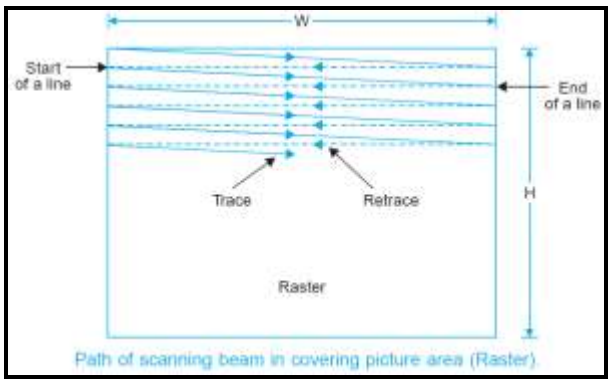
Important Instructions to examiners:

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.

Q1 A) Attempt any six :- **12M**

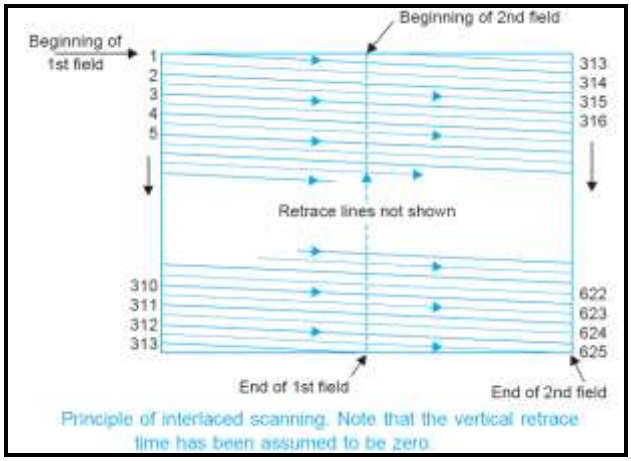
a) Give types of scanning with neat diagram.

Ans:- **Progressive Scanning:-** **01M**



Path of scanning beam in covering picture area (Raster)

Interlace Scanning:- **01M**



Principle of interlaced scanning. Note that the vertical retrace time has been assumed to be zero

b) What is persistence of vision.

Ans:-

Persistence of vision:- **2M**

It is the storage characteristics of the human eye. This arises from the fact that the sensation produced when nerves of the eye's retina are stimulated by incident light does not cease immediately after the light is removed but persists for about 1/16th of a second.

c) List CCIR – B standards.

Ans:- (any four CCIR-B standards) **(½ M each point)**

Number of scanning lines/frame	625
Field (vertical) frequency	50Hz
Line(horizontal) frequency	15625Hz
Aspect ratio(width/height)	4:3
Horizontal trace time	52μs
Horizontal retrace time	12μs
Total scanning line lost in vertical retrace	64μs
Front porch	1.5μs
Back porch	5.8μs
Horizontal sync pulse	4.7μs
Colour sub carrier frequency	4.43MHz
Colour system	Phase Alteration by Line –Delay (PAL-D)
U signal(weighted B-Y)	U=0.493 (B-Y)
V signal(weighted R-Y)	V=0.877(R-Y)
Total vertical blanking duration	1280μs or 1.280ms
Vertical sync pulse	160μs
Pre and post equalizing pulse	5 pulse each
Sync pulse top	100%
Blanking/pedestal level	75%
Black level	72-75%
White level	10-12.5%
Width of video signal	5MHz
Chroma signal bandwidth	-1.3MHz to +1.57MHz
Video IF	38.9MHz
Audio IF	33.4MHz
Inter carrier frequency	5.5MHz
Audio modulation	Frequency Modulation(FM)
Video modulation	Amplitude Modulation (AM)
Total channel width in VHF	7MHz
Total channel width in UHF	8MHz

d) State which type of modulation is used for video signal & why.

Ans:-

(Note: any other relevant reason should be considered)

Type of Modulation:- **1M**

AM is preferred for video signal.

AM is preferred for video signal because the following reasons:- **1M**

- The distortion which arises due to interference between multiple signals is more objectionable in FM than AM because the frequency of the FM signal continuously changes.
- Hence, hardly any steady picture is produced.
- Alternatively if AM were used, the multiple signal paths can at most produce a ghost image which is steady.
- In addition to this, circuit complexity and bandwidth requirements are much less in AM then FM.

e) Which colour difference signals are transmitted and which are eliminated.

Ans:-

Primary Colours: Red, Green & Blue. **1M**

Secondary Colours: Yellow, Magenta, Cyan **1M**

f) What is compatibility with respect to television.

Ans:-

Compatibility with respect to Television:- **2M**

The colour television signal must produce a normal black and white picture on a monochrome receiver without any modification of the receiver circuitry.

g) Which colour difference signals are transmitted and which are eliminated.

Ans:-

(B-Y) & (R-Y) Colour difference signals are transmitted. **1M**

(G-Y) Colour difference signals is not transmitted. **1M**

h) State two disadvantage of digital TV transmission.

Ans:-

Disadvantages (any two) **2M**

1. The biggest disadvantage of the digital TV is the fact that you will need special equipment called digital converter box. The
2. In digital broadcast there is the loss of signals because of bad weather .
3. It can be quite difficult to adjust the antenna (without special equipment e.g. signal level meter).
4. Switching channels is slower because of the time delays in decoding digital signals.

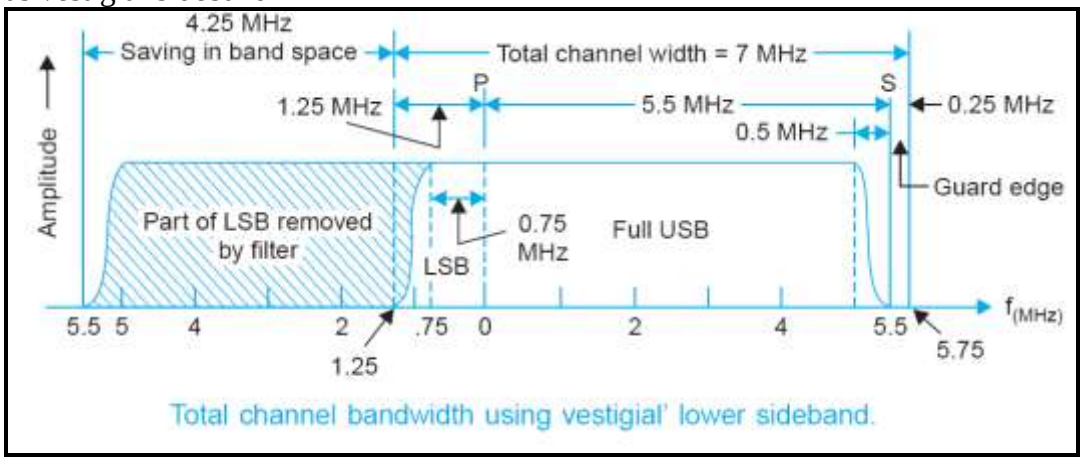
Q1 B) Attempt any two :- **8M**

a) What is VSB transmission & draw VSB representation diagrammatically.

Ans:-

VSB Transmission:- **2M**

- In the video signal very low frequency modulating components exist along with the rest of the signal. These components give rise to sidebands very close to the carrier frequency which are difficult to remove by physically realizable filters.
- Thus it is not possible to go to the extreme and fully suppress one complete sideband in the case of television signals. The low video frequencies contain the most important information of the picture and any effort to completely suppress the lower sideband would result in objectionable phase distortion at these frequencies.
- This distortion will be seen by the eye as 'smear' in the reproduced picture. Therefore, as a compromise, only a part of the lower sideband, is suppressed, and the radiated signal then consists of a full upper sideband together with the carrier, and the vestige (remaining part) of the partially suppressed lower sideband. This pattern of transmission of the modulated signal is known as vestigial sideband



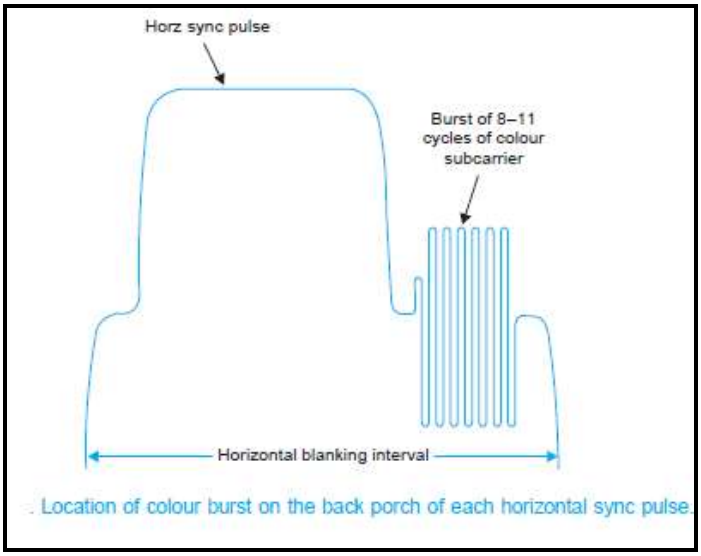
b) What is the purpose of colour burst signal? Draw colour composite video signal.

Ans:-

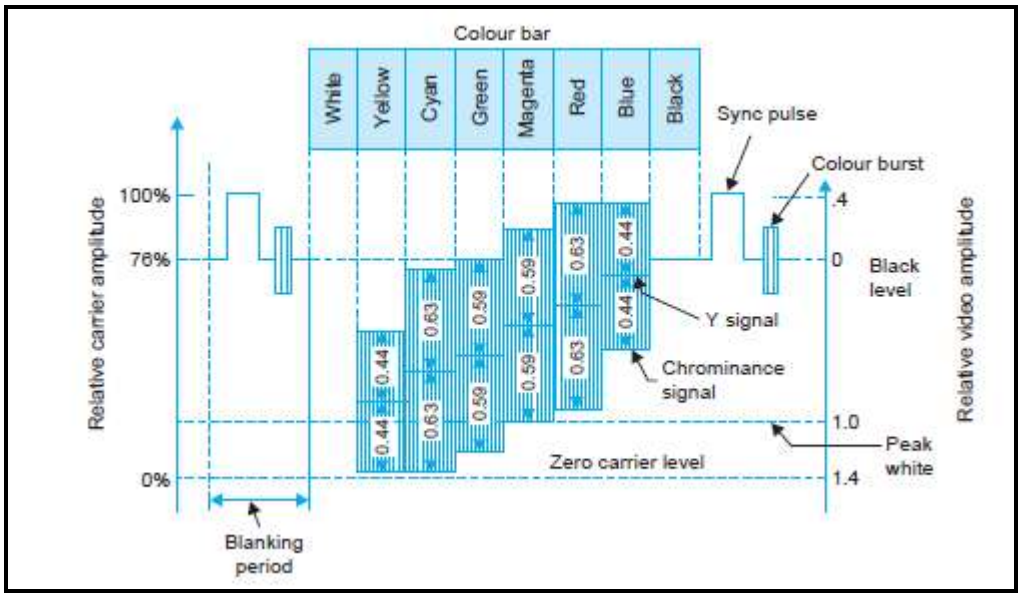
Purpose of colour burst signal:- **1M**

- The transmitted signal does not contain the subcarrier frequency but it is necessary to generate it in the receiver with correct frequency and phase relationship for proper detection of the colour sidebands. To ensure this, a short sample of the subcarrier oscillator, (8 to 11 cycles) called the "colour burst" is sent to the receiver along with sync signals. Subcarrier frequency is 4.43MHz.
- The colour burst is gated out at the receiver and is used in conjunction with a phase comparator circuit to lock the local subcarrier oscillator frequency and phase with that at the transmitter.
- As the burst signal must maintain a constant phase relationship with the scanning signals to ensure proper frequency interleaving, the horizontal and vertical sync pulses are also derived from the subcarrier through frequency divider circuits.

