out the ringing current to the telephone set of the called party. Simultaneously, the control equipment sens out a ringing tone to the calling subscriber. The frequency of ringing tone is 133 Hz or 400 hZ, sometimes modulated with 25 Hz or 33 Hz.

3) Busy tone : It is a ring burst 400 Hz signal with silence period in between. A busy tone is sent to the calling subscriber whenever the switching equipment or junction line is not available to put through the call, or called part is engaged.

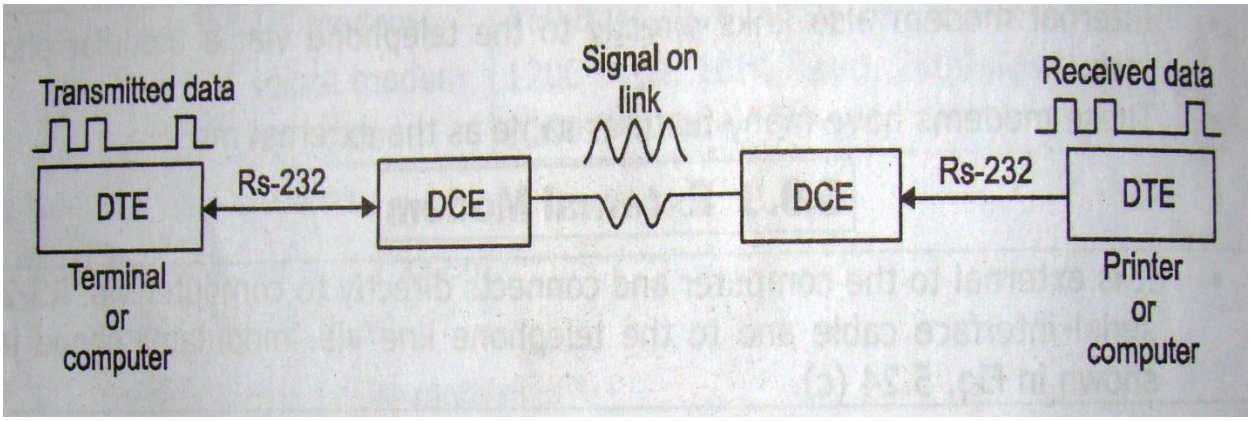
4) Number obtainable tone : This tone may be sent to the calling subscriber due to variety of reasons such that the called party is out of order or called party is disconnected or an error in dialing leading to the selection of space.

5) Routing or call in progress tone :

When a subscriber call is routed through a no. of different types of exchanges, this tone is issued. It is usual that a subscriber in a new area where the frequencies or timings of the tones are different from those in his own area confuses signaling tone. In order to overcome this problem, recorded voices that announce messages in modern exchanges.

c) RS 232 standard (1 mark for diagram, 3 marks for expl)

The RS 232 standard is a very common standard for communicating between a terminal, printer, test instrument or similar device and its associated communication interface for the link.



Data terminal equipment (DTE) generates the data to be sent or using the data that are received.

DCE is data communication equipment takes signal to and fro the DTE, makes it compatible.

The physical and electrical connection interface between DTE and DCE is defined by RS 232 so that DTE and DCE can plug directly.

Spec :

1) RS 232 –C specifies the signaling rate between DTE and DCE and a digital signal is used on all interchange circuits.

2) The RS 232 standard specifies that logic '1' is to be sent as a voltage in the range -3V to -25V (Mark) and logic '0' to be sent for voltage range +3V to +25V

3) The voltage between -3V to + 3V is invalid range.

4) Thus to send a 'mark' the voltage level should be close to -25V & for 'space" the voltage level should be close to +25V

d) **Amplitude Modulation (AM)**

1) Def: Amplitude modulation (AM) is the process of changing the amplitude of a high frequency carrier signal in proportion with the instantaneous value of modulating signal (information.

2) m (modulation index) In AM wave modulation index (m) is defined as the ratio of amplitude of modulating signal to the carrier signal m = Em/EC

m – Modulation index.

Em – amplitude of modulating signal.

Ec – amplitude of carrier signal.

(In AM m = 1).

