Q. 1(a) Attempt any THREE of the following:

Q. 1(a) (i) Draw and explain Dolby-NR System.

Dr. Ray Dolby introduced a novel system for providing 10 – 15 dB improvement in recording and playback tapes. In normal pre-emphasis, it is presumed that weak intensity is present only in high frequencies. This is not always the case. All weak signals, irrespective of frequencies need to be emphasized. This difficulty is solved by Dolby as explained below:

When the strength of signals falls below a pre-determined level (say, 40 dB over the noise level), the circuits boost the strength before recording. All signals which are 40 dB or higher, pass through the Dolby system direct without any change. The lower level signals pass through the boosting stages which boost these signals by 10 – 15 dB. Boosting is done before recording. Signal in the absence of boosting is shown in Figure 1.

(a) After boosting, recording noise remains unchanged but signal is boosted as shown in Figure 1(a).

(b) During playback, signal and noise both are reduced as shown in Figure 1(b).

(c) Thus, Figure 1(c) indicates that signal to noise ratio is finally improved.

![Diagram showing Dolby-NR System](image)
Q.1(a) (ii) Explain the different types of lenses used in CD player. [4]

(A) CD Lens

Collimation Lens
The collimator lens is used to produce completely parallel beams of laser. This lens together with the objective lens is used to focus the laser beam to the disc surface.

Concave Lens (In Single-Beam Linear Optical Block)
In single-beam linear optical block assembly this concave lens is used to concentrate the laser beam, reflected from the disc surface, onto the photodiode array. This lens is mainly used to improve the sensitivity of the photodiode array.

Quarter Wave Plate (In Three-Beam Linear Optical Block)
The direct laser beam going towards the disc surface, when passed through this plate gets optically rotated by 45 degrees. The reflected laser beam is...
further rotated by 45 degree, when the beam pass through this for the second time. This cause the optical polarization between the direct laser beam, going towards the disc, and the reflected laser beams to differ by 90 degree. The reflected beam is now of the correct polarization to enable efficient deflection of it within the prism, towards the photo-diode array.

**Objective Lens**
Before hitting the disc surface, the laser beam comes out of the pick-up assembly through an objective lens. The objective lens is used to focus the laser beam onto the CD surface and to receive the reflected laser beam. This lens is moved up/down to achieve the focus of the laser beam on the disc surface. The objective lens is always kept in focus using a system similar to the voice coils system used in the audio speakers. It is also moved horizontally in the linear pick-up assembly to keep the laser beam in proper track. In players that use the radial tracking method the objective lens unit does not move horizontally (laterally).

**Cylindrical Lens (In Three-Beam Linear Optical Block)**
The main function of this lens is to enable the reflected beam from the CD to assist in creating the necessary signal to make sure that focus of the laser beam on the playing surface of the disc is maintained.

![Cylindrical Lens to get Focus Error](image)
When the beam is correctly focused, a circular beam of light will land on the four photo-diode elements. If the beam becomes out of focus, the cylindrical lens will distort the beam elliptically. As shown in the figure, the distortion depends upon the direction of mis-focus. This distortion is known as “astigmatism”.

Q.1(a) (iii) Draw the CVS and name different parts in it.

(A)

Composite video signal consists of three different lines as shown in figure.
(i) The level of the video signal when the picture details being transmitted corresponds to maximum whiteness to be handled called as peak white level. This is fixed at 10 to 12.5% of the maximum value of the signal.
(ii) The black level corresponds to approximately 72%.
(iii) The synch pulses are added at 75% level called the blanking level.
(iv) The region between black level and blanking level is called as ‘pedestal’.
(v) However they merge and appears to be one practically so the picture information vary between 10% to 75% of the CVs.
(vi) The darker the picture the higher will be the voltage within those limits.
Q.1(a) (iv) Explain separation of u and v signal with the help of block diagram. [4]

(A) Separation of U A V signal
As we known that in the transmitter both U A V are combined with each other. Hence we have to separate them in the receiver. For V signal, For line N the phase shift is +90°, therefore the equation for combine signal can be written as u+jv. For the next line [+1] the V signals have a phase shift of -90°. Hence the equation of combined signal is u-jv. For separation purpose we sub & add the signal u+jv & u-jv as shown in figure.

Actually, the operation of u & v signal is done with the help of transformer action. As known in figure it consists of transistor Qi, transformer T1, centre tapped transformer T2 and PAL Delay line. The signal after passing through PAL Delay line appears across winding A of centre tapped transformer. The colour signal is also directly fed to the centre point of transformer via potentiometer R2. Thus, delay line provides the signal to the centre tapped transformer having equal magnitude and opposite phase in winding A & B. On the other hand the direct signal induces in winding A & B. Thus, addition takes place in winding B hence we get U signal at winding B since subtraction takes place in winding A hence we get V signal across winding A.
The detail circuit of operation of U & V signals is as shown below:

Q.1(b) Attempt any ONE of the following:

Q.1(b) (i) Write a short note on Vidicon Camera tube.