Diagram:- **1M**



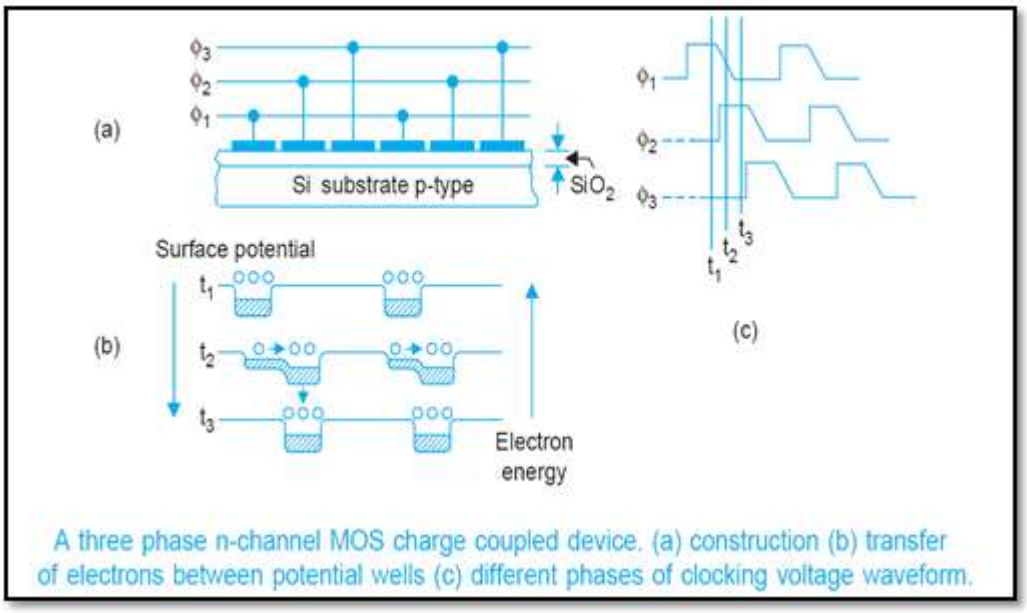
Colour Composite Video Signal:- **2M**



c) Draw neat diagram of CCD camera & state it's working.

Ans:-

Diagram:- **2M**



A three phase n-channel MOS charge coupled device. (a) construction (b) transfer of electrons between potential wells (c) different phases of clocking voltage waveform.

Explanation:- **2M**

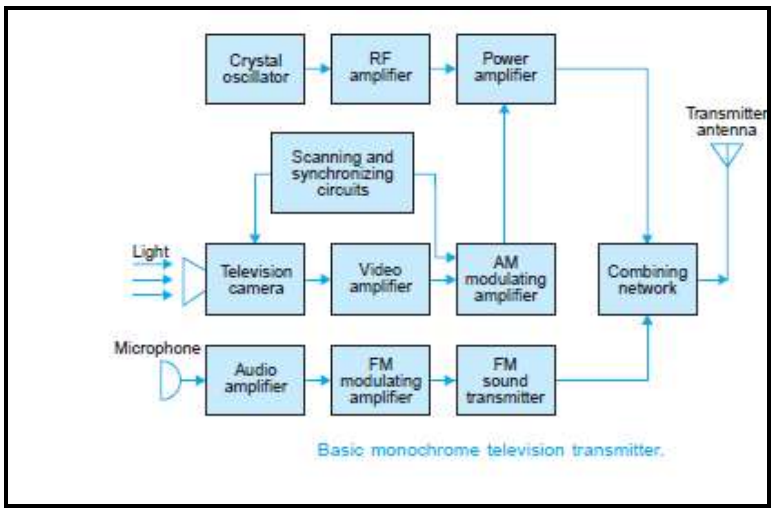
- The operation of solid state image scanners is based on the functioning of charge coupled devices (CCDs) which is a new concept in metal-oxide-semiconductor (MOS) circuitry.
- The CCD may be thought of to be a shift register formed by a string of very closely spaced MOS capacitors. It can store and transfer analog charge signals—either electrons or holes—that may be introduced electrically or optically.
- The charge of one element is transferred along the surface of the silicon chip by applying a more positive voltage to the adjacent electrode or gate, while reducing the voltage on it.
- The accumulation of charge carries under the first potential wells of two consecutive trios is shown in Fig. (b) Where at instant t1 a potential φ1 exists at the corresponding gate electrodes.
- In practice the charge transfer is affected by multiphase clock voltage pulses (see Fig. (c)) which are applied to the gates in a suitable sequence. The manner in which the transition takes place from potential wells under φ1 to those under φ2 is illustrated in Fig. (b).
- A similar transfer moves charges from φ2 to φ3 and then from φ3 to φ1 under the influence of continuing clock pulses. Thus, after one complete clock cycle, the charge pattern moves one stage (three gates) to the right.
- The clocking sequence continues and the charge finally reaches the end of the array where it is collected to form the signal current.
- The lines are then independently addressed and read into a common output diode by application of driving pulses through a set of switches controlled by an address register

Q2 Attempt any four:- **16M**

a) Draw block diagram of monochrome TV transmitter & give its working.

Ans:-

Diagram:- **02M**



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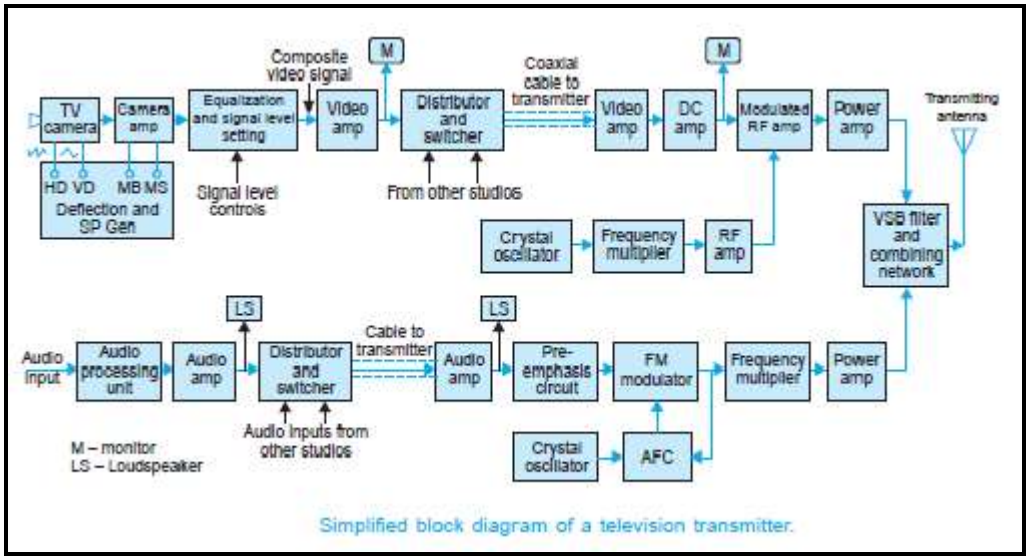

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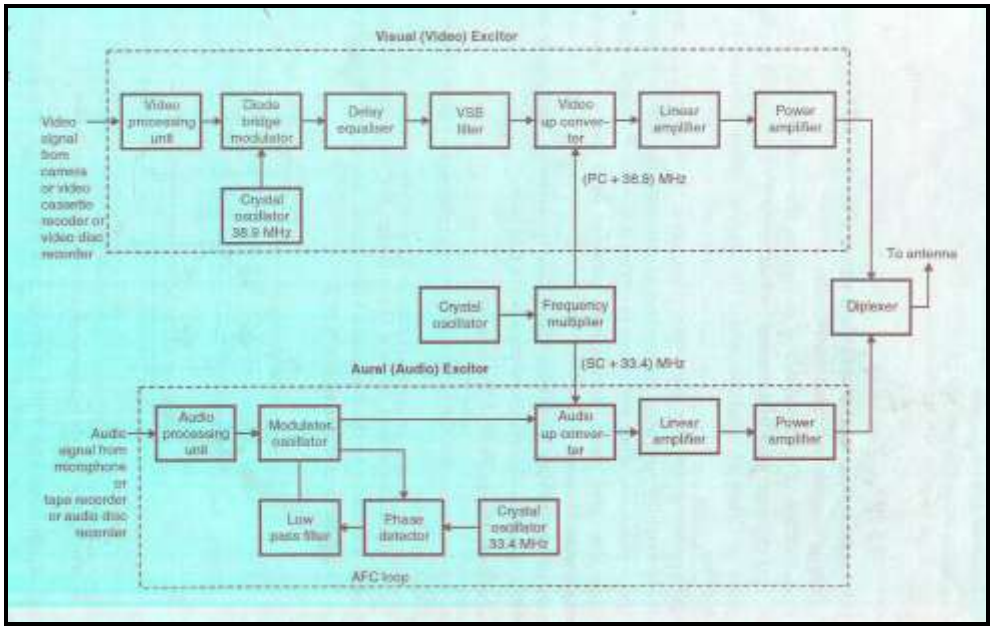


