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.

Q1) a) Attempt any SIX of the following: (12 M)

i) Define aspect ratio.

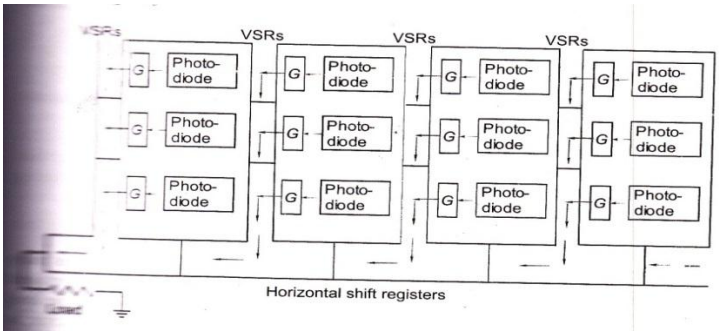
Ans: Width to height ration of picture fame is called aspect ratio.
Width is longer than height. For conventional TV is 4:3

ii) What is colour burst signal? Why is it present in the back porch?

Ans: Colour burst signal is 8to 11 cycle of colour subcarrier frequency placed at back porch of horizontal blanking period as identic signal.
It is placed at back porch to provide indicators to receiver that next coming line is having colour information.

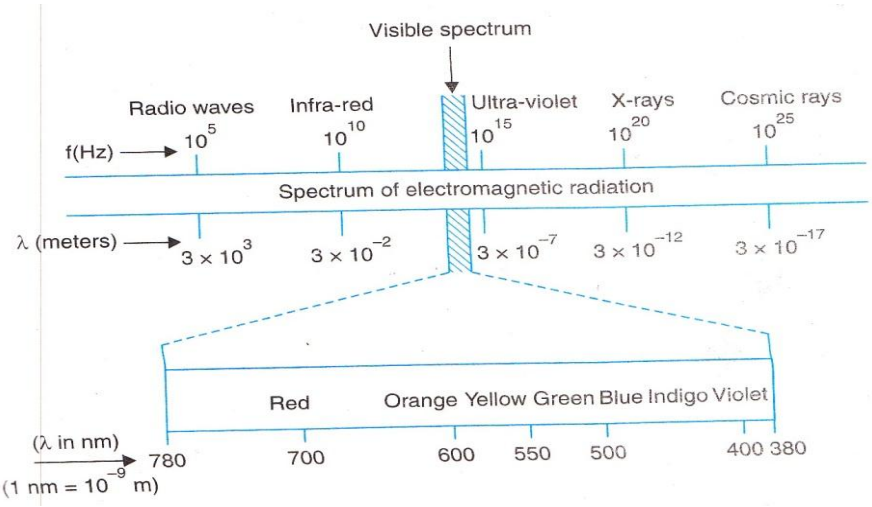
iii) Draw the diagram of CCD camera?

Ans:



iv) Draw visible light spectrum.

Ans:



v) State one application of additive & subtractive mixing.

Ans:

Application of Additive mixing:

1. TV transmission & reception
2. Stage show light effect

Application Subtractive mixing:

1. Painting
2. Drawing coloring.

vi) How much is the bandwidth required for transmission of colour signal? Why?

Ans: Bandwidth required for transmission of colour signal is 3MHz (±1.5 MHz after modulation) as human eye cannot perceive/detect any changes in colour.

vii) How is differential phase error removed in PAL system?

Ans: Differential phase error is removed in PAL system by transmitting positive & negative V-signal on each alternate line.

viii) What is the role of vertical & horizontal blanking pulse?

Ans: **The role of vertical blanking pulses:**

Makes the scanning beam to move from bottom to top after each field & makes it invisible.

The role of horizontal blanking pulses:

Makes the scanning beam move from right to left after each line i.e. retrace of each line making it invisible.

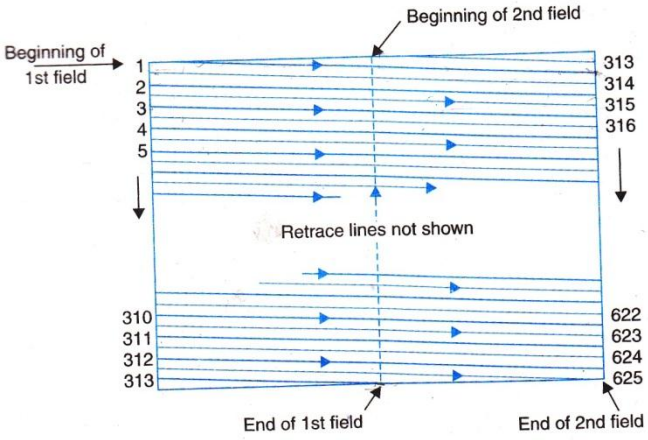
Q1) b) Attempt any Two of the following: (8 M)

i) Describe the interlace scanning with diagram. State its advantages.

Ans: (Diagram – 2M, Description- 1 M)

The total number of lines is divided into two groups called 'field'. Each field of 312.5 lines scanned alternately.

For the first field scanning starts from line 1 from the left most point & ends at 313 line in the middle of bottom line. During vertical retrace the scanning beam reaches at the center of top line. Thus the second field starts from center of the top line and ends at the right most point of the bottom line i.e.625 line.



Advantages : **(Any Two 1 M)**

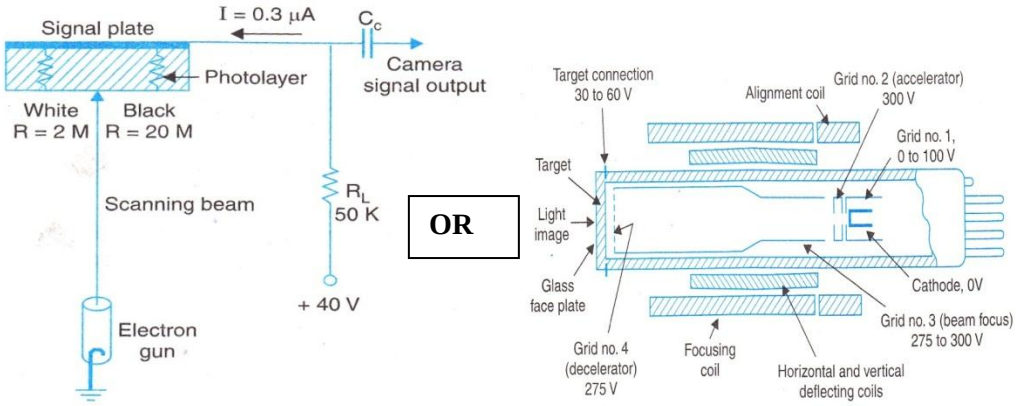
i) Reduces flicker

ii) BW is reduced

iii) Speed is increased without increasing BW.

ii) Describe the operation of vidicon camera tube.

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



Explanation:

- The signal plate is kept positive by an external source of supply. When light produces free electrons in the material, these migrate to be positive signal plate, leaving deficiency of electrons on the semiconductor material towards gun side.
- Thus the deficiency of electrons (or the positive charge) for any element on the gun side of the semiconductor will be proportional to the light incident on that

point. This means that a charge image proportional to the optical image has been form on the gun side of antimony trisulphide.

- White leaves marked 1, 2, 3 produce maximum charge shown by the number of dots: medium grey leaves mark 4 & 8 produce medium charge: and dark leaves mark 5, 6 & 7 produce minimum charge. Black back ground and black circle in the center of the picture do not produce any charge and so have been shown white in the charge image.
- When the scanning lands on the target material, it will leave electrons in the material just sufficient to neutralize the deficiency of electrons (or positive charge).
- The electrons in the remaining in the beam will return back under the influence of positive grids. These returning electrons are not utilized in the vidicon.

iii) State the specification of PAL burst signal & state the selection of exact PAL colour sub carrier frequency.

Ans:

Specification of PAL burst signal: (Any Two 2 M)

1) Eight to ten cycles of 4.43 MHz colour sub carrier
2) Located at the back point of Horizontal Blank pulses
3) Magnitude should lower than Horizontal sync pulse

Selection of PAL color subcarrier frequency: (2M)

The sub carrier frequency is chosen on a half line offset and F_{sc} is made on odd multiple off 1 quarter of the line frequency.Gapes in the Y signal occur at odd multiples of half the line frequency (fH/2, 3fH/2, 5fH/2---) if sub carrier frequency is chosen to be the half line frequency the harmonies of sub carrier will easily fit into the gapes existing between the harmonies of the line frequency. Also the luminance side bands go on becoming weaker and weaker as they move from the picture carrier. if the frequency of the picture sub carrier is chosen to be near the upper end of the channel band with the strongest side bands of colour where the weakest side bands of black and white signal exist.This will eliminate all changes of interference between band width (Y) signal and chrominance signal. Based on this consideration 567^{th} harmonic of the half the line frequency is chosen as sub carrier frequency in PAL system.

$$Fsc = 567*fh/2$$

$$= 567* 15625/2$$

$$Fsc = 4.43 \text{ MHz}$$

Q2 Attempt any FOUR of the following: (16M)

a) Define horizontal and vertical resolution. Calculate horizontal and vertical resolution for 625 line system.