Frequency modulation

1) Def - FM is a system of modulation in which the instantaneous frequency of the carrier is varied in proportion with the amplitude of the modulating signal. The amplitude of the carrier signal remaining constant.
2) Modulation index (mf) in FM decides the band width of the FM wave.

mf = frequency deviation / modulating frequency = δ/ mf.

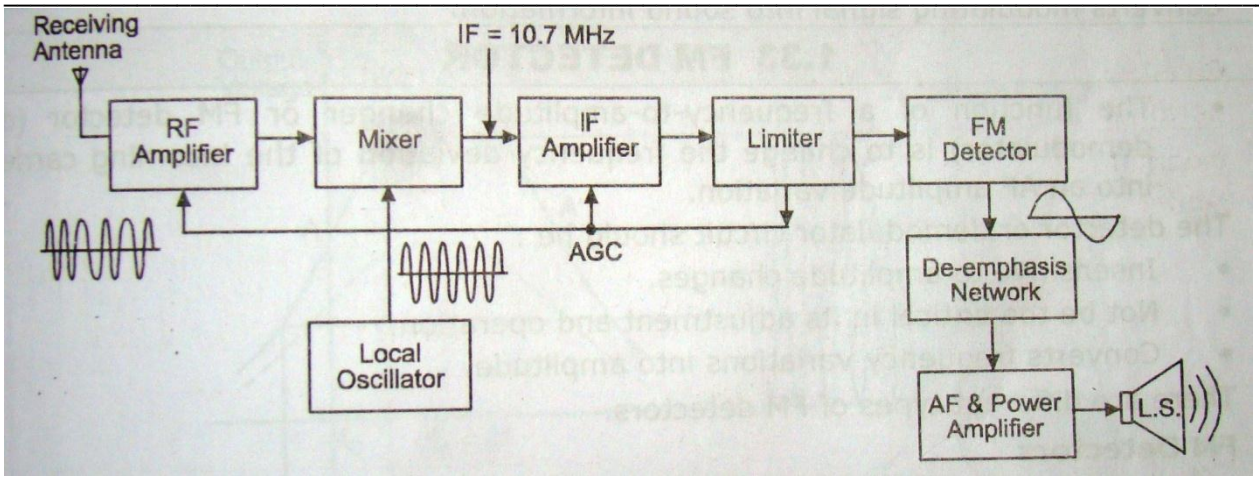
It also decides the no of side bands having significant amplitude mf > 1.

(1 mark definition each AM & FM and 1 mark each for def of modulation index AM & FM resp)

f) Compare ASK, FSK and PSK (4pts 4 marks)

Parameter	ASK	FSK	PSK
Variable parameter	Amplitude	Frequency	Phase
Noise immunity	Low	High	High
Bit rate	Suitable upto 100 bits/sec	Suitable upto 1200 bits /sec	Suitable for high bit rate greater than 1800 bits/sec
Application	Low speed modem	Medium speed modem	High speed modem

Q 6. a) (2 marks for diagram, 2 marks for expl.)



The figure shows the block diagram of super heterodyne FM receiver:-

Various block description

Antenna :- The antenna of an FM receiver is generally half wave dipole for the 88-108MHz band.

RF tuner:- The RF tuner includes an RF amplifier & frequency converter (Mixer + local oscillator). RF amplifier is always used in FM receiver. It reduces effect of noise image frequency interference, the possibility of oscillator radiations from the antenna etc. It is tuned to the RF carrier frequency in the 88 to 108MHz band.

There are two stages of frequency conversion

- The first frequency converter circuit converts the incoming RF signal to an IF signal of 10.7MHz. This is done by beating the incoming signal frequency with the local oscillator frequency in the mixer. At the output of the mixer only the difference frequency which is the IF of 10.7MHz is selected and fed to the second frequency converter

- The second frequency converter circuit converts the incoming RF signal to an IF signal of 455KHz.This signal is fed to the IF amplifier section.

The first IF is kept high for good image frequency rejection and second IF is a relatively low frequency that allows the IF amplifiers to have relatively high gain & still not be susceptible to oscillating

IF amplifier section:- IF amplifier are tuned to 10.7MHz and have a bandwidth of approximately 200KHz. They amplify the IF signal at the output of the tuner to a sufficiently high level before feeding to the limiter stage.