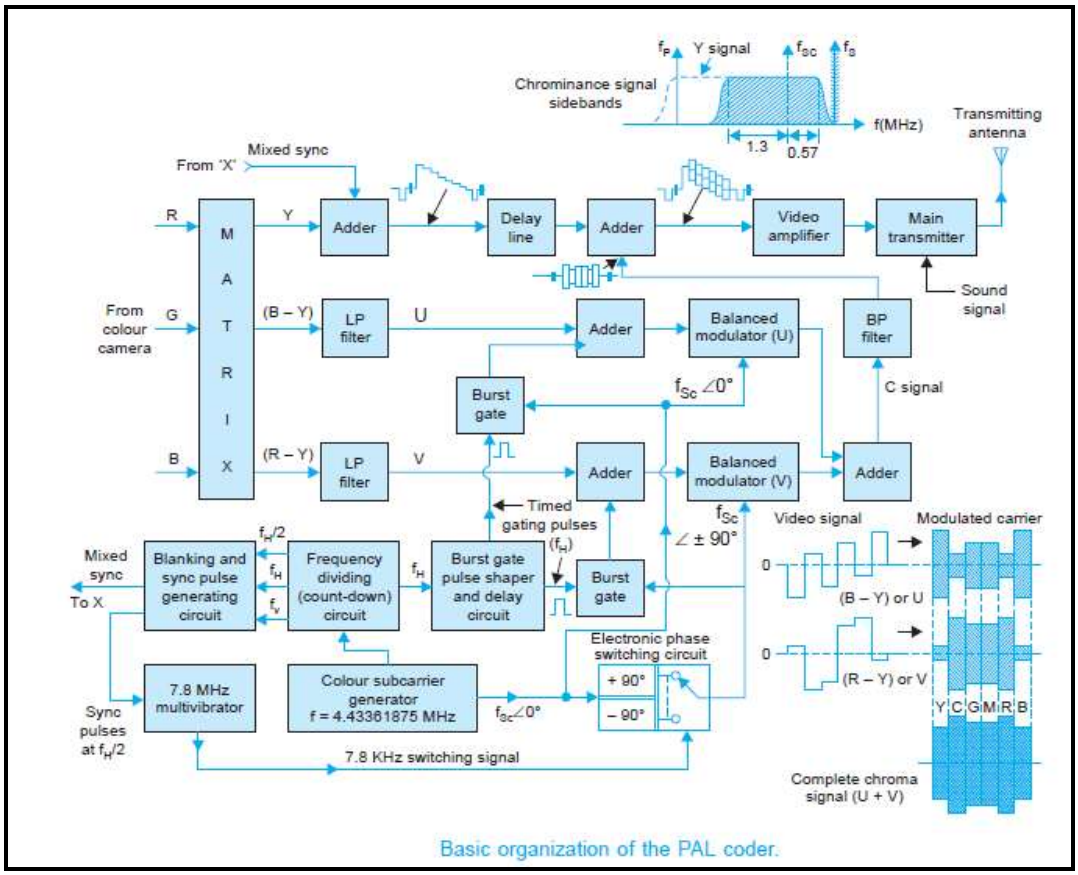
Working:- **02M**

- A TV camera, the heart of which is a camera tube, is used to convert the optical information into a corresponding electrical signal, the amplitude of which varies in accordance with the variations of brightness. The microphone converts the sound associated with the picture being televised into proportionate electrical signal, which is normally a voltage.
- This electrical output, regardless of the complexity of its waveform, is a single valued function of time and so needs a single channel for its transmission. The audio signal from the microphone after amplification is frequency modulated, employing the assigned carrier frequency.
- In FM, the amplitude of the carrier signal is held constant, whereas its frequency is varied in accordance with amplitude variations of the modulating signal.
- It is essential that the same coordinates be scanned at any instant both at the camera tube target plate and at the raster of the picture tube, otherwise, the picture details would split and get distorted.
- To ensure perfect synchronization between the scene being televised and the picture produced on the raster, synchronizing pulses are transmitted during the retrace, *i.e.*, fly-back intervals of horizontal and vertical motions of the camera scanning beam.
- Thus, in addition to carrying picture detail, the radiated signal at the transmitter also contains synchronizing pulses.

b) Draw block diagram of PAL encoder & Describe function of each block.

Ans:-

Diagram:- **2M**



Basic organization of the PAL coder.

Explanation:- **2M**

- Above Figure is the functional diagram of a PAL coder. The gamma corrected *R*, *G* and *B* signals are matrixed to form the *Y* and the weighted colour difference signals. The bandwidths of both (*B* – *Y*) and (*R* – *Y*) video signals are restricted to about 1.3 MHz by appropriate low pass filters. In this process these signals suffer a small delay relative to the *Y* signal. In order to compensate for this delay, a delay line is inserted in the path of *Y* signal.
- The weighted colour difference video signals from the filters are fed to corresponding balanced modulators. The sinusoidal sub-carrier is fed directly to the *U* modulator but passes through a ± 90° phase switching circuit on alternate lines before entering the *V* modulator.
- Since one switching cycle takes two lines, the square wave switching signal from the multivibrator to the electronic phase switch is of half-line frequency *i.e.*, approximately 7.8 KHz. The double sideband suppressed carrier signals from the modulators are added to yield the quadrature amplitude modulated (Q.A.M.) chrominance (*C*) signal. This passes through a filter which removes harmonics of the subcarrier

frequency and restricts the upper and lower sidebands to appropriate values. The output of the filter feeds into an adder circuit where it is combined with the luminance and sync signals to form a composite colour video signal. The bandwidth and location of the composite colour signals (*U* and *V*) is shown along with the *Y* signal in Fig.

- The colour burst signal is also fed to the modulators along with the *U* and *V* signals through the adders. The burst signals are obtained from the circuits that feed the colour subcarrier signal to the two modulators. However, before feeding the burst signals to the *U* and *V* adders these are passed through separate burst gates. Each burst gate is controlled by delayed pulses at *fH* rate obtained from the frequency dividing circuit. The gating pulses appear during the back porch period. Thus, during these intervals the (*B* – *Y*) *i.e.*, *U* modulator yields a subcarrier burst along –*U* while the (*R* – *Y*) *i.e., V* modulator gives a burst of the same amplitude but having a phase of ± 90° on alternate lines relative to the – *U* phasor. At the outputs of the two modulators, the two burst components combine in the adder to yield an output which is the vector sum of the two burst inputs. This is a subcarrier sinewave (≈ 10 cycles) at + 45° on one line and – 45° on the next line with reference to – *U* phasor.
- The colourplexed composite signal thus formed is fed to the main transmitter to modulate the station channel picture carrier in the normal way. The sound signal after being frequency modulated with the channel sound carrier frequency also forms part of the RF signal that is finally radiated through the transmitter antenna system.

c) Define:-

i. Aspect ratio

ii. Persistence of Vision

iii. Image continuity

iv. Gross structure

Ans:-

Aspect Ratio:- **1M**

It is defined as the width of the screen to the height of the screen.

Aspect ratio = width / Height

Generally the ratio is consider as 4:3

Persistence of vision:- **1M**

It is the storage characteristics of the human eye. This arises from the fact that the sensation produced when nerves of the eye's retina are stimulated by incident light does not cease immediately after the light is removed but persists for about 1/16th of a second.

Image continuity:- **1M**

The sensation produced when nerves of the eye's retina are stimulated by incident light does not cease immediately after the light is removed but persists for about 1/16th of a second. Thus if the scanning rate per second is made greater than sixteen, or the number of pictures shown per second is more than sixteen, the eye is able to integrate the changing levels of brightness in the scene. So when the picture elements are scanned rapidly enough, they appear to the eye as a complete picture unit, with none of the individual elements visible separately.

Gross structure:- **1M**

It is defined as Geometric form and aspect ratio of the picture.

d) Describe with neat waveform horizontal blanking pulses

Ans:-

Diagram:- **2M**

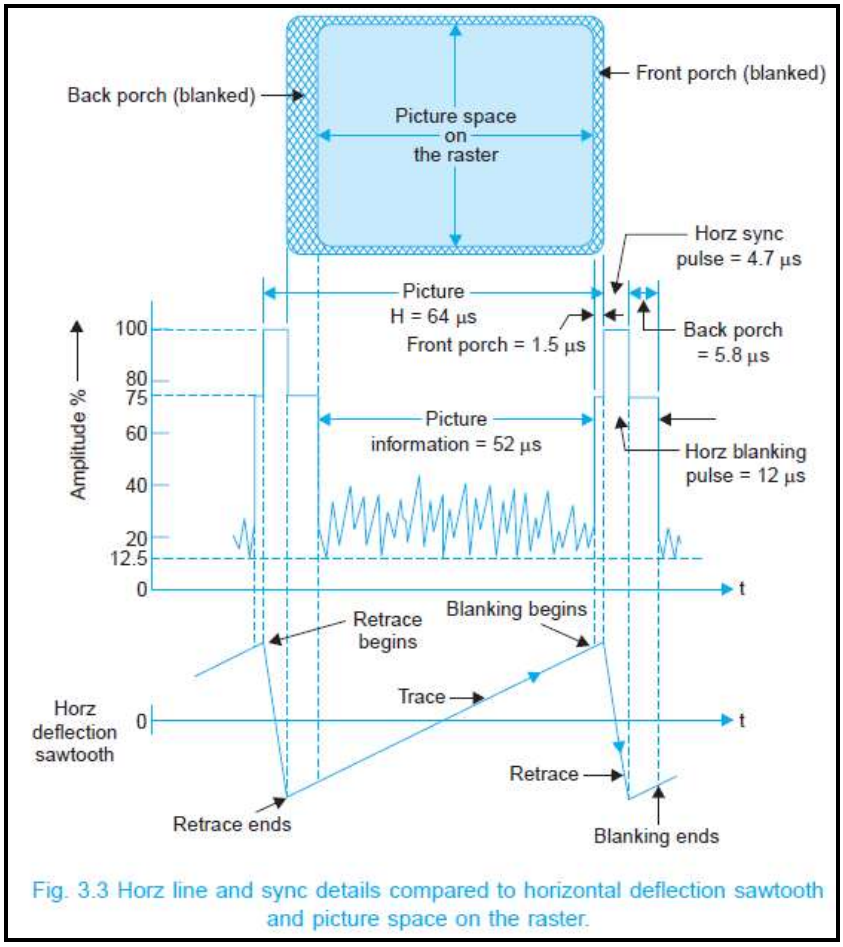


Fig. 3.3 Horz line and sync details compared to horizontal deflection sawtooth and picture space on the raster.

Explanation:- **2M**

- The horizontal blanking period and sync pulse details are illustrated in Fig. The interval between horizontal scanning lines is indicated by H.
- out of a total line period of 64 µs, the line blanking period is 12 µs. During this interval a line synchronizing pulse is inserted. The pulses corresponding to the differentiated leading edges of the sync pulses are actually used to synchronize the horizontal scanning oscillator.
- The line blanking period is divided into three sections. These are the 'front porch' (1.5 µs), the 'line sync' pulse (4.7 µs) and the 'back porch' (5.8 µs).

Front porch:

- This is a **brief cushioning period of 1.5 µs** inserted between the end of the picture detail for that line and the leading edge of the line sync pulse.
- This interval allows the receiver video circuit to **settle down from whatever picture voltage level exists at the end of the picture line to the blanking level before the sync pulse occurs.**

Line sync pulse:

- After the front porch of blanking, horizontal retrace is produced when the sync pulse starts. The flyback is definitely blanked out because the sync level is blacker than black.
- Line sync pulses are separated at the receiver and utilized to keep the receiver line time base in precise synchronism with the distant transmitter. The nominal time duration for the **line sync pulses is 4.7 µs.**
- During this period the beam on the **raster almost completes its back stroke** (retrace) and **arrives at the extreme left end of the raster.**

Back porch:

- This **period of 5.8 µs** at the blanking level allows plenty of time for line flyback to be completed. It also permits time for **the horizontal time-base circuit to reverse direction of current for the initiation of the scanning of next line.**
- The back porch also provides the necessary amplitude equal to the blanking level (reference level) and enables to **preserve the dc content of the picture information** at the transmitter.
- At the receiver this level which is independent of the picture details is utilized in the AGC (automatic gain control) circuits to develop true AGC voltage proportional to the signal strength picked up at the antenna.
- **It also contains colour burst signal for colour picture reproduction.**

e) List advantages of PAL TV system.