(A)

The Vidicon came into general use in the early 50's and gained immediate popularity because of small size and ease of operation.

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

Figure 2, illustrates the structural configuration of a typical Vidicon, and Figure 2 shows the circuit arrangement for developing camera signal output.
As shown there, the target consist of a thin photo conductive layers of either selenium or antimony 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 $R_L$.

The beam that emerges from the electron gun is focussed on surface of the photo conductive layer by combined action of uniform magnetic fields 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 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.

Q.1(b) (ii) Explain the working of Dish Antenna used in cable TV and give its specification. [6]

(A) Dish Antenna

Why dish antenna having meshy structure : 
- While installing the dish antenna look angles are taken into consideration.
- Once look angle adjusted installation should not be disturbed.
Due to atmospheric changes like rain, winds there is a possibility of change in look angle of dish, due to meshy structure, rain and wind will go through holes by keeping fix position of dish antenna.

The parabola is a plane curve defined as the locus of a point which moves so that its distance from another point (called the focus) plus its distance from a straight line (directrix) is constant. These geometric properties yield an excellent microwave or light reflector.

**Principle**: The parabolic reflector collects all the electromagnetic waves from satellite due to parabolic shape reflected rays concentrate at focal point which gives the high gain signal.

![Diagram of a parabola with labeled parts](image)

The ratio of the focal length to the mouth, diameter (AF/CD) is called aperture of the parabola just as in camera lenses.

- A practical reflector employing the properties of the parabola will be a three dimensional bowl-shaped surface, obtained by revolving the parabola about the axis AB.
- The resulting geometric surface is the paraboloid, often called a parabolic reflector or microwave dish.
- When it is used for reception exactly the same behaviour is manifested, so that this is also a high gain receiving directional antenna reflector.
- The principle of reciprocity which states that the properties of an antenna are independent of whether it is used for transmission or reception.
- The reflector is directional for reception because only the rays arriving from BA direction i.e. normal to the directrix are brought together at the focus.
- On the other hand, rays from any other direction are canceled at that point, again owing to path length differences.
The reflector provides a high gain because like the mirror of a reflecting telescope, it collects radiation from a large area and concentrates it all at the focal point.

Specifications of Dish Antenna:
(i) Size – 8 feet
(ii) Gain – 36 dB
(iii) Band – C – (3.7 to 4.2 GHz downlink frequency)
(iv) Look angle – 360° rotation in azimuth, 18 to 90° rotation in elevation

Q.2 Attempt any FOUR of the following:

Q.2(a) Draw and explain Cross-over network with it’s frequency response.

(A) Crossover Networks
- When a multiway loudspeaker system is used to get flat frequency response for the entire range of audio frequencies, it is essential to have a cross-over network to divide the incoming signal into separate frequency ranges for each speaker.
- In the absence of crossover networks, the speakers will suffer overheating and the output will be distorted when full power at frequencies outside their range is fed to them. Overall efficiency will be much reduced in the absence of crossover networks.

Fig.1: Basic cross-over network.
Crossover network make use of the fact that the capacitive reactance decreases with increase in frequency \([X_c = 1/(2\pi fC)]\), and the inductive reactance increases with increase in frequency \((X_L = 2\pi fL)\). A basic crossover network is illustrated in Figure 1.

The circuit consists of a low pass L C filter across the woofer and a high pass L C filter across the tweeter. The low pass filter permits only low audio frequencies (16 Hz to 1000 Hz) to go to the woofer. The series reactance of L and shunt reactance of C for high audio frequencies prevents these frequencies from going to the woofer.

The high pass filter consisting of C in series and L in shunt allows the high audio frequencies to pass to the tweeter and blocks the low frequencies.

The response curve of a typical crossover network (Figure 1) is shown in Figure 2. It gives attenuation of 12 dB per octave.

\[
L = \frac{R_L \sqrt{2}}{2\pi f_c} \quad \ldots \quad (1)
\]

\[
C = \frac{1}{2\pi f_c R_L \sqrt{2}} \quad \ldots \quad (2)
\]

where, \(R_L\) is the impedance of loudspeaker in ohms and \(f_c\) is the crossover frequency in Hz, \(L\) is the inductance and \(C\), the capacitance of LC circuits.

A commercial three way divider network is shown in Figure 3. In this circuit, capacitor \(C_t\) of 1\(\mu\)F in series with tweeter prevents low and mid frequencies from reaching the tweeter. Similarly, inductance \(L_w\) of 5 mH in series with woofer prevents high frequencies from reaching the woofer.