Ans:

Vertical Resolution: **(1 M)**

The ability of the system to resolve vertical details is called vertical resolution.

OR

The number of pixels on a vertical line on the screen is called vertical resolution.

The vertical resolution $R_v = (N_T - N_L) * K = N_A K$

Where N_T = Total number of lines on screen

N_L = Lines lost in vertical blanking period

K = Kell factor

For 625 lines: RV = (625 – 40) * 0.7 = 409.5 (approximately 409) **(1 M)**

Horizontal resolution: **(1 M)**

The ability of the system to resolve horizontal details is called horizontal resolution.

OR

The number of pixels on horizontal line is called horizontal resolution.

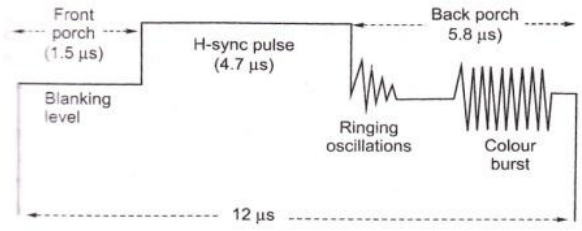
$R_H = R_v * A$

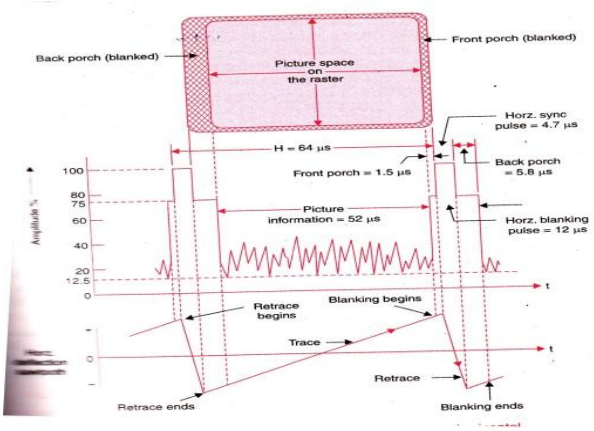
Where A is aspect ratio= 4/3

For 625 lines: RH = 409.5 * 4/3 = 546 **(1 M)**

b) Draw labeled diagram of horizontal sync details. Explain the function of front porch and back porch.

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





OR

Front porch: Its function is to ensure that the H-sync pulse starts from a fixed level. Absence of front porch will upset the synchronization and hence distort the picture.

Back porch: Its function is to absorb the ringing oscillations which are caused during sudden fall of the voltage from the sync loop during fly back.

c) Why FM is used in sound signal and AM used in picture signal?

Ans: Reason for FM used in sound signal (2 M)

- Both FM & AM are capable of giving the same fidelity if desired bandwidth is allotted. The highest modulating audio frequency used is 5 KHz instead of full audio range i.e. from 5 KHz to 15 KHz.
- This limit of highest modulating frequency results in saving of channel bandwidth & only a bandwidth of 10 KHz is needed per channel.(in case of FM, For e.g. if Fm= 5KHz bandwidth = 2Fm= 10KHz)
- Thus it becomes possible to accommodate a large number of radio broadcast stations in the limited broadcast band.
- FM is capable of providing almost Noise Free & high fidelity output. S/N ratio is high in FM system random changes in the amplitude are suppressed in FM
- In FM, where highest audio frequency allowed is 15KHz thus sideband frequency do not exceed too far & can be easily accommodated around the sound carrier that lies 5.5 MHz away from picture carrier.
- The bandwidth assigned to the FM sound signal is about 200 KHz

Reason for AM used in picture signal (2 M)

- In AM detection of baseband signal from the modulated wave is very easy using a single diode rectifier and a simple low pass filter circuit. Its low price makes it popular.
- AM detector does not detect random charges in phase but detects the changes in amplitude. Hence output of the detector is free of phase noise. As eyes are sensitive to face noise, its absence in the output makes AM suitable for picture. FM can detect changes in phase & hence unsuitable for video.

d) Define hue and saturation. State Grassman's law for colour mixing.

Ans:

Hue: (1 M)

Hue is the predominant spectral colour of the received light. Rose is red, sky is blue and grass is green.

Saturation: (1 M)

It represents how much white is present in a colour. Absence of white in a colour makes it fully saturated.

Grassman's Law: **(2 M)**

When a colour is produced by adding their primary colours its luminance is the sum of primary colours light.

100% white=30% red+59% green+11% blue

OR

Y=0.3R+0.59G+0.11B

Where R,G and B are the intensities of green, red and blue lights.

e) State the advantages of PAL system.

Ans: **(Any Four1 M each)**

1) Phase noise causing error in the reproduction of colors is atomically eliminated hence separate hue or tint control is not required.
2) Bandwidth for both U and V signals are the same (1.3 MHz for LSB and 0.5 MHz for USB) which simplifies filtering action.
3) Use of delay lines before demodulators isolates U and V signals from each other which reduce the crosstalk type interference in the colors.
4) Studio mixing is easy
5) The problem of differential phase errors has been successfully over comes in the PAL system.

f) State the features of high definition transmission.

Ans: **(Any Four 1 M each)**

- It includes 1125 scanning lines per frame 60 fields per second
- 2:1 interlace scan
- An aspect ratio of 16:9
- Much improved colour reproduction
- Stereophonic sound
- Bandwidth required is 10 MHz
- System will be digital only.

Q3. Attempt any FOUR of the following. **(16 Marks)**

a) Describe VSB transmission with a diagram.

Ans: - vestigial side band transmission **(2M diagram, 2 M for explanation)**

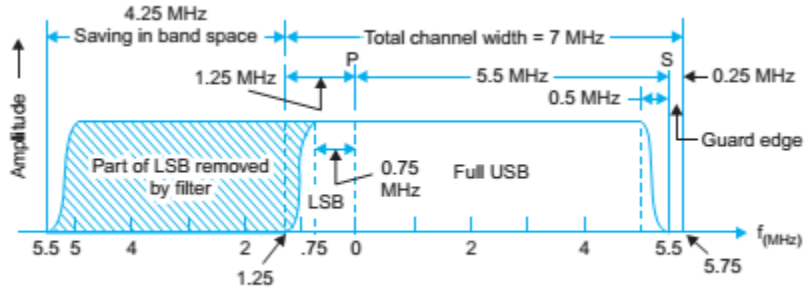


Fig. 4.3 Total channel bandwidth using vestigial' lower sideband.

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) Compare positive and negative modulation.

Ans: - Comparison of Positive and Negative Modulation (1 M for each point)

Sr.No	parameter	Positive modulation	Negative modulation
1	Effect of noise interference on picture signal	In active scanning noise increases in the direction of white level	In active scanning noise increases in the direction of black level.
2	Effect of noise interference on synchronization	It does not effect	It affects
3	Peak power available from transmitter	It requires more	It requires less power
4	Use AGC circuit in the receiver	It does not required	It is required

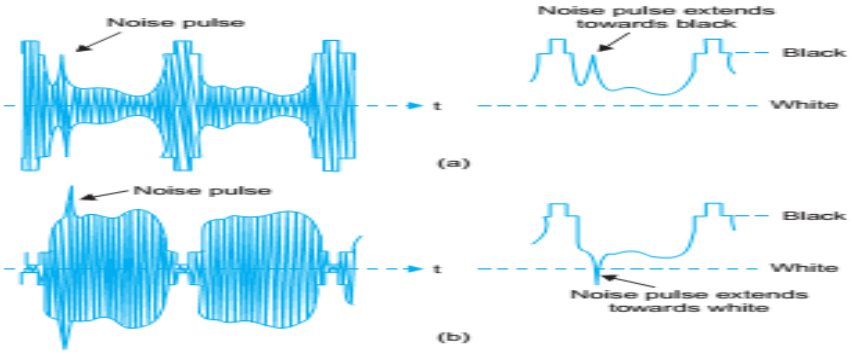


Fig. 7.13. Effect of noise pulses (a) with negative modulation, (b) with positive modulation.

c) Explain persistence of vision. Describe how motion picture is created.