Ans:-

Advantage:- (any four) **1M each**

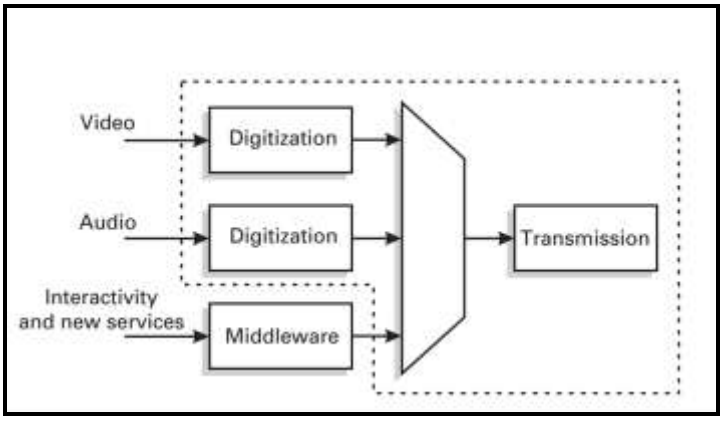
Note:- Any other relevant points can be considered

- The PAL TV systems have greater resolution than NTSC and are more accepted because of its higher quality
- PAL TV systems, hue errors are automatically removed with the utilization of phase alternation of color signals it receives.
- No need of tint control
- With the help of a 1H delay line that produces lower saturation, the chrominance phase errors that may occur in the PAL system are cancelled out.
- The greatest advantage of the PAL TV system over the NTSC system is that it avoids the NTSC system's sensitivity to phase changes through minor modifications where high color fidelity is achieved.
- With the help of a delay line and two adders, the PAL decoder adds color signals of successive lines while canceling out phase errors.
- Excellent colour stability

f) Illustrate the basic fundamental of Digital TV transmission system.

Ans:-

Diagram:- **02M**



Explanation:- **2M**

- A digital television system is made up of a set of standards, as presented in Figure ,which identifies the basic components: video and audio represent the services that are essential to the broadcasting of digital television; interactivity and the new services (e-commerce, Internet access) are added to the system by the middleware.
- These new services, introduced by digital television, originated from data transmission with video and audio.
- They may be used to offer new concepts in the broadcasting of TV programs to the users, or even to send data for applications that do not have a direct connection with television programming.
- With digital television, the viewers will be renamed users, as they participate in interaction with the TV stations and the companies that supply services.

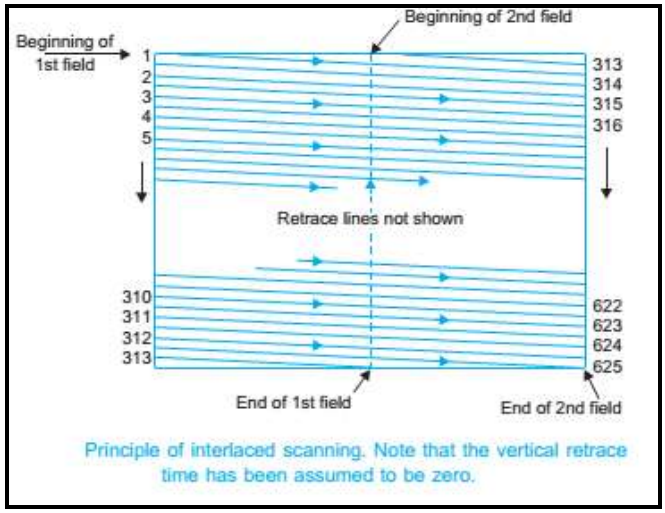
Q3 Attempt any four:- **16M**

a) What are the disadvantage of progressive scanning? Describe Interlace scanning.

Ans:- Disadvantage of Progressive scanning: **2M**

25 frames per second in television pictures is enough to cause an illusion of continuity, they are not rapid enough to allow the brightness of one picture or frame to blend smoothly into the next through the time when the screen is blanked between successive frames. This results in a definite flicker of light that is very annoying to the observer when the screen is made alternately bright and dark

Interlaced Scanning: **2M**



Principle of interlaced scanning. Note that the vertical retrace time has been assumed to be zero.

- In T.V. pictures an effective rate of 50 vertical scans per second is utilized to reduce flicker.
- Total numbers of lines are divided in to two groups called fields (even and odd).
- In T.V. pictures an effective rate of 50 vertical scans per second is utilized to reduce flicker.
- Total numbers of lines are divided in to two groups called fields (even and odd).

b) Describe additive colour mixing with sketch.

Ans:-

Additive mixing: **2M**

In this type of mixing light from two or more colours obtained either from independent sources or through filters can create a combines sensation of a different colour.

Secondary colours result when two primary colours of equal magnitude are additively mixed. By pair wise additive mixing of colours the following complementary colours are produced.

Red (30%) + Green (59%) =Yellow (89%)

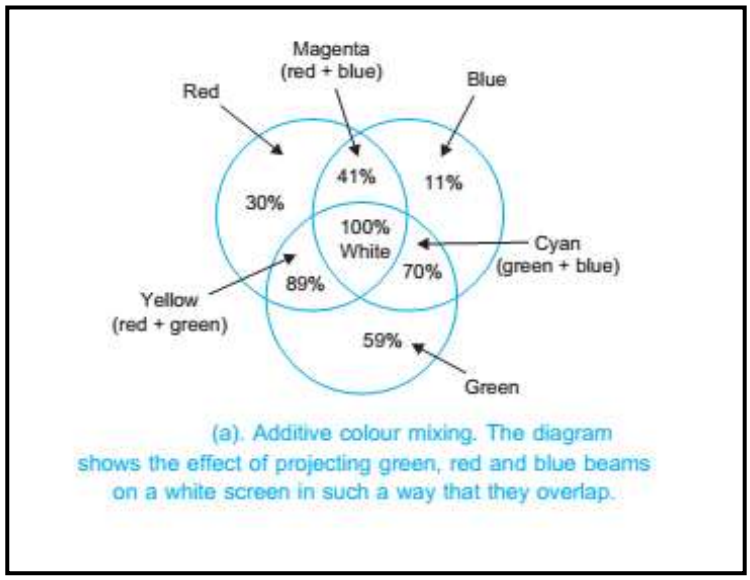
Red (30%) + Blue (11%) = Magenta (41%) (purplish blue)

Blue (11%) + Green (59%) = Cyan (70%) (greenish blue)

Red (30%) + Green (59%) + Blue (11%) = White (100%) (luminance)

Additive mixing occurs when we see the light emitted by the sources.

Diagram:- **2M**



(a). Additive colour mixing. The diagram shows the effect of projecting green, red and blue beams on a white screen in such a way that they overlap.

c) Why FM is used for sound transmission and AM for video.

Ans:-

Preference of FM for Sound Transmission: **2M**

Frequency modulation, provides almost noise free and high fidelity output needs a wider swing in frequency on either side of the carrier. This can be easily allowed in a TV channel, where, because of

1. Very high video frequencies a channel bandwidth of 7 MHz is allotted. In FM, where highest audio frequency allowed is 15 kHz, the sideband frequencies do not extend too far and can be easily accommodated around the sound carrier that lies 5.5 MHz away from the picture carrier.
2. The bandwidth assigned to the FM sound signal is about 200 kHz of which not more than 100 kHz is occupied by sidebands of significant amplitude.

Preference of AM for Picture Signal Transmission:- **2M**

1. At the VHF and UHF carrier frequencies there is a displacement in time between the direct and reflected signals.

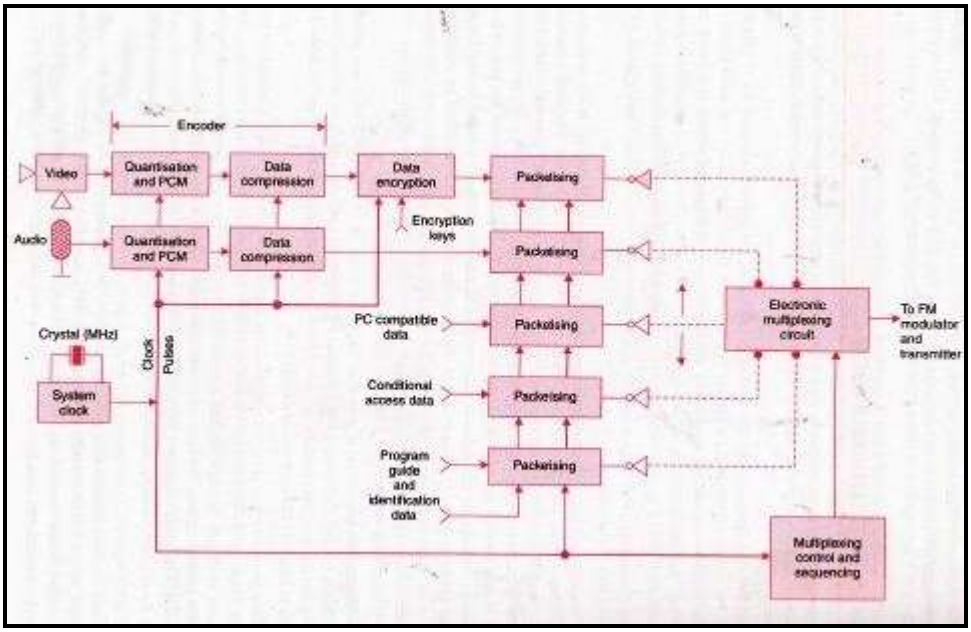
2. The distortion which arises due to interference between multiple signals is more objectionable in FM than AM because the frequency of the FM signal continuously changes. If FM were used for picture transmission, the changing best frequency between the multiple paths, delayed with respect to each other, would produce a bar interference pattern in the image with a shimmering effect, since the bars continuously change as the beat frequency changes. Hence, hardly any steady picture is produced. Alternatively if AM were used, the multiple signal paths can at most produce a ghost image which is steady.

3. Circuit complexity and bandwidth requirements are much less in AM than FM. Hence AM is preferred to FM for broadcasting the picture signal.

d) Draw block diagram of digital TV transmission& describe function of each block.

Ans:-

Diagram :- **2M**



Explanation:- **2M**

Digital TV Transmission; The four stages of digital TV transmission are (1) Signal encoding (2) Processing. (3) Modulation and (4) Transmission.

Signal Processing: The three stages of signal processing are-(i) Data Compression, (ii) encryption and (iii) Packetising.

(i**) Data Compression;** The data compression technique is used to reduce the average data rate to about 3 to 6 Mbps. The compression or reduction in data transfer rate becomes possible because while scanning any scene, the motion and background stays the same for many frames at a time and its repetitive transmission can be avoided by curtailing the available data i.e., compressing it.

ii) Data Encryption: To prevent unauthorized reception of channels for which a special fee is to be paid, their video signals are encrypted before up-linking by inserting, special data called keys, into the pulse train to disturb its sequence and content with the aim to prevent normal reproduction of pictures on the receiver screen.

