Q.2a. Write down the factors on which the bandwidth of video signals depends.

Ans Bandwidth of video signal depends on the following factors-

1. Size of the pixels . smaller the size greater would be bandwidth
2. Scanning speed. Which will depend on the number of lines per frame and the number of frames per second

Q2b.What type of polarity of video signal is needed at the picture tube and how is it achieved?

Answer: The picture tube requires positive polarity signal so that the stronger signal produces brighter glow. After demodulation of negative modulation signal the final polarity of the video signal may be positive or negative depending on the number of amplification stage. If it is positive, it is applied to the control grid of the picture , keeping cathode grounded. If it is negative, it is applied to the cathode and the control grid is kept grounded. Thus in both case grid remains positive with respect to cathode for the incoming video signal

Q2c.Calculate the frequency band covered by TV video signal considering: aspect ratio=4/3, scanning =25 pictures/sec, number of liners per frame=625.

Answer: the number of elements to be scanned with aspect ratio4/3 =625x4x625x25/3. Therefore the time for reversal from black to white is 3/(625x4x625x25). The time for a compltete cycle is (3x2)/(625x4x625x25)sec. Hence frequency band covered by TV video signal is (625x4x625x25)/(3x2)=6.5 MHz

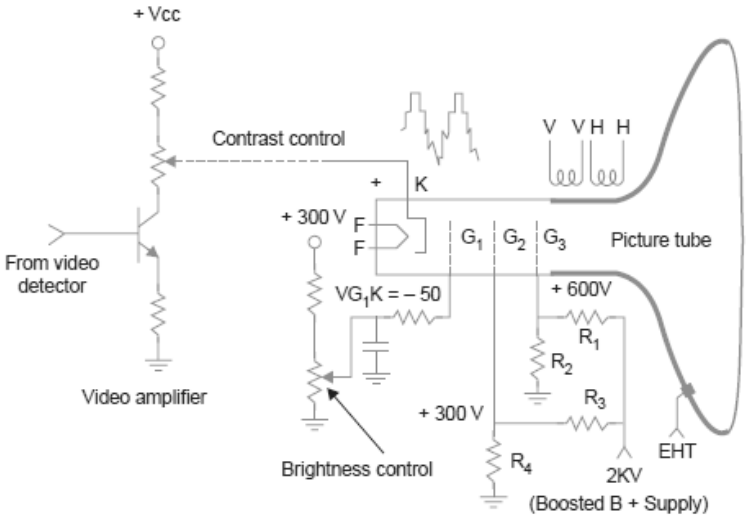
Q.3a. Compare magnetic and electrostatic deflection of beam.

Answer:

Magnetic deflection	Electrostatic deflection
1. Sawtooth current is required	1. Sawtooth voltage is required
2. With a given deflection current, the deflection angle is inversely proportional to the square root of the high voltage	2. With a given deflection voltage, the deflection angle is inversely proportional to the square root of the high voltage
3. Two pairs of deflection coils are used which are mounted externally around the neck of tube just before the bell	3. Two pairs of deflection plates are used which are mounted internally in the electron gun
4. Deflection is much easier for magnetic scanning, especially with very high anode voltage used for picture tube	4. Deflection is not much eaier for electrostatic scanning
5. Bandwidth with electrostatic deflection is limited by yoke inductance and amplifier capabilities	5. Electrostatic deflection can display information with exteremly large bandwidth.

3b.How focusing of electron beam is achieved in TV picture tube? Discuss the factors affecting picture contrast and brightness.

Answer:
Manufacturers usually recommend a sufficiently high voltage to the second anode of the picture tube to produce adequate screen brilliancy for normal viewing. This voltage is always obtained from the output of the horizontal deflection circuit. The dc voltages to the screen grid and focus grid are also taken from the horizontal stage and adjusted to suitable values by resistive potential divider networks. This is shown in Fig.



A variable bias control either in the cathode circuit or control grid lead is provided to control the electron density, which in turn controls the brightness on the screen. This control, known as the 'brightness control', is brought out at the front panel of the receiver to enable the viewer to adjust brightness.
As discussed earlier most modern picture tubes do not require critical focus adjustment. Therefore no focus control is normally provided and instead dc voltage at the focus electrode is carefully set as explained above.
The contrast control through not strictly a part of the picture tube circuit forms part of cathode or control grid circuit. This control is also provided at the front panel of the receiver and its variation enables adjustment of contrast in the reproduced picture.