Ans:- **(Persistence of vision 2 M, Motion picture creation – 2 M)**

'Persistence of vision' or storage characteristics of the human Eye is 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.**

OR

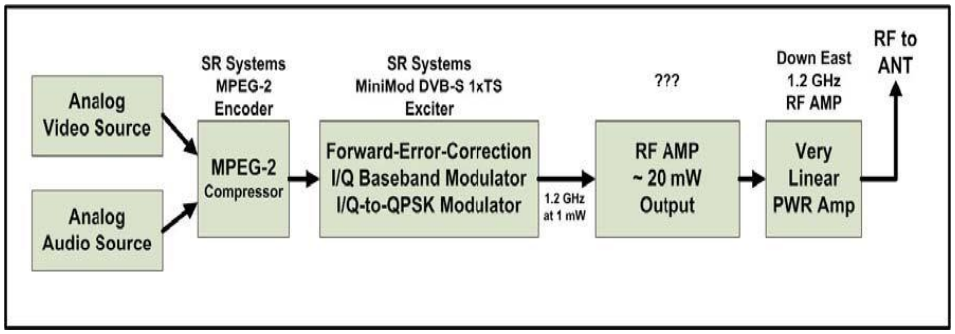
When eye sees a light it continues to see it for about 60ms after the light source is removed this property of eye is called **'Persistence of vision'**

Description of motion picture creation:-

- In motion pictures 24 or 25 frames still pictures of the scene are taken per second and later projected on the screen at the same rate.
- Each picture or frame is projected individually as a still picture, but they are shown one after the other in rapid succession to produce the illusion of continuous motion of the scene being shown
- As a result, a rapid succession of still-film frames is seen on the screen. With all light removed during the change from one frame to the next, the eye sees a rapid sequence of still pictures that provides the illusion of continuous motion.

d) Draw a Block diagram of digital TV transmission and explain its working.

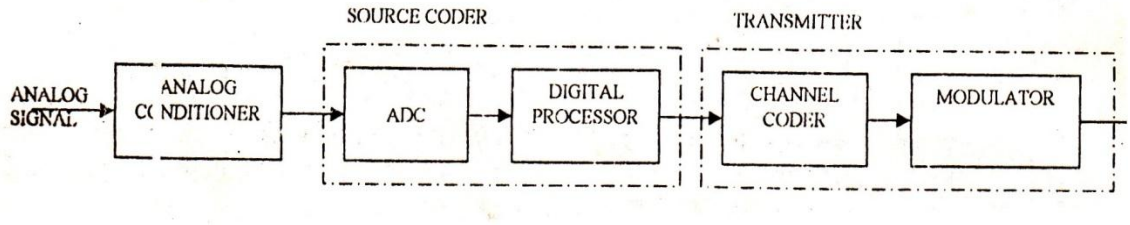
Ans:- **(Block diagram – 2M, Explanation -2M)**



Explanation:-

- Analog audio and video signals from microphone and camera respectively are given to MPEG compressor to convert analog signal to digital signal and compressed to reduce the bandwidth requirement.
- The compressed data is then given to QPSK modulator for I and Q signal modulation. Error detection and correction of digital signal is also done before amplification.
- The modulated signal is then feeded to RF amplifier and power amplifier.
- The amplified signal is then feeded to transmission antenna.

OR



Explanation:

- **Analog Conditioner:**
  The original analog television signal is first conditioned so as to simplify its processing in the subsequent digital devices.
  Conditioning of the analog signal could include the following operation:
  a. The composite colour signal is separated in a suitable device into the luminance signal & the chrominance signal so that each can be digested separately

b. The analog signal may be subjected to pre emphasis by emphasising one range of frequencies over the other so as to improve the subjective quality of the image output.

- **Source coder**:
  The conditioned analog signal goes to the ADC of the source coder where it is sampled, quantized & coded (by say PCM). The signal thus produced is highly redundant & this can be improved through a better form of coding in the digital signal processor.
- **Transmitter:**
  The signal is now fed to the channel coder. Here the term `Channel' may refer to a communication link a TV signal storage device, TV signal correctors, & other units in which the signal may be processed in one way or another. The purpose of the channel coder is to protect the digital TV signal against the interference & noise likely to arise in the channel through the use of more noise immune codes.
  Next the digital signal goes into the transmitter modulator (Any of the digital modulation technique may be employed here) & finally into the channel.

e) Draw Block diagram of PAL and describe function of each section.

Ans:- (Block diagram of PAL encoder or PAL transmitter (2 M, Explanation. 2 M)

Explanation:

Generation of U and V signals:-

The gamma corrected R; G and B signals are matrixes 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 7.8KHz.

Generation of QAM & CCVS:-

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.

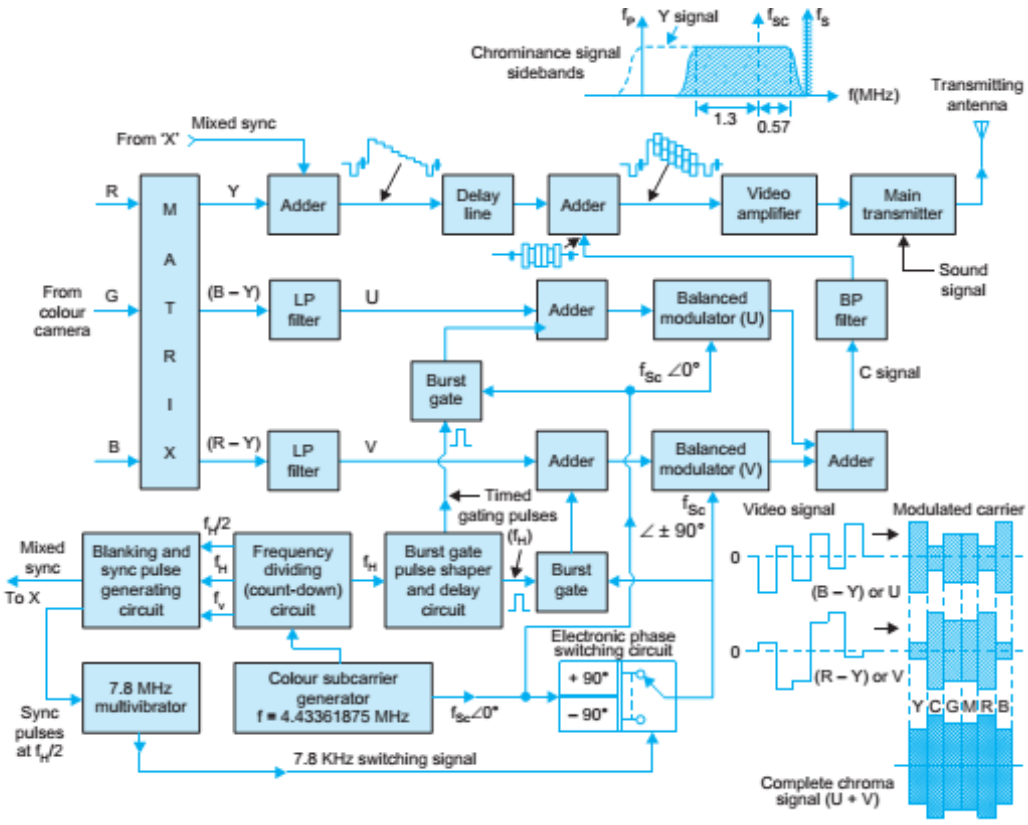
Insertion of colour burst:-

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 f_H 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 sine wave (≈10 cycles) at + 45° on one line and – 45° on the next line with reference to – U phasor.

Final transmission:-

The colour 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,



Block diagram of PAL encoder or PAL transmitter

f) State two advantages and two dis advantages of digital TV Transmission.

Ans:- (Advantages any 2 points 2 M , Disadvantages 2 points – 2 M)

Advantages:-

1. Picture quality is superb. Noise is negligibly small.
2. Ghost image is absent. Flicker is totally removed.
3. U & V signal reformatting can make picture definition sharper.
4. High definition can be achieved more easily on digital TV.
5. The special effect like editing, zooming, blasting, pixilation can be made available in DTV.
6. It provides high reliability due to use of digital ICs and also provides long term stability & reduces cost.
7. It includes availability of video telephone and video conferencing due to public switched telephone networks, connected through satellites.
8. Digital techniques allow error correction from noise, multi-path
9. Digital techniques allow advanced modulation (less bandwidth) and compression
10. Digital TV components will become more common on the marketplace
11. Analog TV components will start to disappear from the marketplace

Dis advantages:-

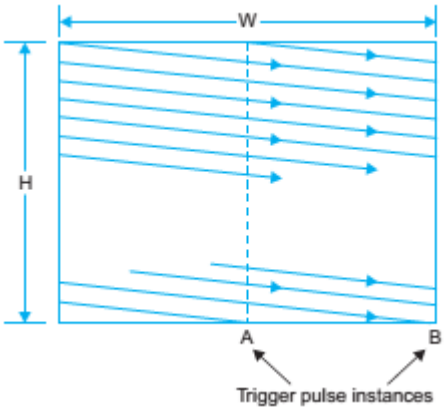
1. High bit rate requires compression before transmission and decompression at the RX. Compression / decompression sometime cause a small noise.
2. In analog system the quality degrades gradually, but in digital system the picture quality remains good till certain S/N ratio, but below that it degrades very rapidly.