Inductances \(L_{s-1}\) and \(L_{s-2}\) of 0.5 mH and 5 mH, respectively in squawker circuit allow only mid frequencies and prevent too low and too high frequencies from reaching the squawker.

Typical divider curve for three way network of Figure 3 is shown in Figure 4. Single element in filtering gives attenuation of 6 dB per octave and double elements give 12 dB per octave.
Considerations for designing cross-over networks

(i) The cross-over frequency for woofer tweeter circuit is where the woofer output curve crosses the tweeter output curve. This is normally 1000 Hz. Hence, woofer gives output between 16-1000 Hz and tweeter from 1000 to 20000 Hz for 2 speaker system.

(ii) Attenuation beyond the cut-off frequency for woofer and before the cut off frequency for tweeter should preferably be 12 dB per octave although 6 dB per octave is acceptable for economy models.

(iii) For a three way speaker system, frequency coverage to the cross-over point is as given below:
   - Woofer : 16 Hz to 500 Hz
   - Squawker : 500 Hz to 5000 Hz
   - Tweeter : 5000 Hz to 2000 Hz
While for two way speaker system, it is as follows:
- Woofer: 16 Hz to 1000 Hz
- Tweeter: 1000 Hz to 20000 Hz

(iv) Inductors and capacitances should be calculated correctly.
(v) Electrolytic capacitors cannot be used as there is no polarization D.C. current.

Q.2(b) What is CCD? Give it’s advantage and disadvantage over Camera tube. [4]

(A) CCD consists of MOS capacitors on a layer of SiO₂ and n or P type substrate as shown it consists of very closely spaced MOS capacitor.

The capacitor can store and transfer the charges generated in them due to light intensity. As shown the chip consists of P-type substrate which is covered with an insulator SiO₂.

Then the metallic gates are deposited on SiO₂. Each gate creates one MOS capacitor thus a large number of MOS capacitor can be formed on entire surface of tube.

Now if the potential is applied to any of the gates, the holes in p-type substrate under that gate will be repelled away and a depletion region will be formed, this depletion region is known as potential wells”.

![Fig.1](image)

**Fig.1**: A three phase n-channel MOS charge coupled device (a) construction (b) transfer of electron between potential wells (c) different phases of clocking voltage waveform.

When the light, from scene falls on the wells electrons are generated. Within it these electrons are attracts towards the gate and they are accumulated towards the surface.

The number of electrons generated depends upon the intensity of light. As a result, the charges at top of substrate represents the optical image.
Charge Transfer

The charge of one element is transferred along the surface of silicon chip by applying a more +ve voltage to the adjacent electrodes or gate while reducing the voltage on it. The minority carriers (electrons in this case) while accumulating in the wells reducing their depth and gets shifted to adjacent well.

This docking sequence continues and charges finally reaches the end of the array, where the diode having capacitance from 1 to 2 pf collects them. Like this the information per line from every MOS capacitor gets converted into charge across the cap.

Q.2(c) Draw the block diagram of PAL- Encoder. [4]

A)

Q.2(d) Explain Half-Line Discrepancy in case of TV. [4]

(A) Half Line Discrepency

As we known that in interlace scanning the first odd field starts from left of the screen and ends at the centre of the screen i.e. at the end we get only a half line. The second even field starts at the middle of the screen and ends at the right of the screen. Thus the vertical sync pulse for the first
odd field will come at end of half line period end the second vertical sync pulse will arrive at the end of full line period. This results in misalignment of the horizontal pulse i.e. they do not appear one above the other but they appears at half line interval.

In the TV we have circuit known as Sync separator, which is basically a clipper circuit. The input to the circuit is a composite video signal, this circuit clips the 0 to 75% waveform of CVS and thus produces only horizontal sync pulse and vertical sync pulse at the output. Now to separate H sync pulse and V sync pulse from each other we make use of High pass filter (differentiator) and Low pass filter (Integrator). The differentiator separates H sync pulse by converting them in to spike. The differentiator is form by using C1 and R1. The integrator separates V sync pulse by converting it into sawtooth waveform. The integrator is form using R2 and C2.

The capacitor C2 charges during the vertical sync pulse time and produces sawtooth waveform. The same capacitor C2 also charges during horizontal sync pulse time to a small amplitude and also discharges fully because duty cycle of horizontal sync pulse is less.

Now let us see what happens at the end of even fields. In case of even fields capacitor C2 charges for horizontal sync pulse and also discharges. For even field the gap between the last horizontal sync pulse and vertical pulse is full line, therefore C2 charges and discharges to zero and then we get vertical sync pulse. Thus at the end of even field for the vertical sync pulse, capacitor C2 charges from zero.