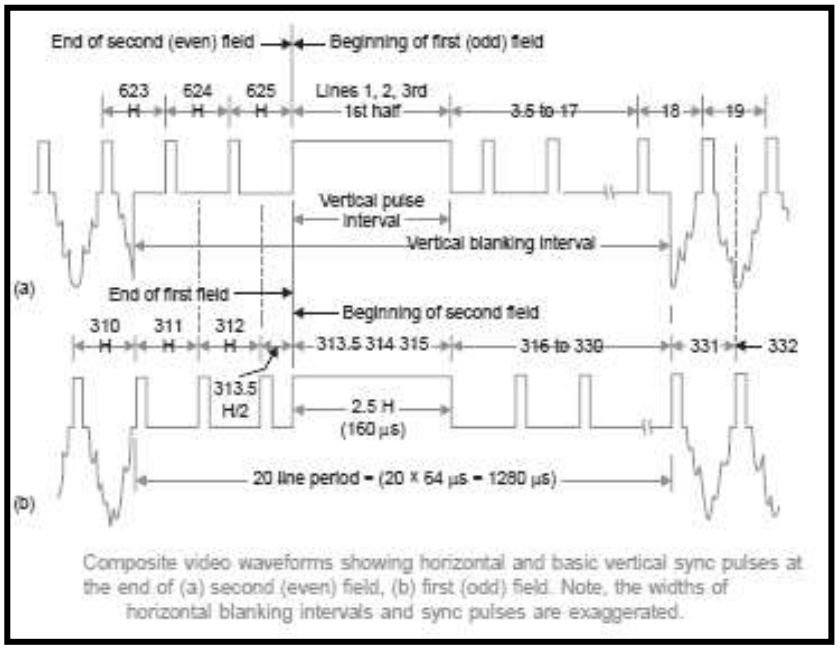
(iii) Data Packets: Besides video and audio signals, conditional information is also transmitted to the customer which includes conditional access data, PC compatible data and program guide. Each set of information is combined in the form of a packet, which contains signals to register identity of each packet thus enabling their easy separation at the receiving end. As necessary, before transmission' all the data packets are time-multiplexed into serial data before further processing at the transmitting site.

(iv) Clock system: All the data processing blocks are fed with clock pulses for initiation, sequencing and time duration control. For this accurate clock pulses are generated by an electronic digital clock driven by a crystal controlled oscillator. Some output clock pulses are delayed by storing them in registers to be retrieved at the time a Sequence is to be encoded in the data packet.

e) What is requirement of V sync pulses in TV system.

Ans:- **Explanation 03M, Diagram 01M**

- The basic vertical sync added at the end of both even and odd fields is shown in Fig. Its width has to be kept much larger than the horizontal sync pulse, in order to derive a suitable field sync pulse at the receiver to trigger the field sweep oscillator.
- The standards specify that the vertical sync period should be 2.5 to 3 times the horizontal line period. If the width is less than this, it becomes difficult to distinguish between horizontal and vertical pulses at the receiver.



Composite video waveforms showing horizontal and basic vertical sync pulses at the end of (a) second (even) field, (b) first (odd) field. Note, the widths of horizontal blanking intervals and sync pulses are exaggerated.

- In the 625 line system 2.5 line period ($2.5 \times 64 = 160$ µs) has been allotted for the vertical sync pulses.

(f) **List advantage & disadvantage of digital TV system.**

Ans:-

Advantages:- (any two) :- **2M**

1. The digital broadcast offers better quality of picture and sound.
2. Digital transmission will be able to broadcast in high-definition. This means that you will be able to watch some of your favorite TV channels in HD for free.
3. Digital TV transmission improves sound, which will help you to make watching television way better.
4. The digital broadcast consumes less bandwidth than the analog one. This will free space for more wireless networks, which on the other hand will improve the communication services.
5. With the digital television, you will have access to more channels. You had probably noticed that with analog TV you have access to just a couple of TV channels, but with the new digital technology the TV stations will have the ability to broadcast more channels simultaneously.

Disadvantages (any two) **2M**

5. The biggest disadvantage of the digital TV is the fact that you will need special equipment called digital converter box. The
6. In digital broadcast there is the loss of signals because of bad weather .
7. It can be quite difficult to adjust the antenna (without special equipment e.g. signal level meter).
8. Switching channels is slower because of the time delays in decoding digital signals.

Q4 Attempt any four:- **16M**

a) Describe TV channel allocation for Band I and Band III

Ans:- TV channel allocation for band I & band III:- **Band I 01M, Band III 03M**

Band	***Channel No.***	***Frequency range***	***Picture carrier Frequency (MHz)***	***Sound carrier Frequency (MHz)***
BAND I (41-68 MHz)	1	41–47 (not used)		
	2	47–54	48.25	53.75
	3	54–61	55.25	60.75
	4	61–68	62.25	67.75

BAND III (174-230 MHz)	5	174–181	175.25	180.75
	6	181–188	182.25	187.75
	7	188–195	189.25	194.75
	8	195–202	196.25	201.75
	9	202–209	203.25	208.75
	10	209–216	210.25	215.75
	11	216–223	217.25	222.75
	12	223–230	224.25	229.75

b) Draw the Schematic of silicon Diode array camera tube, describe its operation.

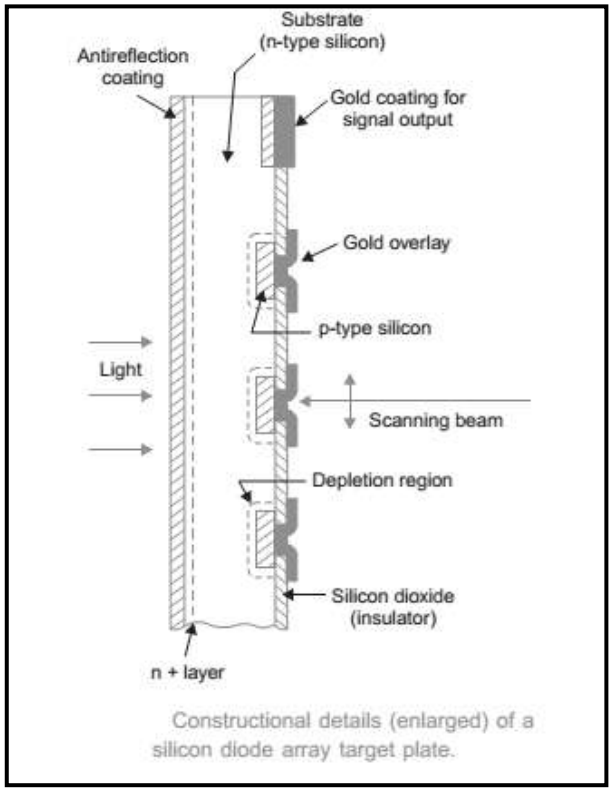
Ans:-

Scanning and Operation:- **2M**

The photodiodes are reverse biased by applying +10 V or so to the *n* + layer on the substrate. This side is illuminated by the light focused on to it from the image. The incidence of light generates electron-hole pairs in the substrate. Under influence of the applied electric field, holes are swept over to the '*p*' side of the depletion region thus reducing reverse bias on the diodes. This process continues to produce storage action till the scanning beam of electron gun scans the photodiode side of the substrate. The scanning beam deposits electrons on the *p*-side thus returning the diodes to their original reverse bias. The consequent sudden increase in current across each diode caused by the scanning beam represents the video signal. The current flows through a load resistance in the battery circuit and develop a video signal proportional to the intensity of light falling on the array of photodiodes. A typical value of peak signal current is 7 μA for bright white light.

The vidicon employing such a multi diode silicon target is less susceptible to damage or burns due to excessive high lights. It also has low lag time and high sensitivity to visible light which can be extended to the infrared region.

Diagram :- **2M**



Constructional details (enlarged) of a silicon diode array target plate.

c) Write the function of blanking pulses and DC level, pedestal height.

Ans:-

D.C. component of the video signal: **1M**

- In addition to continuous amplitude variations for individual picture elements, the video signal has an average value or dc component corresponding to the average brightness of the scene. In the absence of dc component the receiver cannot follow changes in brightness.

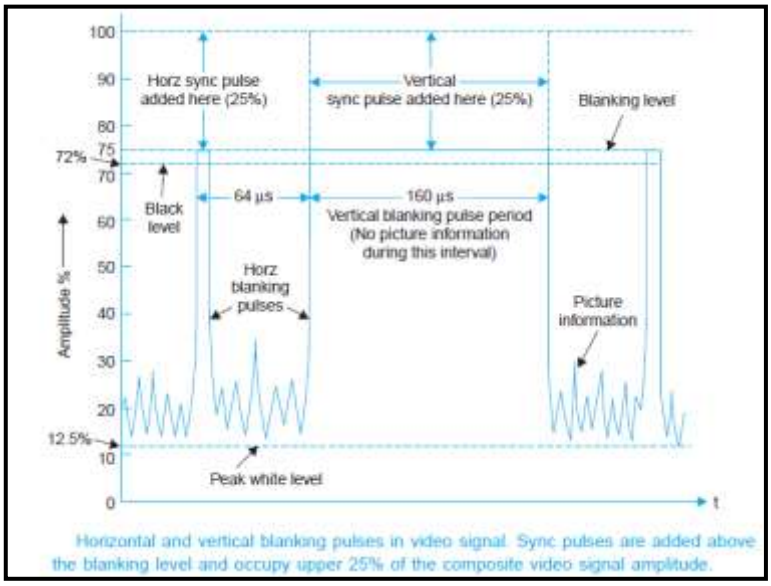
Pedestal height: **1M**

- Pedestal height is the distance between the pedestal level and average value (dc level) of the video signal. This **indicates average brightness** since it measures how much the average value differs from black level.
- The output signal from TV camera is of very small amplitude. Hence, it is amplified by multistage high gain amplifiers. Sync and blanking pulses are added to it and then signal is clipped at proper value to form pedestal.
- Pedestal height determines brightness of scene. Large pedestal height makes picture brighter and vice versa. Operator who observes the picture in studio adjusts level for desired brightness by adding dc component to ac signal.

Blanking pulses: **1M**

- The composite video signal contains blanking pulses to make retrace line invisible.

- This is done by increasing the signal amplitude slightly more than the black level during retrace period
- Composite video signal contains horizontal and vertical blanking pulses.
- Repetition of rate of horizontal blanking pulses per frame is 15625 Hz (line frequency)
- Vertical blanking pulse frequency is 50Hz (field frequency)
- Sync pulses are having amplitude in upper 25 percent of video signal.

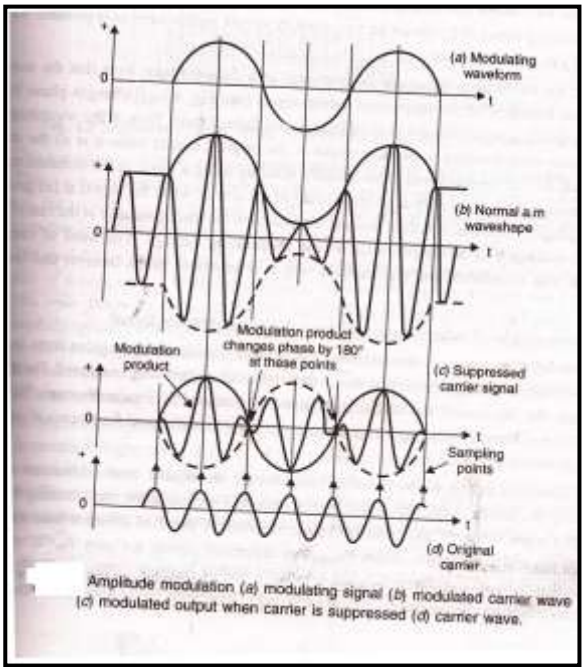


Horizontal and vertical blanking pulses in video signal. Sync pulses are added above the blanking level and occupy upper 25% of the composite video signal amplitude.