Q. 4 Attempt any FOUR of the following. (16 marks)

a) Why does all TV systems have Odd number of lines?

Ans: - (4 M)

In interlaced scanning it is essential that the starting points at the top of the frame is separated exactly one half lines between first and second fields.
To achieve this it is necessary to feed two regularly spaced synchronizing pulses to the field time base during each frame period. One of these pulses must arrive in the middle of a line and the next at the end of a line.
Thus the vertical time base must be triggered 50 times per second. For half line separation between the two fields only the topmost and the extreme bottom lines are then half lines whereas the remaining lines are all full lines.
If there are x number of full lines per field, where x may be even or odd, the total number of full lines per frame is then 2x, an even number.



Therefore, when the two half lines get added the total number of lines per frame becomes odd. Thus for interlaced scanning the total number of lines in any TV system must be odd. With an even number of lines the two fields are bound to fall on each other and interlaced scanning would not take place.

b) Describe the use of Pre and Post equalizing pulses.

Ans: - **(Diagram -1M, Need of pre and post equalizing pulses -3M)**

- The drawback which occurs on account of the half line discrepancy five narrow pulses are added on either side of the vertical sync pulses. These are known as pre-equalizing and post-equalizing pulses. Each set consists of five narrow pulses occupying 2.5 lines period on either side of the vertical sync pulses.
- The effect of these pulses is to shift the half-line discrepancy away both from the beginning and end of vertical sync pulses.
- Pre-equalizing pulses being of 2.3 µs duration result in the discharge of the capacitor to essentially zero voltage in both the fields, despite the half-line discrepancy before the voltage build-up starts with the arrival of vertical sync pulses.
- Post-equalizing pulses are necessary for a fast discharge of the capacitor to ensure triggering of the vertical oscillator at proper time. If the decay of voltage across the capacitor is slow as would happen in the absence of post-equalizing pulses, the oscillator may trigger at the trailing edge which may be far-away from the leading edge and this could lead to an error in triggering.

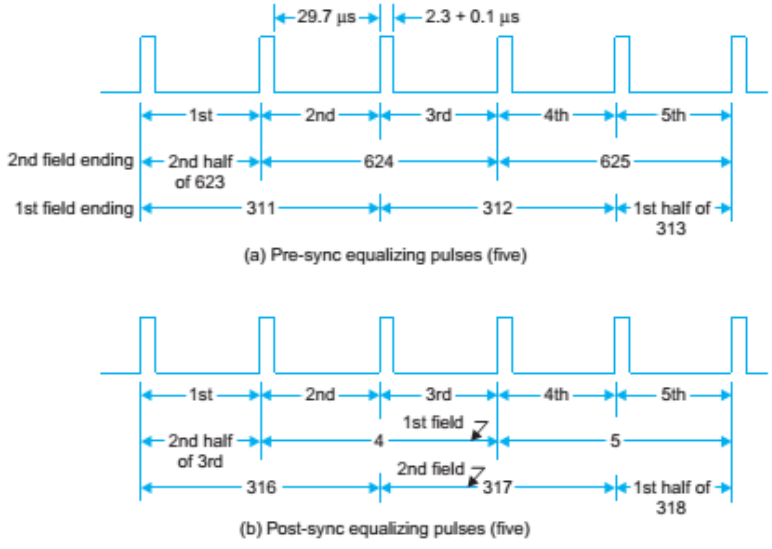


Fig. 3.8 Pre-sync equalizing and Post-sync equalizing pulses.

Thus with the insertion of narrow pre and post equalizing pulses, the voltage rise and fall profile is essentially the same for both the field sequences and the vertical oscillator is triggered at the proper instants, exactly at an interval of 1/50th of a second.

c) Describe the operation of color camera tube with diagram.

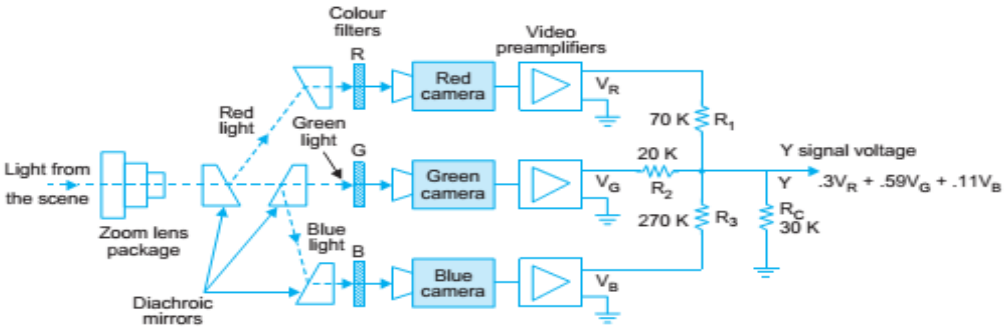
Ans: - (Block diagram of colour camera - 2M, Explanation - 2M)

Explanation:-

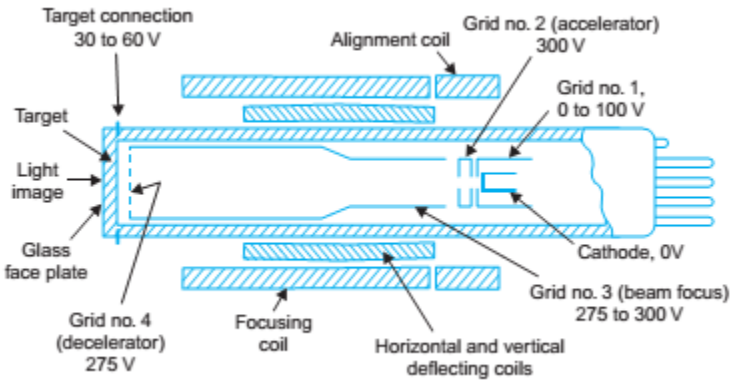
It essentially consists of three camera tubes in which each tube receives selectively filtered primary colours. Each camera tube develops a signal voltage proportional to the respective colour intensity received by it.

Light from the scene is processed by the objective lens system. The image formed by the lens is split into three images by means of glass prisms. These prisms are designed as dichroic mirrors.

A dichroic mirror passes one wavelength and rejects other wavelengths (colours of light). Thus red, green, and blue colour images are formed. The rays from each of the light splitters also pass through colour filters called trimming filters. These filters provide highly precise primary colour images which are converted into video signals by image-orthicon or vidicon camera tubes. Thus the three colour signals are generated. These are called Red (R), Green (G) and Blue (B) signals.



OR



Vidicon camera tube functions on the principle of photoconductivity, where the resistance of the target material shows a marked decrease when exposed to light.

The target consists of a thin photo conductive layer of either selenium or anti-mony compounds. This is deposited on a transparent conducting film, coated on the inner surface of the face plate. This conductive coating is known as signal electrode or plate. Image side of the photo layer, which is in contact with the signal electrode, is connected to DC supply through the load resistance RL. The beam that emerges from the electron gun is focused on surface of the photo conductive layer by combined action of uniform magnetic field of an external coil and electrostatic field of grid No 3. Grid No. 4 provides a uniform decelerating field between itself, and the photo conductive layer, so that the

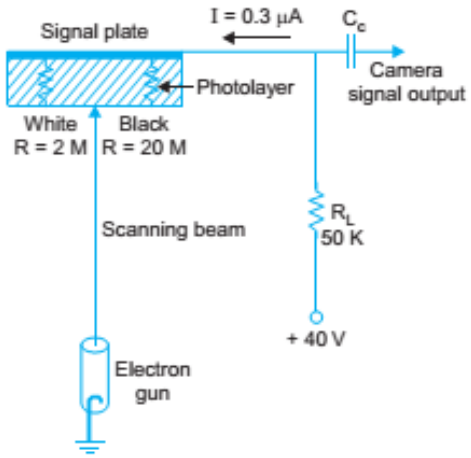


Fig. 6.7. Circuit for output signal from a Vidicon camera tube.

electron beam approaches the layer with a low velocity to prevent any secondary emission. Deflection of the beam, for scanning the target, is obtained by vertical and horizontal deflecting coils, placed around the tube.

d) Describe frequency interleaving used in TV system.