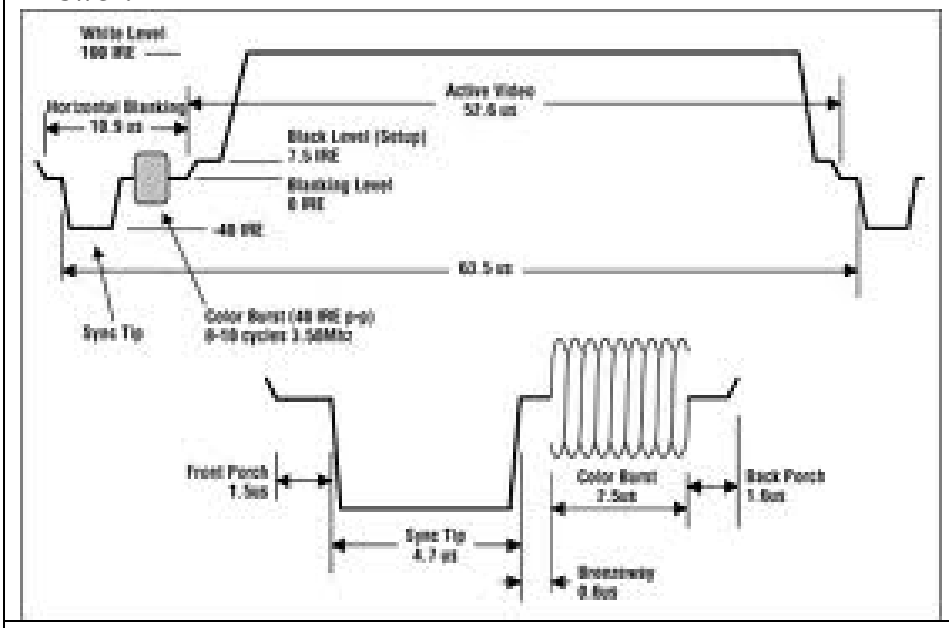
Q.4a. How the interlaced scanning reduces flicker and conserve bandwidth?

Answer: A video frame is made of horizontal lines that are scanned from one side of a display to the other. Progressive video scanning happens when each line of a video frame is scanned, one after another. Interlaced scanning fills the entire frame with only half the lines, which requires half the time, thus doubling the perceived frame rate and reducing flicker. electron beam scans every alternate line instead of scanning each successive line. When the beam reaches at the end of the picture frame, then its again jumps to the top and starts scanning for the lines that were not scanned or skipped in previous scanning. So, the total lines are divided into two groups. These two groups are known as fields. The name of these two groupsare:
Even Field and Odd Field. Both fields are scanned alternately. This types of scanning is known as Interlaced scanning. In this type of scanning, the flicker is reduced to a greater

extent because the picture frame is covered from top to bottom at the double rate.
One of the most important factors in any video system is the bandwidth it uses, since more bandwidth means a more expensive and complex system. Interlaced video reduces the signal bandwidth by a factor of two, for a given line count and refresh rate when compared to progressive scan devices.

b.Draw and explain the composite video signal of negative polarity for a horizontal line, showing H-blanking pulse, H-sync pulse, colour burst signals and variable video signal.

Answer:



Q.5 a. How does colorplexed video signal indicate hue, saturation and luminance of the picture information?

Answer: Page no. 194 of text book 1.

Q.5b. Explain how the 'Y' and color difference signals are developed from the camera outputs? Why is the 'Y' signal set = 0.3R + 0.59G – 0.11B?

Answer: It would be very difficult to transmit or record Red, Green, Blue and Luminance.
It would take up too much bandwidth in transmission, and too much memory in recording.
Instead, we just transmit and record (and often process) just the Luminance, Red & Blue signals. By leaving out the green, which is often quite high in amplitude, we reduce our bandwidth and memory requirements.
Because the Red & Blue signals are usually quite low in amplitude we modify them first by combining them with the inverted Luminance signal. In this form they are known as COLOUR DIFFERENCE signals.
The RED COLOUR DIFFERENCE SIGNAL IS CALLED R-Y.
The BLUE COLOUR DIFFERENCE SIGNAL IS CALLED B-Y.

Y + (R-Y) = R
Y + (B-Y) = B
Remembering that Y = R + G + B, we get:-
Y - (B + R) = G
So by transmitting just a reasonably high quality Luminance signal, and combining it with reasonably low quality Chrominance in the form of colour difference signals, we manage to squeeze everything into a relatively small space in terms of bandwidth & memory requirements. This is called Composite video.
If we want better quality we keep the three signals separate, and use three wires to carry the signal instead of just one. In this form the video signal is called COMPONENT VIDEO. All modern professional equipment handles the signal in component form. The diagrams on the following pages illustrate colour bars in component form.
THE WEIGHTED VALUES OF COLOUR DIFFER- In their raw form, the colour difference signals can be so high in amplitude that distortion would occur during processing, recording and transmission. In the colour bars example used earlier, if the luminance signal level is one unit high in amplitude, the R-Y signal will be 1.4 units high, and the B-Y signal will be 1.78 units high. To prevent this happening, the colour difference signals are reduced in amplitude:- The R-Y signal is reduced to 50% of its original amplitude. The B-Y signal is reduced to 39% of its original amplitude.