Limiter:- The FM wave which is transmitted by the FM transmitter has constant amplitude. But during propogation, noise & other unwanted signal get added to it & change its amplitude. These unwanted amplitude changes must be removed before signal goes for demodulation otherwise distortion appears in the demodulation signal as the demodulators react to amplitude changes as well as frequency changes

The amplitude limiter will remove all the unwanted amplitude variations from the received signal. This circuit is basically an IF amplifier tuned to 455KHz.

FM detector:- The FM detector circuit recovers the audio information from the FM signal.

De-emphasis network: It is used in the receiver to compensate for pre-emphasis carried out at the transmitter. De-emphasis is accompanied with a correspondence reduction in noise.

Audio amplifiers:- Those perform the function of raising the power level of the audio signal to a sufficient high value so as to satisfactorily drive the loud speaker.

b) Four modes of operation: (1 mark for each mode)

1. Mobile unit initialization:

-When a mobile unit is activated, the receiver scans 21 set-up channels which are designated among the 416 channels.

-It then selects the strongest and nearest and locks on for a certain time.

-This self location is user independent and reduces load on the cell site at transmission.

2. Mobile originated call:

-A request for service is sent on a selected set-up channel obtained from a self location scheme.

-The cell site receives it and in directional cell site selects the best directive antenna for the voice channel to use.

-At a same time the cell site sends a request to the MTSO via a high speed data link.

-The MTSO selects an appropriate voice channel for the call and the cell site acts on it through the best directive antenna to link to the mobile unit.

3. Network originated call:

-When a landline party dials a mobile unit number the telephonic zone office originates that the number is mobile number and forwards the call to MTSO.

-The MTSO sends a paging message to certain cell sites based on the mobile unit number and the search algorithm.

-The mobile unit recognizes its own identification on a strong set-up channel locks it and responds to the cell site.

-The mobile unit also follows the instructions to tune to an assigned voice channel.

4. Call termination:

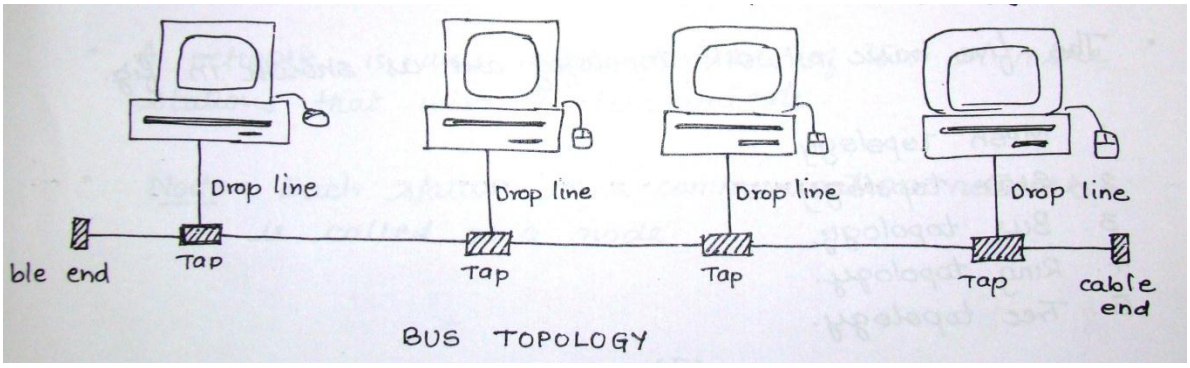
-When the mobile user turns off the transmitter, a particular signal transmits to the cell site and both sides free the voice channel.

-The mobile unit resumes a search mode through the strongest set up channel.

c) The bus topology is usually used when a network installation is small, simple or temporary as shown.

(2 mark for diagram 2 marks for expl)

-On a typical bus network the cable is just one or more wires, with no active electronics to amplify the signal or pass it along from computer to computer.



-When one computer sends a signal through the cable, all the computers on the network receive the information, but the one with the address that matches the one encoded in the message accepts the information while all the other reject the message.

-The speed of the bus topology is slow because only one computer can send a message at a time. A computer must wait until the bus is free before it can transmit.