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

The actual video signal is introduced between the line sync pedestals, the overall spectra still remains 'bundled' around the harmonics of the line frequency(f_h, $2f_h$, 3 f_h ….) and the spectrum of individual bundles become a mixture of continuous portion due to the video signal are discrete frequencies due to the field sync.

Therefore, a part of the bandwidth in the monochrome television signal goes unused because of spacing between the bundles. This suggests that the available space could be occupied by another signal. It is here where the colour information is located by modulating the colour difference signals with a carrier frequency called 'colour

subcarrier'. The carrier frequency is so chosen that its sideband frequencies fall exactly mid-way between the harmonics of the line frequency.

This requires that the frequency of the subcarrier must be an odd multiple of half the line frequency.

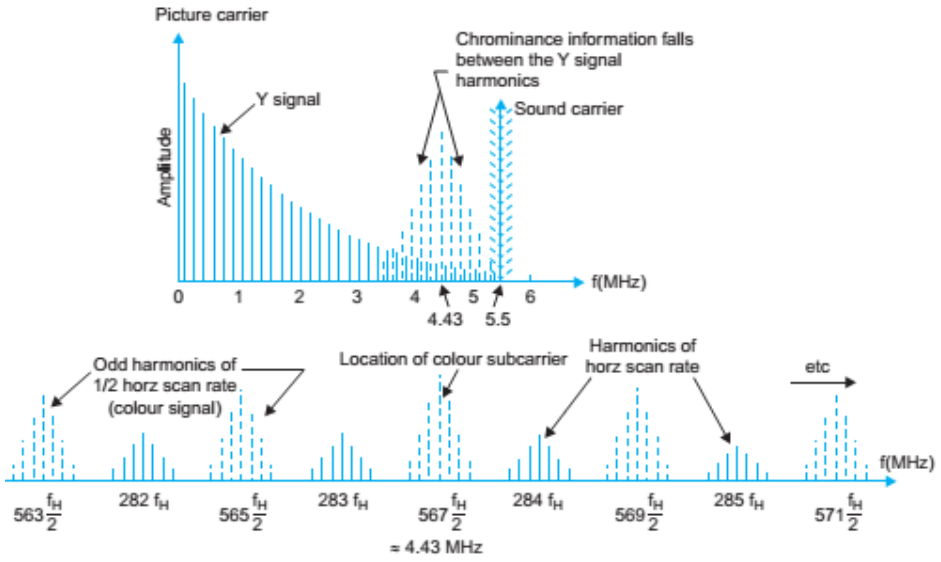


Fig. 26.2. Interleaving of the colour signal.

e) Describe the generation of color difference signal with the help of block Diagram.

Ans: - (Diagram - 2M, Explanation of generation of colour difference signal-2M)

Explanation: The 'Y' signal is modulated and transmitted as is done in a monochrome television system.

Instead of transmitting all the three colour signals separately the red and blue camera outputs are combined with the Y signal to obtain what is known as colour difference signals.

Colour difference voltages are derived by subtracting the luminance voltage from the colour voltages. Only (R– Y) and (B – Y) are produced. It is only necessary to transmit two of the three colour difference signals since the third may be derived from the other two. The voltage V_Y is obtained from the resistance matrix is low because RC is chosen to be small to avoid crosstalk. Hence it is amplified before it leaves the camera sub chassis. Also the amplified Y signal is inverted to obtain – Y as the output. This is passed on to the two adder circuits. One adder circuit adds the red camera output to – Y to obtain

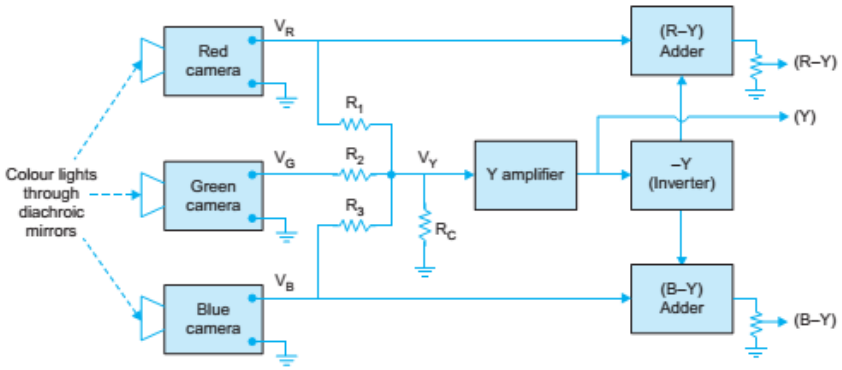


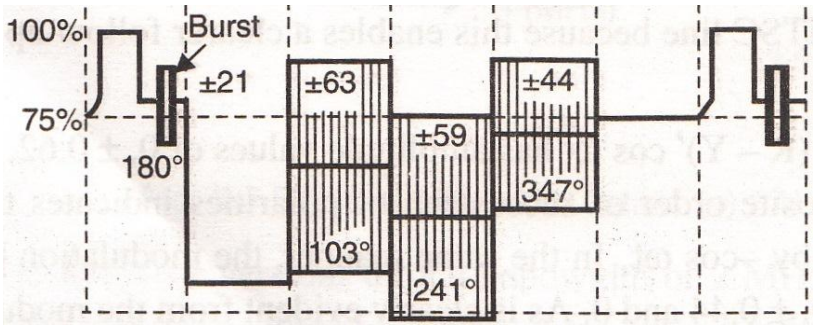
Fig. 25.9. Production of luminance and colour-difference signals.

the (R – Y) signal. Similarly the second adder combines the blue camera output to – Y and delivers (B – Y) as its output.

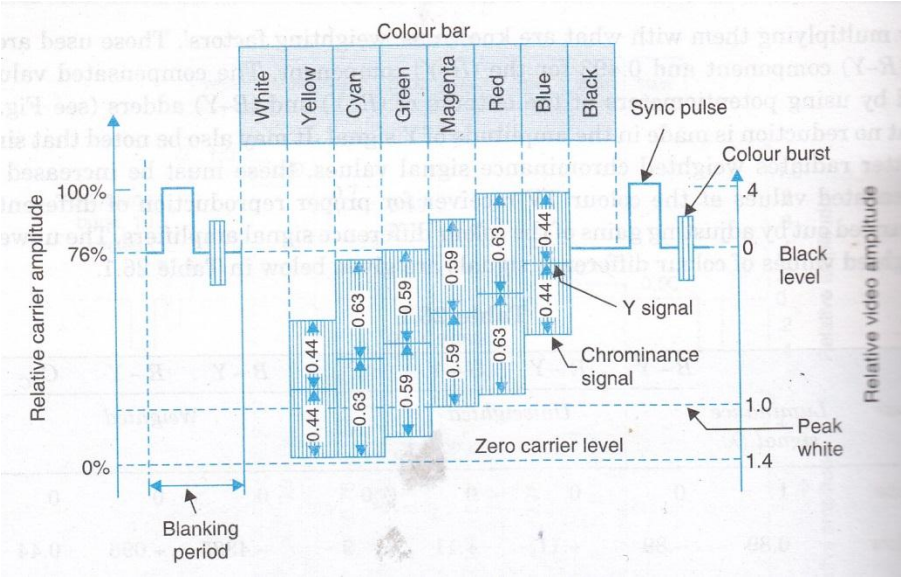
The difference signals thus obtained bear information both about the hue and saturation of different colours.

e) Draw labeled diagram of CCVS and explain.

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



OR



Explanation :- The Chrominance signal is added with luminance signal along with blanking and sync pluses and color burst signal. The resultant is called as CCVS (color composite video signal).

The color burst consists of 8 to 11 cycles of color sub carrier located at back porch of H-blanking pulse.

Q5. Attempt any FOUR of the following: (Mark 16)

a) What is compatibility of colour signal? State the factors to be considered for compatibility.

Ans :

Compatibility is the ability of a monochrome receiver to receive the color transmitted signal and produce correct monochrome picture with all the details without any modification in monochrome receiver and signals from a black and white system can provide a monochrome picture an a color receiver. **(2 M)**

Following factors are to be considered for compatibility. **(Any four factors - 2 M)**

1. The transmitted signal should use same deflection frequency sync pulses and blanking signal as used in monochrome system.
2. The color transmission should be done in the same bandwidth as corresponding monochrome signal transmission.
3. The location and spacing of picture and sound carrier frequency should remain same in the transmission (5.5 MHz).