Diagram:- **1M**

d) Describe suppressed colour sub - carrier transmission.

Ans:- **4M**



Amplitude modulation (a) modulating signal (b) modulated carrier wave (c) modulated output when carrier is suppressed (d) carrier wave.

In TV picture signal is amplitude modulated; the colour sub carrier is suppressed while transmitting colour difference to the higher video frequency range.
The reason for suppressing the carrier is the large amplitude of carrier as compared to side band frequency component. If carrier is remain as part of modulated signal it can cause serious interference and dot patterning in colour reception. Thus the colour carrier is suppressed before transmission and again regenerated at the receiver for demodulating for colour signal. The suppressed signal is shown in figure above figure.

In colour TV the colour difference signals are modulated by push pull modulator which generates double side band suppressed carrier amplitude modulated signal. As shown in the block diagram below.

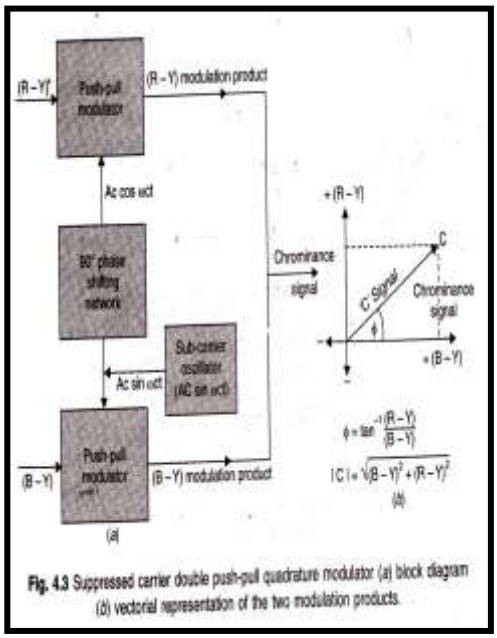


Fig. 4.3 Suppressed carrier double push-pull quadrature modulator (a) block diagram (b) vectorial representation of the two modulation products.

The push pull modulator not only suppressed the carrier but also eliminates the higher harmonics and enables easy addition of the quadrature outputs to form chrominance signal.

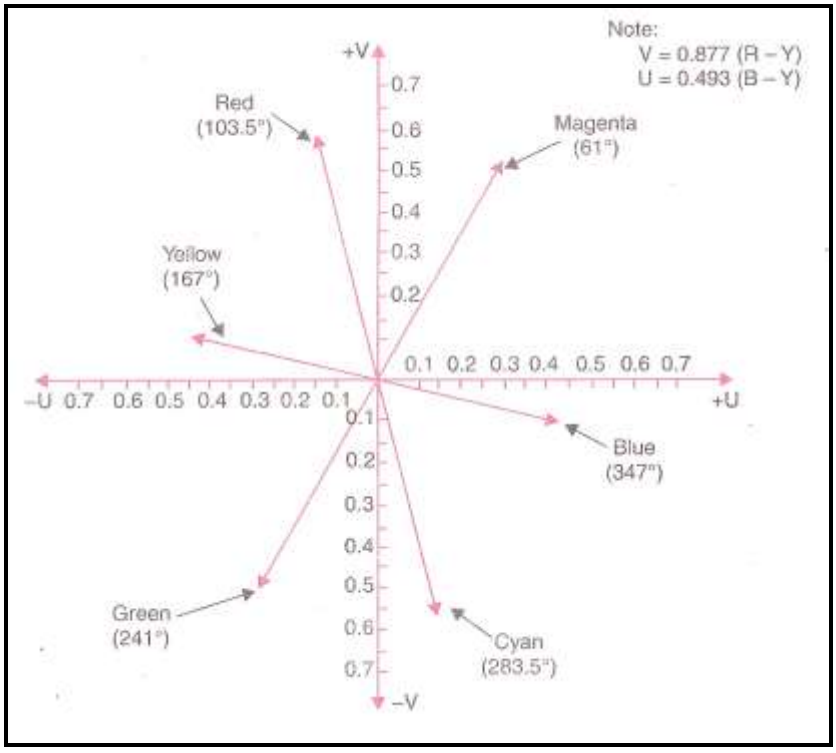
The carrier is suppressed to avoid interference with luminance signal.

e) Describe phasor diagram of PAL colour signal.

Ans:- **1 M for 'C' Value , 03M, diagram 03M**

(Note:- phasor diagram has to be drawn not described… calculations of values to be done.)

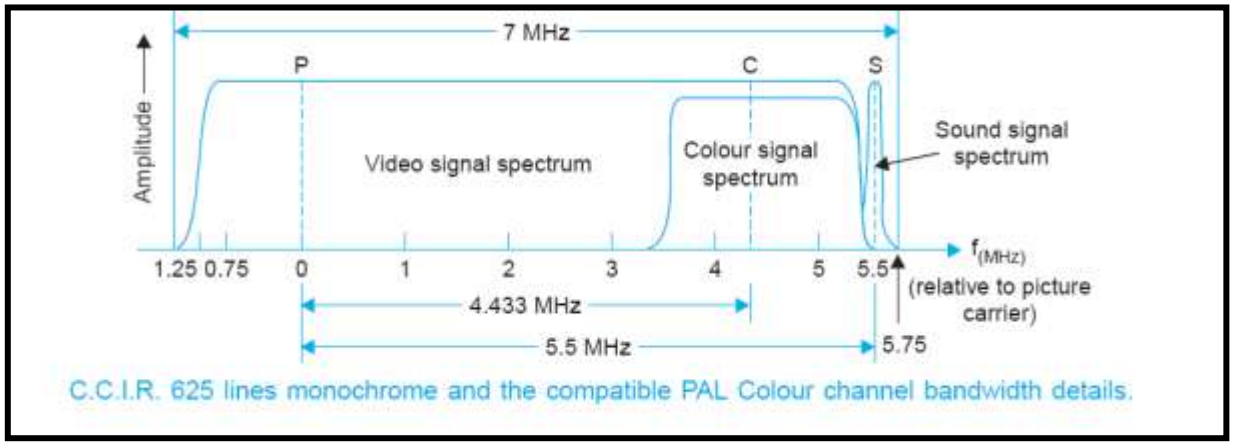
COLOUR	Y	U	V	'C'	ϕ
White	1	0	0	0	0°
Yellow	0.89	– 0.4385	+ 0.0965	0.44	167°
Cyan	0.70	+ 0.148	– 0.614	0.63	283°
Green	0.59	–0.29	– 0.5174	0.59	241°
Magenta	0.41	+ 0.29	+ 0.5174	0.59	61°
Red	0.31	– 0.148	+ 0.614	0.63	103°
Blue	0.11	+ 0.4385	– 0.0965	0.44	347°
Black	0	0	0	0	0°



f) Differentiate between bandwidth of colour signal over luminance signal.

Ans:

Diagram:- **1M**



C.C.I.R. 625 lines monochrome and the compatible PAL Colour channel bandwidth details.

Explanation:- **3M**

In the PAL colour system which is compatible with the C.C.I.R. 625 line monochrome system, the colour subcarrier frequency is located 4.433MHz away from the picture carrier. The bandwidth of colour signals is restricted to about ± 1.2MHz around the subcarrier. Fig gives necessary details of the location of monochrome (picture), colour & sound signal spectrums, all within the same channel bandwidth of 7MHz .

The luminance signal is transmitted with full frequency bandwidth of 5 MHz for maximum horizontal details in monochrome .Where as such large bandwidth is not necessary for colour signals; as for very small details human eye perceive only brightness but not the colour.

For small colour areas video frequencies does not exceed 0.5 MHz, for medium size areas frequency spectrum between 0.5 MHz to 1.5 MHz and only two primary colours are needed.

Therefore, for finer colour details human eye cannot distinguish between green and yellow colours. Thus maximum bandwidth necessary for colour signal transmission is around 3 MHz. (+/- 1.5 MHz).

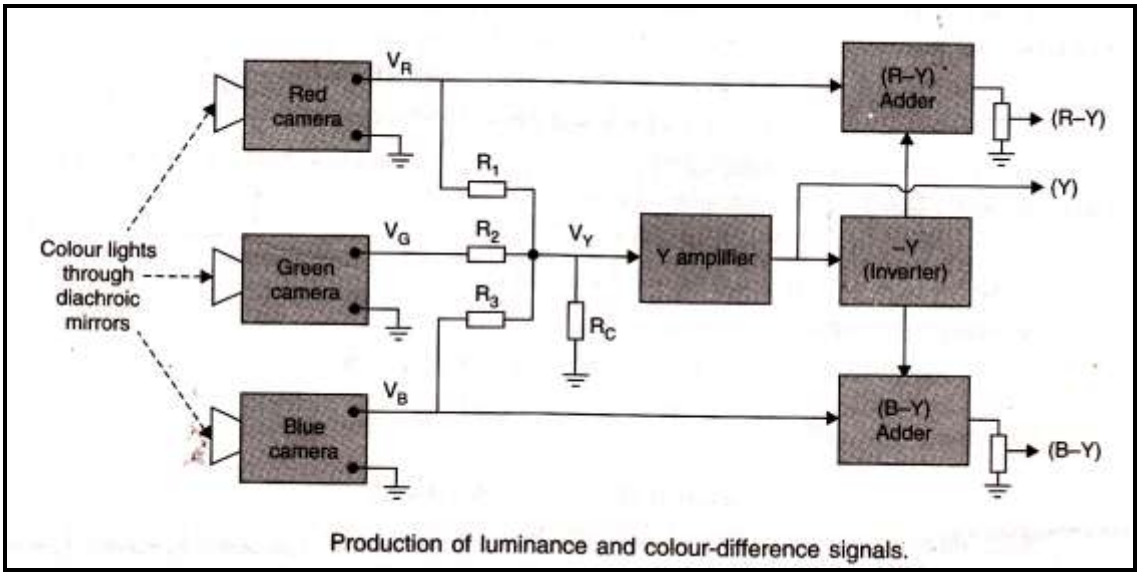
Q5 Attempt any four:- **16M**

a) Draw neat diagram & write the process of separation of U & V signals.

Ans:-

(Note:- The question should be " generation of U & V signal" and not " separation of U & V signal" as mentioned in the question paper.)

Diagram:- **2M**



Production of luminance and colour-difference signals.

Working :- **2M**

Y = 0.3R + 0.59B +6 0.11B

(R-Y) = 0.7R – 0.59G – 0.11B

(B-Y) = -0.3R – 0.59G + 0.89B

To generate U & V signals, luminance signal Y, colour signals R,G &B are combined together.Colour difference signals are generated by subtracting luminance voltage from colour voltage. Only (R - Y) & (B - Y) signals are produced.