Q.6a. Justify the choice of 3.579545MHz as the sub carrier frequency in the NTSC system. How does it affect the line and field frequencies?

Answer:

If we wanted to define the rates to the Nth degree, the important starting point is the field rate. The NTSC color frame rate was defined as (60 * 1000/1001) Hz, which is a bit more than 59.94 Hz. From this rate, all the others in the system are defined. The line rate is 262.5 times this, and the color subcarrier is defined as 455/2 times the line rate. This is often given as simply 3.579545 MHz, but the color subcarrier was actually derived from the line/field rates rather than the other way around.

The whole thing was done so as to avoid (or at least minimize) interaction between the luminance, chrominance, and audio subcomponents in the standard color signal. This could have been achieved by moving either the audio subcarrier or adjusting the line and frame rates as described above. Unfortunately, the latter route was chosen, leaving us with this very strange looking set of rates.

The precise color burst frequency winds up being 3.579545.4545... under this definition, but giving it to the nearest Hz is within the tolerances of the system.

Q6 b. Explain with the block diagram how both (B-Y) and (R-Y) signals are combined around the same sub carrier frequency by Quadrature modulation? Why is the color signal bandwidth requirement much less than those of Y signal?

Answer: When televising colour scenes even when voltages R, G and B are not equal, the 'Y ' signal still represents monochrome equivalent of the colour because the proportions 0.3, 0.59 and 0.11 taken of R, G and B respectively still represent the contribution which red, green and blue lights make to the luminance. This aspect can be illustrated by considering some specific colours.

Desaturated Purple

Consider a desaturated purple colour, which is a shade of magenta. Since the hue is magenta (purple) it implies that it is a mixture of red and blue. Two word desaturated indicates that some white light is also there. The white light content will develop all the three i.e., R, G and B voltages, the magnitudes of which will depend on the intensity of desaturation of the colour.

Thus R and B voltages will dominate and both must be of greater amplitude than G. As an illustration let R = 0.7, G = 0.2 and B = 0.6 volts. The white content is represented by equal quantities of the three primaries and the actual amount must be indicated by the smallest voltage of the three, that is, by the magnitude of G.

Thus white is due to 0.2 R, 0.2 G and 0.2 B. The remaining, 0.5 R and 0.4 B together represent the magenta hue.

(i) The luminance signal Y = 0.3 R + 0.59 G + 0.11 B. Substituting the values of R, G, and B we get Y = 0.3 (0.7) + 0.59 (0.2) + 0.11(0.6) = 0.394 (volts).

(ii) The colour difference signals are:

(R – Y) = 0.7 – 0.394 = + 0.306 (volts)

(B – Y) = 0.6 – 0.394 = + 0.206 (volts)

(iii) Reception at the colour receiver—At the receiver after demodulation, the signals, Y, (B – Y) and (R – Y), become available. Then by a process of matrixing the voltages B and R are obtained as:

R = (R – Y) + Y = 0.306 + 0.394 = 0.7 V

B = (B – Y) + Y = 0.206 + 0.394 = 0.6 V

(iv) (G – Y) matrix—The missing signal (G – Y) that is not transmitted can be recovered by using a suitable matrix based on the explanation given below:

Y = 0.3 R + 0.59G + 0.11B

also (0.3 + 0.59 + 0.11)Y = 0.3R + 0.59G + 0.11B

Rearranging the above expression we get:

0.59(G – Y) = – 0.3 (R – Y) – 0.11 (B – Y)

(G – Y) = – 0.51(R – Y) – 0.186 (B – Y). Substituting the values of (R – Y) and (B – Y) (G – Y) = – (0.51 × 0.306) – 0.186(0.206) = – 0.15606 – 0.038216 = – 0.194G = (G – Y) + Y = – 0.194 + 0.394 = 0.2, and this checks with the given value. (v) Reception on a monochrome receiver—Since the value of luminance signal Y = 0.394 V, and the peak white corresponds to 1 volt (100%) the magenta will show up as a fairly dull grey in a black and white picture. This is as would be expected for this colour.

Q.7 a. Explain the EIA Standard for Color-Bar Signal.