4. The color transmitted signal must have same luminance information as a monochrome signal would have when it transmits the same picture.
5. The CCVS should contain color transmission in addition along with color synchronizing signal (color burst) required for its detection.
6. The color transmission should be carried in such a way that it does not affect the reproduction of picture on the screen of black and white screen.

b) State CCIR-B standards for colour signal.

Ans : **(any 8 points ½ M Each)**

CCIR-B standards for color signal

1. Number of lines per picture =625.
2. Aspect ratio =4:3.
3. Interlace ratio = 2:1.
4. Line frequency = 15625 Hz.
5. Frame frequency = 25 frames/sec.
6. Field frequency = 50 fields/sec.
7. Channel bandwidth = 7 MHz .
8. Video bandwidth = 5 Mhz.
9. Sound carrier related to picture = 5.5 Mhz.
10. Line period H = 64us.
11. Field period = 20ms.
12. Picture IF = 38.9 Mhz.
13. Sound IF = 33.4 Mhz.

c) State the different channel allocation with frequency band for Band I and Band III.

Ans :

T.V channel allocation for Band I and Band III

VHF band 1(41 – 68 Mhz) channel 2,3 & 4. Channel width 7 Mhz **(2 M)**

Channel number	Frequency band (Mhz)
2	47 – 54
3	54 – 61
4	61 – 68

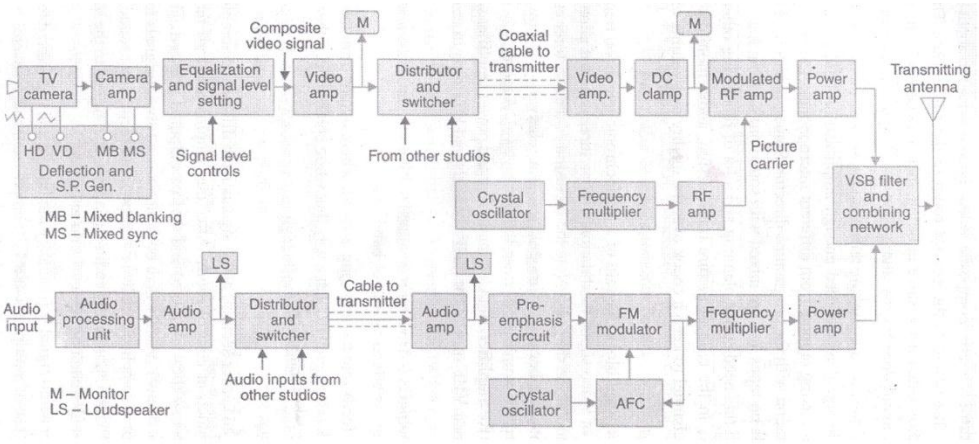
VHF band III (174 – 230 Mhz) ch. 5 - 12. Channel width 7 Mhz **(2 M)**

Channel number	Frequency band (Mhz)
5	174 – 181
6	181 – 188
7	188 – 195
8	195 – 202
9	202 – 209
10	209 – 216
11	216 – 223
12	223 - 230

d) Draw the block diagram of monochrome T.V. transmitter and describe the function of each block.

Ans :

Block diagram of monochrome T.V transmitter (2 M)



Functions of main blocks in above block diagram **(2 M)**

1. T.V camera:- converts light information into video signals.
2. Camera amplifier:- amplifies the o/p of TV camera as it is very weak.
3. Equalization and signal level setting:- using various signal level controls, signal levels are adjusted to get good quality picture.
4. Video amplifier:- amplifies the o/p.
5. Distribution and switcher:- the o/p of video amplifiers is fed to Distribution and switcher. In addition to this i/p, the Distribution and switcher is also fed with the o/p of video tape & telecine machine.
6. Video amplifier:- the o/p from Distribution and switcher is fed to video amplifier to get amplified.

7. DC clamp:- while coup[ling this signal, DC component get lost . Therefore it is reinserted by using DC clamp or DC restorer circuit.
8. Modulated RF amp:- o/p DC clamp is amplitude modulated & amplitude
9. Power amp:- Increases power level at signal to be transmitted which fed to antenna.
10. In the sound section, o/p from microphone is amplified, pre emphasized, frequency modulated and fed to power amplifier.
11. V&B filter a combining network: combines audio & video signals & feeds it to antenna.

e) Explain why (G-Y) signal is not transmitted for colour signal transmission.

Ans :- **(4 Marks)**

The color difference signals can be written as

(G- Y) = - 0.51 (R – Y) – 0.186 (B – Y)

(R – Y) = - 1.96 (G – Y) – 0.36 (B – Y)

(B – Y) = - 2.76 (R – Y) – 5.36 (G – Y)

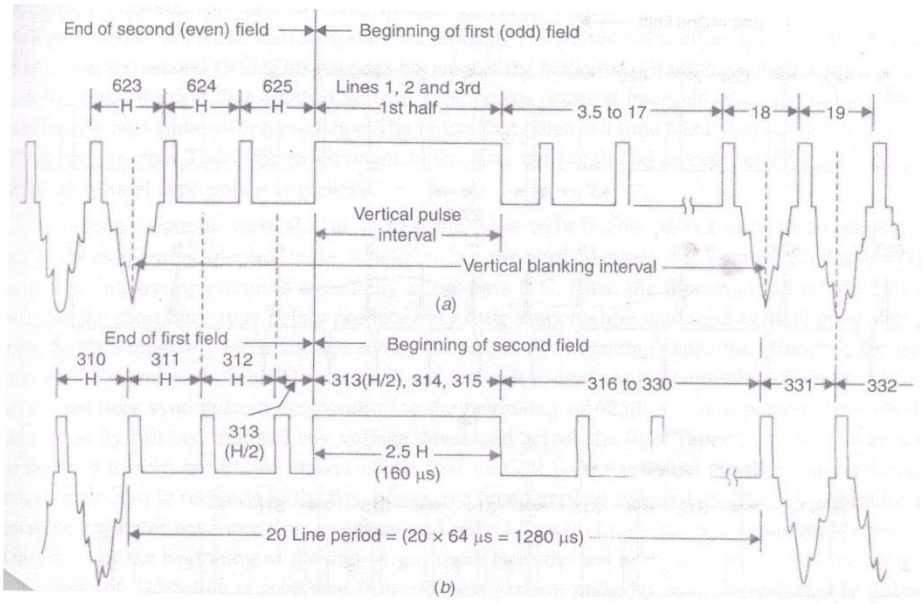
In all colour T.V.system, (G – Y) signal is not selected for transmission because –

i) (G – Y) can be obtained by (RY) & (B-Y). Above equation 1. Indicates that only fractions of (R-Y) & (B-Y) are needed i.e. amplitude of (G-Y) is smallest in the three signals. If (G-Y) is selected for transmission, then we will need amplifiers. To get (R- Y) & (B – Y)
ii) The proportion of G contents in Y is relatively large (59%). Hence the amplitude of (G-Y) is small as compared to (R-Y) & (B-Y). This causes S/N problems at the transmitting end. There is no such problem with (R-Y) & (B-Y). therefore in color transmitter only (R-Y) & (B-Y) is transmitted and (G-Y) is obtained at receiver end from these two signals.

f) Draw the labeled waveform of vertical sync pulse. Why is the vertical sync pulse serrated?

Ans:-

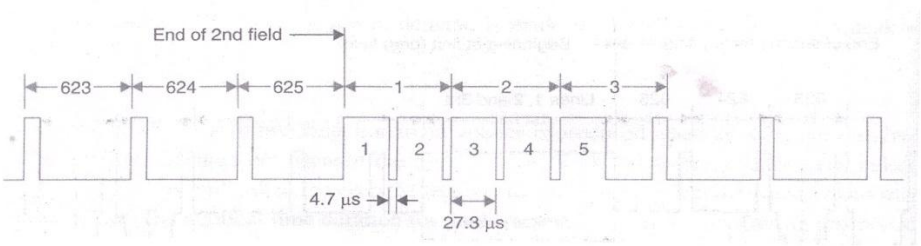
Labeled waveform of vertical sync pulse :- (2 M)



Function of serrations in V-sync pulse (2 M)

Serrations in V-Sync pulse help to maintain the synchronization of horizontal (line) oscillator. In the absence of serrations, there will be no leading edges for the duration of V-sync pulse to trigger H-oscillator. So the receiver Horizontal oscillator will either lose sync or stop oscillating. To maintain continuity in the sequence of line pulse, V-sync pulses are serrated. With this, both H & V sync. Actions can go simultaneously.