(Note: however, if students draw diagram for separation of U & V signal and write its working, full marks should be given)

The Chroma signal at the input of chroma band pass amplifier is passed through a PAL delay line, adder & subtractor unit. The object of delay line is to delay the chrominance signal by almost one line period

(≈64μs). The adder & subtractor circuit receives two signals simultaneously namely U + jv & U – jv. Therefore the picture information of two consecutive lines are transmitted to adder & subtractor simultaneously.

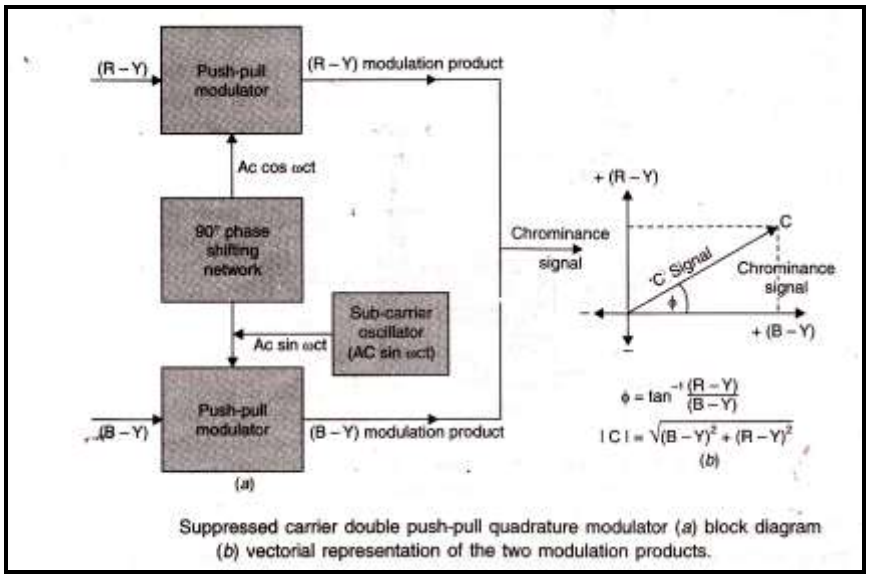
Output of adder = 2U

Output of subtractor = 2V with polarity alteration from line to line in synchronism with transmitted signal.

b) Draw block diagram & give working of QAM for PAL system.

Ans:-

Diagram :- **2M**



Suppressed carrier double push-pull quadrature modulator (*a*) block diagram (*b*) vectorial representation of the two modulation products.

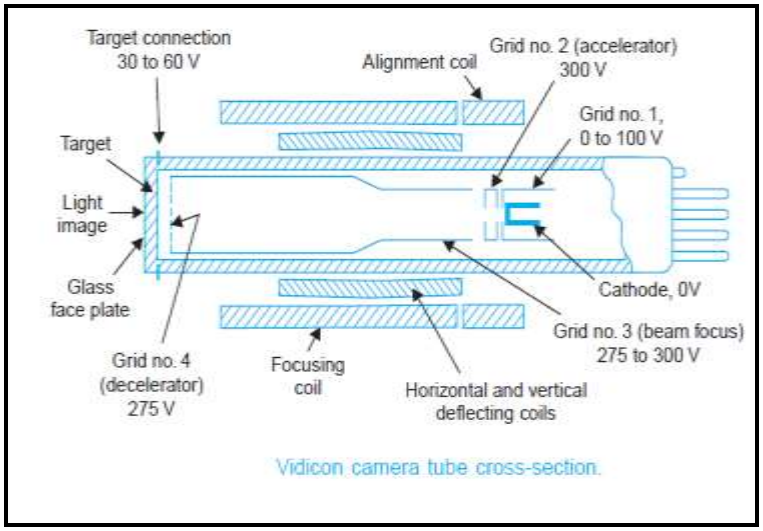
Working :- **2M**

The problem of transmitting (B-Y) & (R-Y) video signals simultaneously with one carrier frequency can be solved by creating two carrier frequencies from same colour sub carrier. Here two modulators are used one for (B-Y) & other for (R-Y) modulator. Carrier frequency is generated by crystal oscillator & fed to (B-Y) modulator. Before feeding it to (R-Y) modulator, it is given a relative phase shift of 90^0. Now two modulated sub carrier are added vertically to produce resultant 'C'.]C] signal represents sum of two AM signals, Mutually at right angle with each other, this technique is called as Quadrature amplitude modulation.

c) Describe the working of Vidicon camera with neat diagram.

Ans:-

Diagram:- **2M**



Vidicon camera tube cross-section.

Working:- **2M**

Light from the scene is focused by an optical lens on to vidicon target. Light passes through the glass face place & internal conductive surface to photoconductive image plate that is scanned by electron beam. The resulting camera signal is taken from the target ring image end of photo conductive target is connected to DC supply (40V).

In absence of light, the photo conductive layers behaves as an insulator. When light falls on it, e;lectrons from conduction level of atoms becomes free. Therefore change image is formed.

When low energy electron beam sweeps past each picture element of target plate, it deposits just enough electrons on target plate to discharge each point to zero potential. Therefore discharge current flows through R_L. This is camera output signal.

d) List CCIR – B standards for PAL colour TV.

Ans:- (Any 8 point) **(½ M each point)**

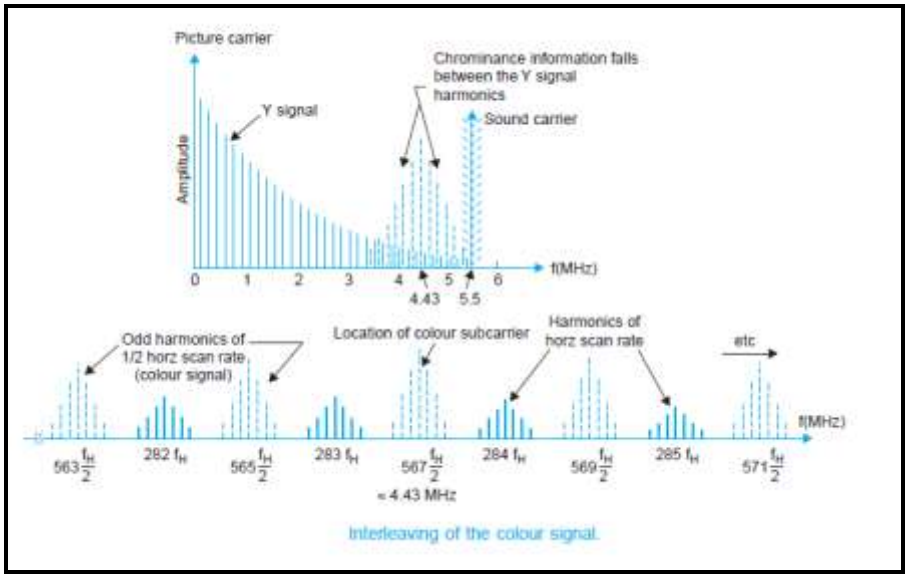
Number of scanning lines/frame	**625**
Field (vertical) frequency	**50Hz**
Line(horizontal) frequency	**15625Hz**
Aspect ratio(width/height)	**4:3**
Horizontal trace time	**52µs**
Horizontal retrace time	**12µs**
Total scanning line lost in vertical retrace	**64µs**
Front porch	**1.5µs**
Back porch	**5.8µs**
Horizontal sync pulse	**4.7µs**

Colour sub carrier frequency	**4.43MHz**
Colour system	**Phase Alteration by Line –Delay (PAL-D)**
U signal(weighted B-Y)	**U=0.493 (B-Y)**
V signal(weighted R-Y)	**V=0.877(R-Y)**
Total vertical blanking duration	**1280µs or 1.280ms**
Vertical sync pulse	**160µs**
Pre and post equalizing pulse	**5 pulse each**
Sync pulse top	**100%**
Blanking/pedestal level	**75%**
Black level	**72-75%**
White level	**10-12.5%**
Width of video signal	**5MHz**
Chroma signal bandwidth	**-1.3MHz to +1.57MHz**
Video IF	**38.9MHz**
Audio IF	**33.4MHz**
Inter carrier frequency	**5.5MHz**
Audio modulation	**Frequency Modulation(FM)**
Video modulation	**Amplitude Modulation (AM)**
Total channel width in VHF	**7MHz**
Total channel width in UHF	**8MHz**

e) Describe the utilization of interleaved space for colour signal transmission.

Ans:-

Diagram:- **2M**



Interleaving of the colour signal.

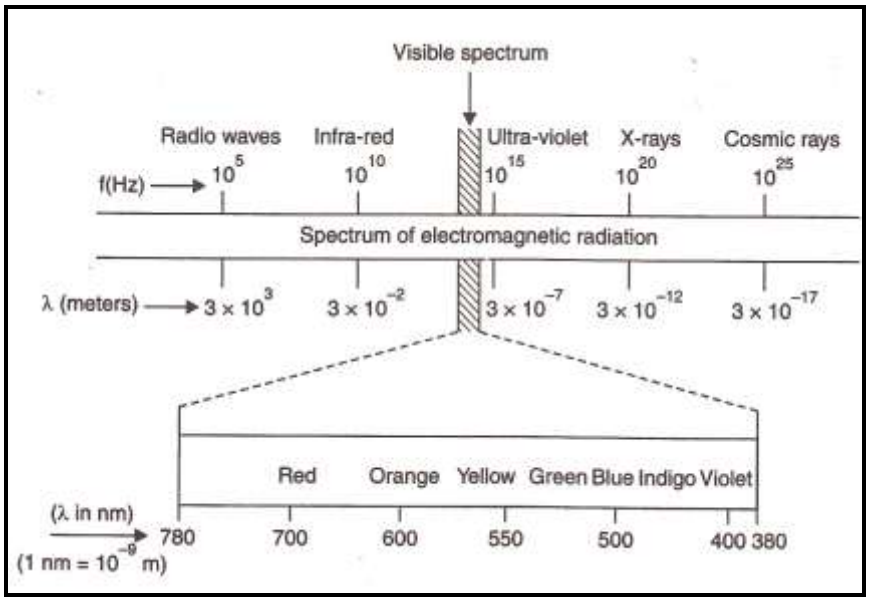
Working:- **2M**

When picture carrier is modulated by luminance signal at line frequency 15625Hz, the video signal is not continuous one. It consists of dusters of energy located around harmonics at frame frequency (25Hz,50Hz). Thus individual clusters are separated by wide gap, which can be used to accommodate colour information. This process of accommodating information of one signal in gap occurring in other signal is called frequency interleaving.

f) Draw visible light spectrum with wavelength and frequency.

Ans:-

Diagram :- **4M**



Q6 Attempt any four:- **16M**

a) Define:-

i) Luminance

ii) HUE

iii) Saturation

iv) Contrast

Ans:-

Luminance:- **1M**

It is defined as amount of light intensity perceived by human eye regardless of the colour

HUE:- **1M**

It is the predominant spectral colour in the received light.

Saturation:- **1M**

It represents purity of colour. It may be taken as an indication of how little the colour is diluted by while.

Contrast:- **1M**

This is the difference in intensity between black & white parts of the picture over & above the brightness level.

b) Describe vertical resolution & horizontal resolution.