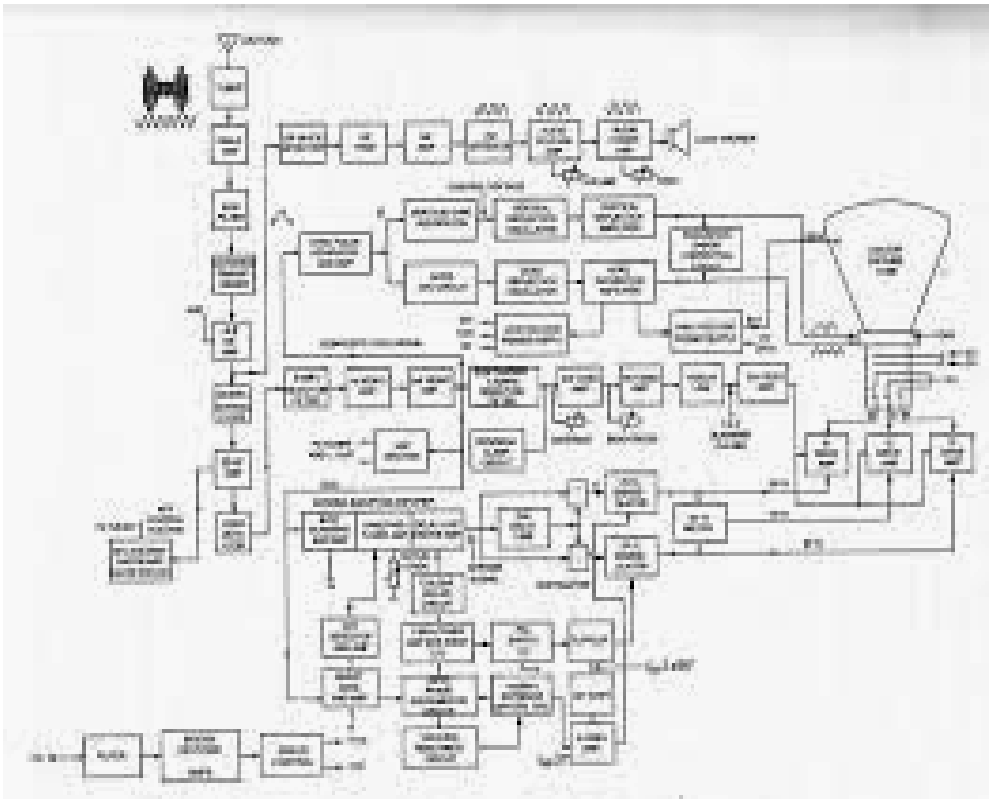
Answer: Page Number 200 of Text Book 1

b. Explain stair-step test signals.

Answer: Page Number 210 to 212 of textbook 1

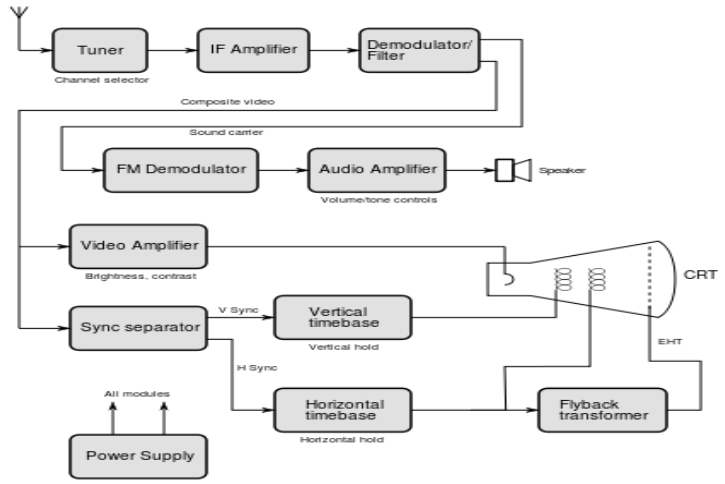
Q.8 a. Draw the block diagram of colour TV receiver and explain the function of each block in brief.

Answer:



b.Draw the block diagram of sound carrier in TV receiver. Explain briefly, how the intercarrier sound signals as obtained at video detector is processed to produce sound output? Why is a de-emphasis circuit rs provided after FM detector?

Answer:



Q.9 Write short notes on the following:- (8+8)

(i) The use of oscilloscope in TV servicing
(ii) Three Steps to Effective Trouble Shooting

Ans 9) Page Number 424 of Text Book 1

TEXTBOOK

1. Basic Television and Video Systems, Bernard Grob and Charles E. Herndon, SixthEdition, 1999, McGraw Hill International Edition