The serrated V sync pulse is as shown below:



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

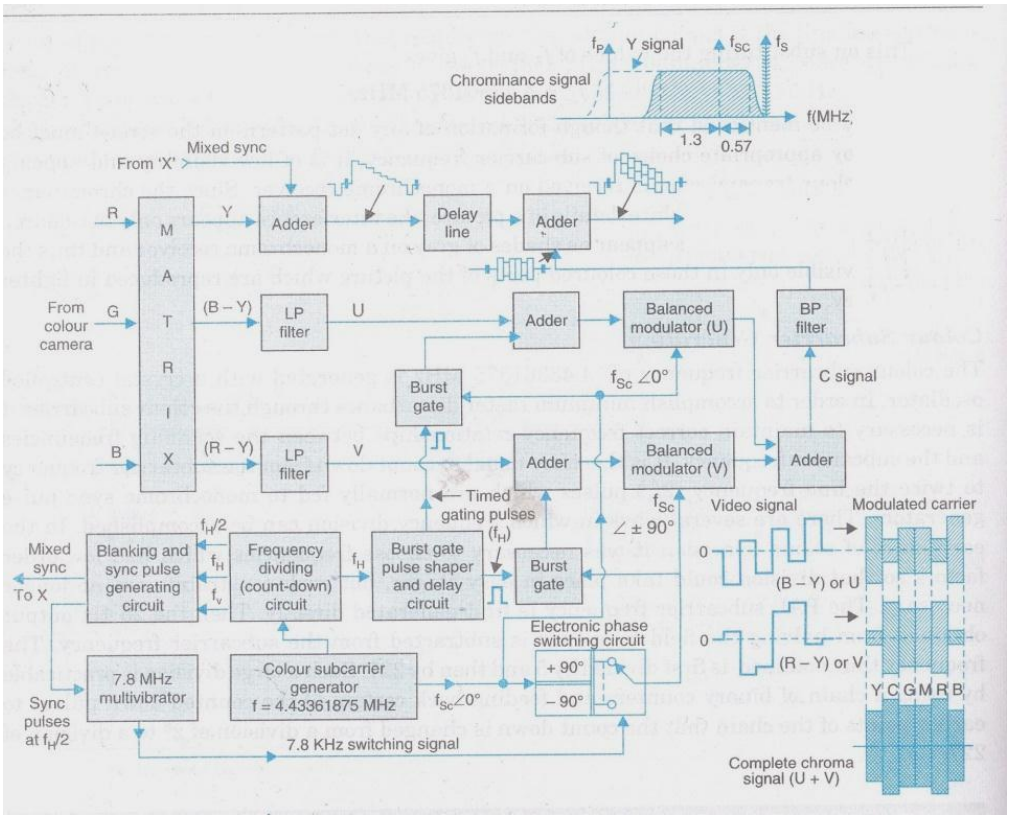
a) Describe the function PAL encoder and state the function of each block

Ans: (Note : Students are not expected to draw the diagram but even if they draw the diagram without writing the explanation full mark should be given.)

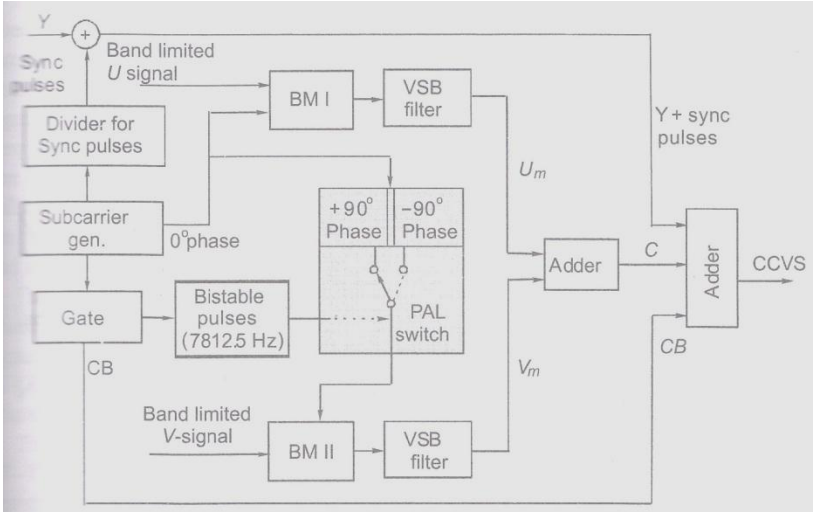
The German PAL (Phase Alteration by Line) system is on of the main colour TV system used in the world in India we have adopted this system. The system has two parts encoder & decoder.

PAL encoder accepts R, G, B signals from colour camera and converts them into a form which is suitable for transmission. **(1 M)**

PAL encoder consists of following main blocks.



OR



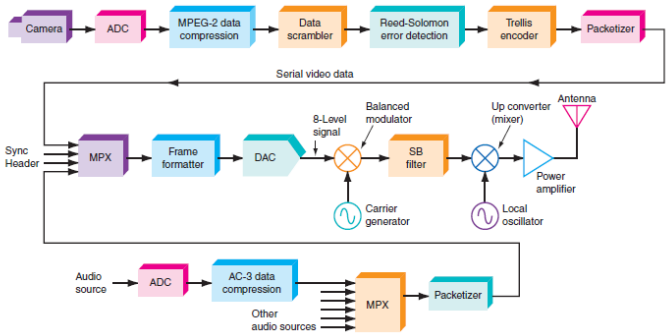
Function of each block: - **(3 M)**

- The Red(R), Green (G) and Blue (B) signals are generated by the colour camera tube.
- The Matrix section is used to obtain the Y, B-Y, R-Y signals
- The bandwidth of both B-Y and R-Y video signals are restricted to about 1.5 MHz by LPF.
- In this process these signals suffer a small delay relating to Y signal. In order to compensate for this delay, a delay line is inserted in the path of Y signal.
- The U and B signals are fed to corresponding balanced modulators.
- The 4.43 MHz sinusoidal subcarrier from a highly stable oscillator is fed directly to U modulator but passes through $\pm 90^0$ phase switching circuit on alternate lines before entering the V modulator.
- Since 1 switching line takes two lines, the square wave switching signal from multivibrator to the electronic phase switch is of half-line frequency. i.e. 7.8125 KHz.
- The DSBSC signals from the modulators are added to give QAM chrominance signal (C).
- This signal passes through a filter which removes harmonics at sub carrier frequency and restricts to the upper and lower side bands to the desire value.
- The output of filter feed into an adder circuit where it is combined with the luminance and sync signals to form CCVS.
- The color burst signal is fed to the modulator along with U and V signals through adders. The burst signals are obtained from the circuit that feds color subcarrier signal to the two modulators.

- Before feeding the burst signals to the U and V adders these are passed through separate burst gates, which ensures that the burst signal arrives during the back porch interval.

b) Draw the block diagram of HDTV transmitter and describe its workings.

Ans :- **(HDTV Transmitter: Block Diagram- 2M, Working-2M)**



Working:-

- The video from the camera consists of the *R*, *G*, and *B* signals that are converted to the luminance and chrominance signals. These are digitized by A/D converters. The luminance sampling rate is 14.3 MHz, and the chroma sampling rate is 7.15 MHz.
- The resulting signals are serialized and sent to a data compressor. The purpose of this device is to reduce the number of bits needed to represent the video data and therefore permit higher transmission rates in a limited-bandwidth channel. MPEG-2 is the data compression method used in HDTV.
- The MPEG-2 data compressor processes the data according to an algorithm that effectively reduces any redundancy in the video signal. For example, if the picture is one-half light blue sky, the pixel values will be the same for many lines. All this data can be reduced to one pixel value transmitted for a known number of times. The algorithm also uses fewer bits to encode the color than to encode the brightness because the human eye is much more sensitive to brightness than to color.
- The MPEG-2 encoder captures and compares successive frames of video and compares them to detect the redundancy so that only differences between successive frames are transmitted. The signal is next sent to a data randomizer.
- The randomizer scrambles or randomizes the signal. This is done to ensure that random data is transmitted even when no video is present or when the video is a constant value for many scan lines. This permits clock recovery at the receiver.
- Next the random serial signal is passed through a Reed-Solomon (RS) error detection and correction circuit. This circuit adds extra bits to the data stream so that transmission errors can be detected at the receiver and corrected. This ensures high reliability in signal transmission even under severe noise conditions. In HDTV, the

RS encoder adds 20 parity bytes per block of data that can provide correction for up to 10 byte errors per block.