Ans:-

Vertical resolution:- **2M**

The ability of scanning system to resolve the vertical details in a scene is called vertical resolution. It can be expressed as

$$Vr = Na * K$$

Where Vr = vertical resolution, Na = active no. of lines and K = Kell factor

Horizontal resolution:- **2M**.

The ability of scanning system to resolve horizontal details i.e changes in brightness levels of elements along a horizontal scanning line is called horizontal resolution.

Horizontal resolution = Na * aspect ratio.

c) Colour signal is suppressed before transmission of TV signal, Give reason.

Ans:-

In TV transmitter, the colour difference signals (R-Y) & (B-Y) are weighted down & them modulated by colour subcarrier frequency 4.45MHz to obtain chrominance signal.(by using QAM)

This signal is transmitted with a suppressed subcarrier because amplitudes of the two carrier components are large compared to the sidebands products and if it is not suppressed, it will cause interference with Y signal when combined with it.

Due to suppressed colour carrier, we do not get any interference in the monochrome receiver when they are receiving colour information and also in the colour receiver when they receive monochrome information.

d) State the features and Characteristics of HD signal transmission.

Ans:-

Feature & Characteristics of HD signal Transmission:- (8 parameters) (½ * 8 = 4M)

i) T.V scanning Line :1250

ii) Aspect ratio : 16:9

iii) Interlace ratio: 1: 1 progressive

iv) Active lines: 1152

v) Field frequency: 40Hz

vi) Line frequency: 62.5KHz

vii) Luminance signal Y = 20MHz

viii) Sample per active line: 1920

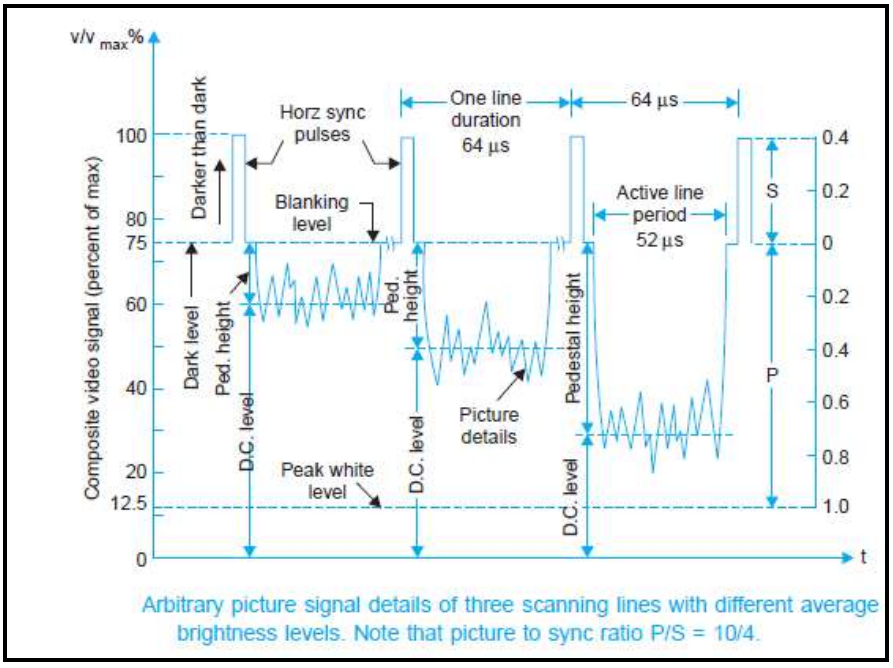
ix) Wide band colour signal: 7Mhz

x) Narrow band colour signal: 5.5MHz

e) Draw colour composite video signal & label it.

Ans:-

Diagram:- **4M**



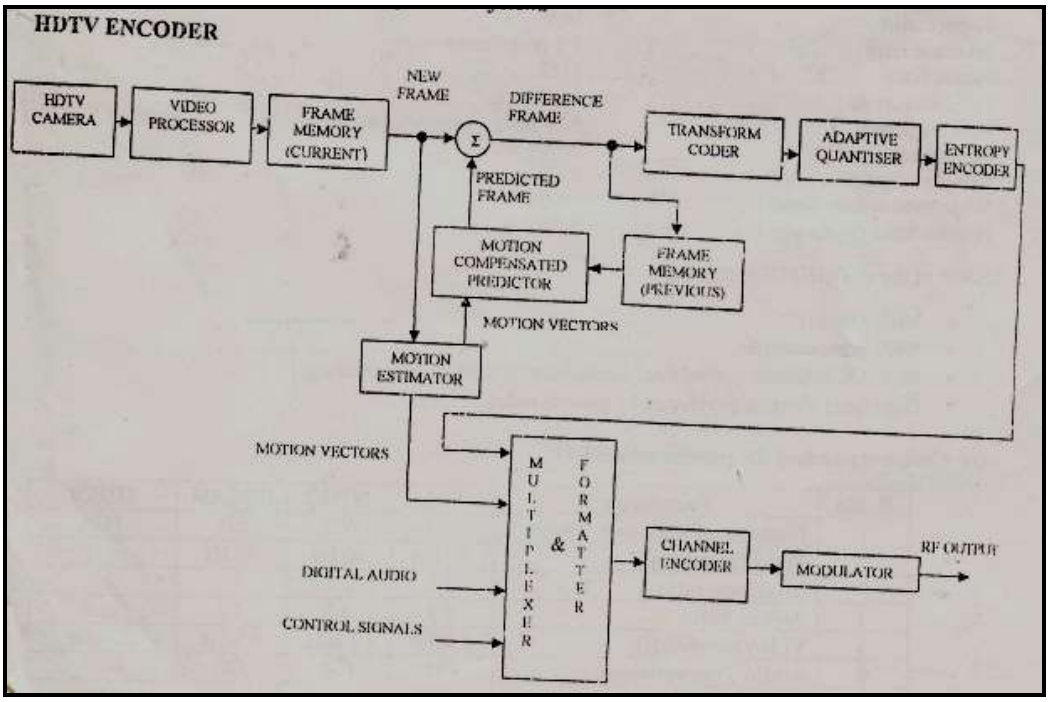
Arbitrary picture signal details of three scanning lines with different average brightness levels. Note that picture to sync ratio P/S = 10/4.

f) Draw block diagram of HDTV & describe function of each block.

Ans:-

Diagram:- **2M**

(Note:- Any of the below diagram can be considered)



Basic Operation

- A frame of the input video signal (output stored of the HDTV camera) after being suitably processed is in the frame memory (current) and referred to as new frame.
- A predicted frame is generated by past frames accumulated in the frame memory (previous).
- A difference frame is obtained by subtracting the predicted frame from the new frame. since the predicted frame closely represents the new frame, there is little information left to be transmitted in the difference frame. this is the first step in video compression.
- Further compression, of the video signal is achieved by using:

  i) a transform coder

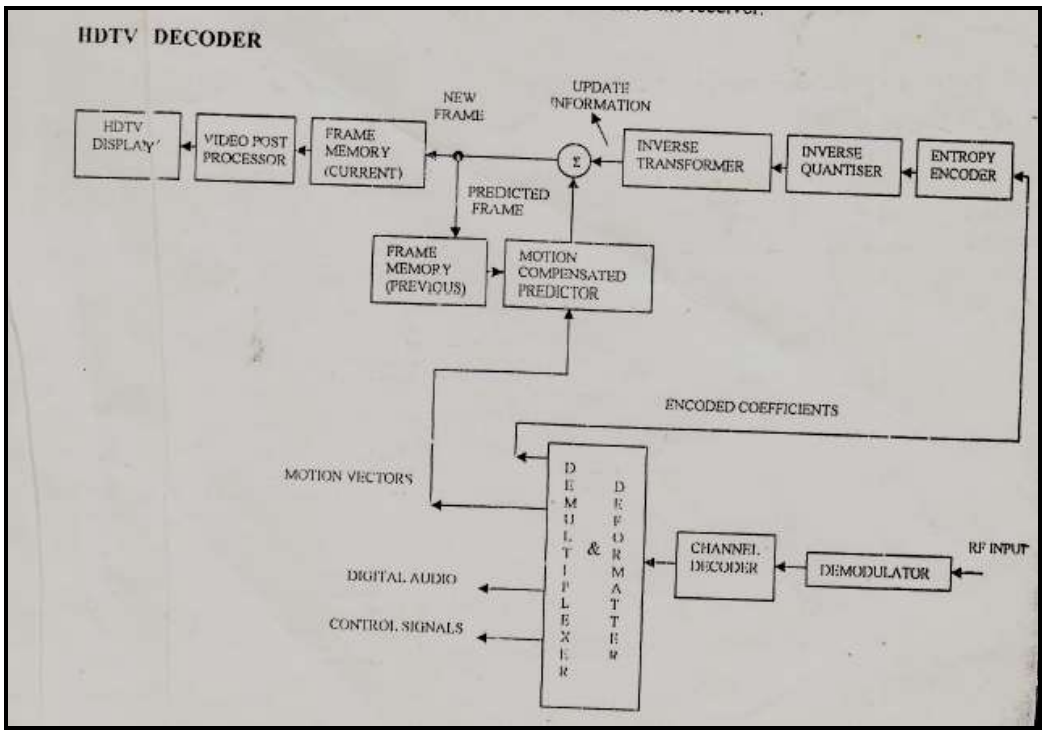
  ii) Entropy encoding which takes advantage of redundancy in the signal obtained at the output of the transform coder.

- The coded signals along with the digital audio & control signals are multiplexed.
- To take care of error during transmission the output of the multiplexer is passed through the channel encoder.
- This is the final signal which feeds the modulator.

Note:- Video information typically remains un changes from frame to frame, except for some displacement owing

To their motion. Motion related coding operations are employed to improve the performance of compression. To reduce the receiver complexity, motion vectors are evaluated at the transmitter site to frame original video signals and are sent as a side information to the receiver.

OR

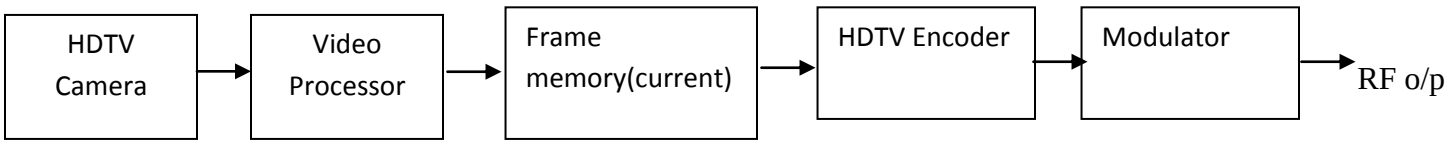


Basic Operation:-

- RF signal is demodulated in the demodulator
- Channel decoder corrects any errors that occurred during transmission.
- The demultiplexer separates out encoded signals, motion vectors, digital audio & control signals
- The encoded signals are processed in an inverse manner recovering the decompressed signals. This is the update information.

- The update information is added to the predicted frame to reconstruct the new frame.
- The new frame signals are fed to the HDTV display after suitably processed in the video processor. Here the high quality images are finally displayed.

OR



OR