- The bus topology requires a proper termination at both the ends of the cable.

-Without termination when the signal reaches the end of the cable, it returns back and travels back to the cable.

-The transmitted waves and reflected waves, if they are in phase add and if they are out of phase cancel. Thus adding and cancellation of wave leads to Standing wave which can distort the normal signals which are travelling along the cable.

d) Advantages of PCM: (2 marks for adv. 2 marks for dis adv.)

-Major advantage of PCM is that the information does not lie in any property of the pulse, but it lies

In the presence or absence of the pulse. Thus if noise distorts the pulse, it makes no difference so long as the decision regarding the presence or absence of the pulse is correct.

-Convenient for long distance communication

-High transmitter efficiency

-High noise immunity

-Good signal to noise ratio

Disadvantages of PCM:

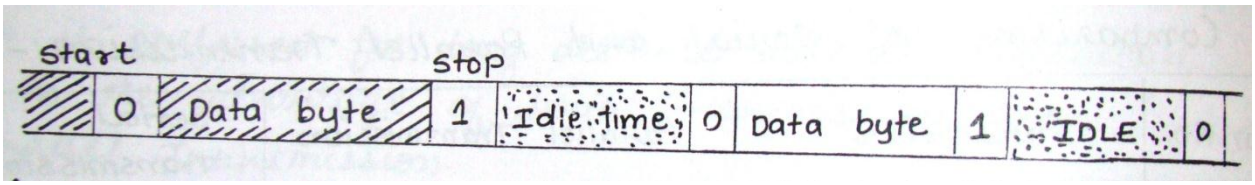
-Encoding, decoding and quantizing circuit of PCM is very complex.

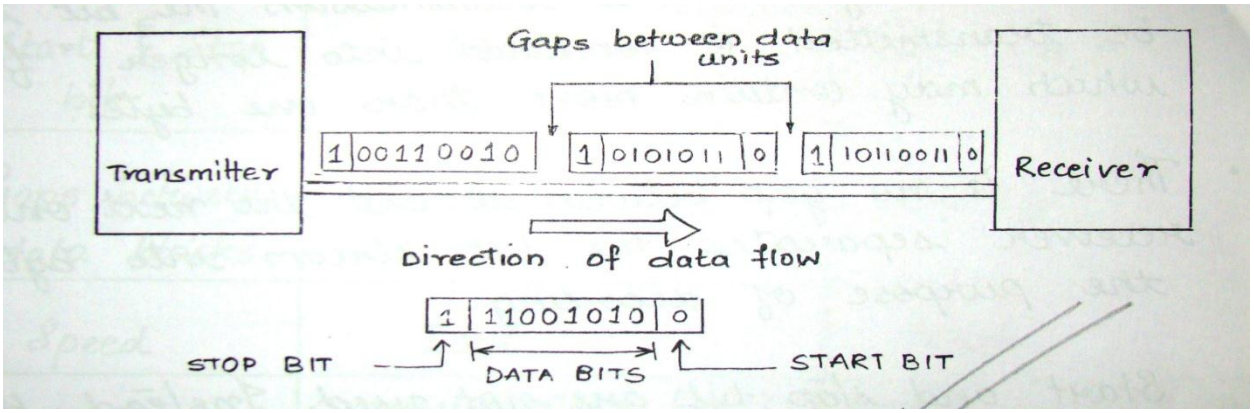
-Requires large bandwidth compared to analog system

-Quantization error. As 3.8v and 4.3v is quantized as 4v only

-If due to noise ,amplitude of pulse is unexpectedly below or above the threshold level, then receiver may misinterpret the pulse.

e) Asynchronous transmission:- (2 marks for diagram 2 marks for expl)





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

-Only one byte at a time. After sending one byte next byte can be sent after an arbitrary time delay.

-The transmitter and receiver operate at different clock frequencies.

-As the data transmission can commence at any time it becomes difficult for the receiver to understand the instant at which the byte has been transmitted.

-To help the receiver to receive the data bytes START & STOP bits are used along with each data byte as shown in figure. This start bit is always 0 and stop bit is always 1.

-The idle time in between two data bytes is not constant. The idle time is also called as the gaps between the data types.