- The signal is next fed to a trellis encoder. This circuit further modifies the data to permit error correction at the receiver. Trellis encoding is widely used in modems. Trellis coding is not used in the cable TV version of HDTV. The audio portion of the HDTV signal is also digital. It provides for compact disk (CD) quality audio.
- The audio system can accommodate up to six audio channels, permitting monophonic sound, stereo, and multichannel surround sound. The channel arrangement is flexible to permit different systems. For example, one channel could be used for a second language transmission or closed captioning. Each audio channel is sampled at a 48-kbps rate, ensuring that audio signals up to about 24 kHz are accurately captured and transmitted. Each audio sample is converted to an 18-bit digital word. The audio information is time-multiplexed and transmitted as a serial bit stream at a frequency of 48 kbps _ 6 channels _ 18 bits _ 5.185 Mbps A data compression technique designated AC-3 is used to speed up audio transmission.

c) State the characteristic of digital transmission.

Ans **(Any 8 characteristic 4M)**

1. Signal: Discrete signal represented as either changes in voltage or changes in light level.
2. Traffic measurement is in bits per second: (T_1 line carries 1.544 MBPS, E1line carries 2.048 MBPS)
3. Bandwidth is high is which support a high speed data & emerging application that involved video & multimedia.
4. Network capacity is high: Multiplexers are used in digital transmitter & therefor multiple conversations share same communication channel therefore transmission efficiency is high.
5. Good network manageability: The digital transmission network elements can be controlled, monitor & managed remotely.
6. Low power requirement: (As only two discrete level –zero & one-are need to be transmitted)
7. Security is good as encryption is used.
8. An error rate is low (of the order of 10^{-7} for twisted pair, of the order of 10^{-9} for satellite & of the order of 10^{-11} for optical fiber.)

d) Explain suppressed colour sub-carrier transmission in T.V.

Ans: **(4 M)**

In T.V. transmitter, the colour difference signals R-Y & B-Y are weighed down & then modulated by a colour subcarried frequency 4.43MHz (by using QAM system to obtain chrominance signal ‘c’. This signal is transmitted with a suppressed sub carrier because amplitudes of the two carrier components are large compared to the sideband products and if its is not suppressed, it will cause interference with Y signal when combined with it.

Thus sub carrier is suppressed to minimized interference produced by C signal both on monochrome receivers when they are receiving color transmission and in the luminance channel of the color receiver. Hence the transmitted signal does not carry any sub carrier frequency.

However it is necessary to generate a sub carrier with correct frequency and phase relationship for proper detection of color sidebands.

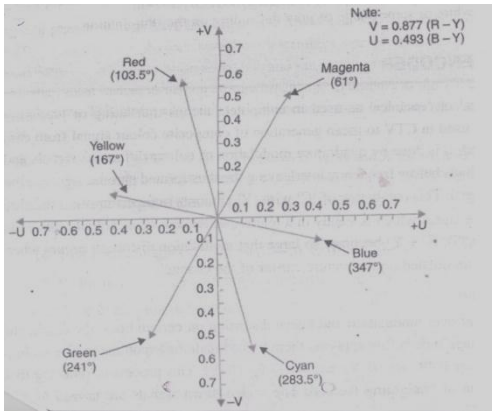
To ensure this, a short sample of sub carrier oscillator signals (8 to 11 cycles) called color burst signal is send to the receiver along with sync signal. This signal is located on the back porch of H – blanking pedestal. This signal do not interfere with H – sync pulse because of its low amplitude.

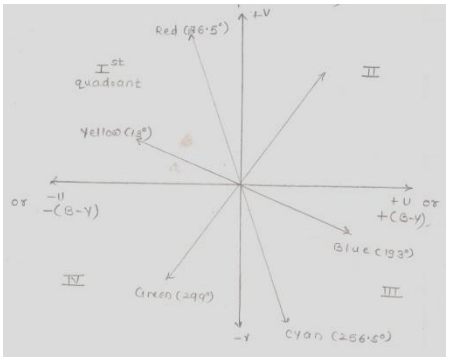
This signal along with AFC circuit is used to lock local oscillator to correct frequency and phase as that of transmitter and color sub carrier is regenerated at the receiver.

e) Explain phasor diagram for weighted and unweighted primary and secondary colours.

Ans:- Phasor diagram for weighted primary and secondary colors where angles are measured with reference to +U axis. **(2 M)**

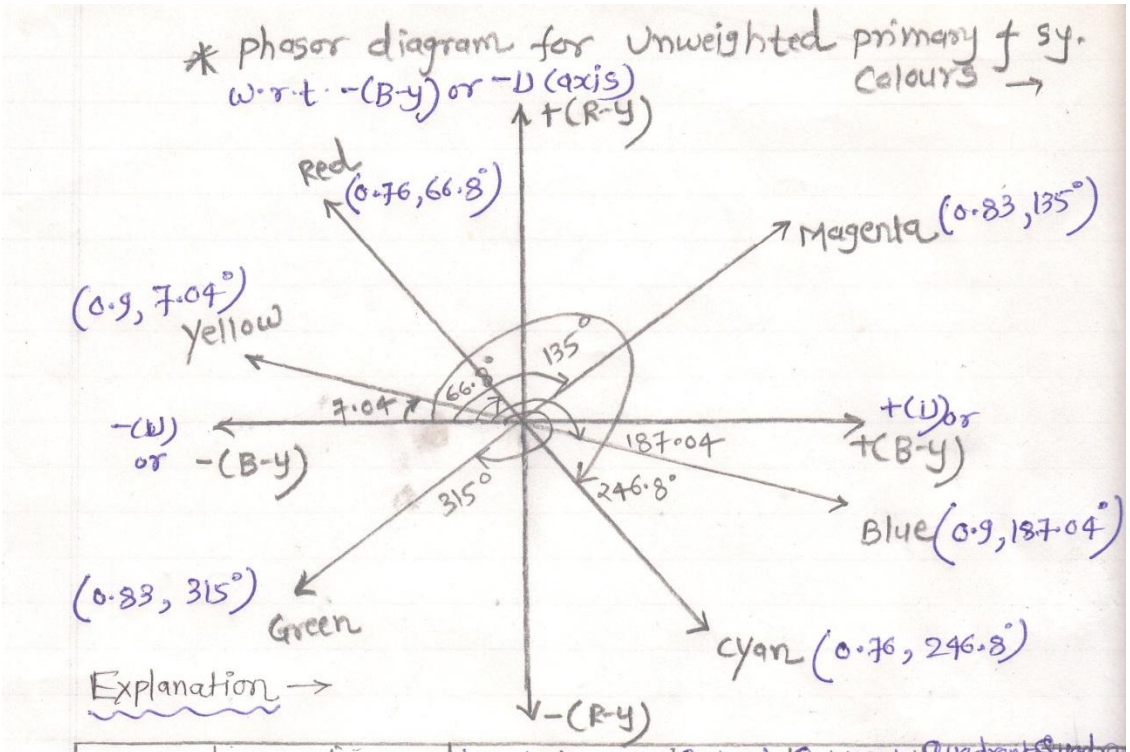
COLOUR	Y	U	V	'C'	ϕ
White	1	0	0	0	0°
Yellow	0.89	– 0.4385	+ 0.0965	0.44	167°
Cyan	0.70	+ 0.148	– 0.614	0.63	283°
Green	0.59	–0.29	– 0.5174	0.59	241°
Magenta	0.41	+ 0.29	+ 0.5174	0.59	61°
Red	0.31	– 0.148	+ 0.614	0.63	103°
Blue	0.11	+ 0.4385	– 0.0965	0.44	347°
Black	0	0	0	0	0°





OR

Phasor diagram for UN weighted primary and secondary colors. (2M)



Explanation →

Colours	R-y	B-y	|Csc|	∠ in degree	∠ w.r.t +(B-y)	∠ w.r.t -(B-y)	Quadrant w.r.t -(B-y)	Quadrant w.r.t +(B-y)
White	0	0	0	0	—	—	-	
Yellow	+0.11	-0.89	0.9	7.04	172.9	7.04	I	II
cyan	-0.7	+0.3	0.76	66.8	293.2	246.8	III	IV
Green	0.59	-0.59	0.83	45	225	315	IV	III
magenta	+0.59	+0.59	0.83	45	45	135	II	I
Red	+0.7	-0.3	0.76	66.8	13.5	66.8	I	II
Blue	-0.11	+0.89	0.9	7.04	353	187.04	III	IV
Black	0	0	0	0	0	0		

OR Phasor diagram drawn w.r.t +(B-y) axis should give Marks.

f) Draw human eye response to different colours.

Ans:- **(4 M)**