Now let us see what happens at the end of odd fields.

The gap between the last horizontal sync pulse is half line because of which capacitor CZ charges but do not discharges to zero, when the sync, pulse appear. It means that at the end of odd field when capacitor CZ smarts charging for vertical sync pulse then at the beginning of charging its voltage is not zero. Thus at the end of odd field the capacitor CZ will charge to more voltage and it will charge early compare to the end of even field. Thus at the end of odd field vertical oscillator will trigger early whereas at the end of even field it will trigger later. This problem is known as "Half Line Discrepancy".
To overcome the above problem we make use of equalizing pulses. Thus we add 5 narrow equalizing pulses before the vertical sync pulse. The equalizing pulses are designed in such a way that their ON time period is less and OFF time period is more and these pulses ensures that capacitor C2 will discharges fully to zero before the vertical pulse arrives. The width of equalizing pulses is 2.3usec. and they are available for period of 2.5 lines.

Similar to pre-equalizing pulses we add 5 post-equalizing pulses after the end of vertical sync pulse. These pulses ensure exact discharge of capacitor C2 to zero. These pulses also occupies 2.5 lines period.

The pre and post equalizing pulses are added at the end of both even and odd field.

Q.2(e) Draw and explain block diagram of DTH system. [4]

(A) Direct To Home System (DTH)

Introduction:
- DTH stands for Direct-to-Home television.
- DTH is defined as the reception of satellite programming with a personal dish in an individual home.
- DTH does not need the local cable operator and puts the broadcast directly in touch with the consumer.
How does DTH works?

Fig.: DTH Block Diagram.

- A DTH network consists of a broadcasting centre satellites, encoders, multiplexers, modulators and DTH receivers.
- A DTH service provider has to lease Ku-band transponders from satellite.
- The Encoder converts the audio, video and data signals into the digital format and the multiplexer mixes these signals.
- At the user end, there will be a small dish antenna and set-top box to decode and view numerous channels.
- On the user’s end, receiving dishes can be as small as 45 cm in diameter.
- DTH is an encrypted transmission that travels to the consumer directly through a satellite.
- DTH transmission is received directly by the consumer at his end through the small dish antenna.
- A set-top box, unlike the regular cable connection, decodes the encrypted transmission.

Q.3 Attempt any FOUR of the following: [16]

Q.3(a) What is color burst signal? Why and how it is added in CVS. [4]

(A) Generation of chrominance signal:

Quadrature amplitude modulation:

In colour TV has 2 weighted colour signals (U & V) are to be modulate then it means that we should use 2 carrier but only one carrier i.e. colour sub carrier is available for modulation. This problem is solved by creating 2 carrier without any change in numerical value this is as shown in figure. We
use 2 balance modulator 1 for signal U and other for signal V. The colour sub carrier frequency is generated with the help of crystal oscillator the carrier is given directly to the balance modulator for U. Where as balance modulator for V gets the carrier through a phase shifting circuit. Thus the phase shifting circuit provides +90° phase shift for odd line and −90° phase shift for even line it means the phase of carrier given to balance modulator V alters line by line hence system is known as Phase Alternation by Line (PAL).

The colour sub carrier should not be transmitted it should be suppressed because if we transmit colour sub carrier along with the colour signal then this colour sub carrier mix up with the 5.5 MHz sound carrier and generates the beat frequency. These beat frequency act as a noise and creates unnecessary dots and bars on the picture image. Hence for the modulation of U & V colour signal we make use of balance modulator which suppress the colour sub carrier and solves the problem.

**Colour Burst Signal:**
Since the 2 carrier components in the balance Quadrature modulator therefore it is necessary to regenerate them at the receiver for demodulation. Hence we transmit 8 to 10 cycles of colour sub carrier along with the colour signal. These 8 to 10 cycles are situated at the back porch of horizontal blanking period. This signal is known as colour burst signal. It is separated at receiver and used to lock the sub carrier oscillator with that at the transmitting end. The colour burst does not interfere with the horizontal sync pulse because it follows them and is of lower amplitude.
Q.3(b) Explain working of LNBC with help of block diagram. [4]

(A) LNBC
The main function of the LNBC is to convert collected signal to a low frequency range to minimize losses in co-axial cable that carry dish antenna signals to control room.

The figure shows block diagram of LNBC or also called front end converter.
- The composite signal collected by the feed horn is fed to a Low Noise Amplifier (LNA) which provides enough gain while maintaining maximum possible signal-to-noise ratio.
- The LNA output fed to a converter which converts the incoming microwave (high frequency) signals to a lower frequency range.
- This is done using local oscillator frequency of converter.
- A Band Pass Filter (BPF) at the output of mixer separates the wanted I.F. signals from other signals.
- These signals are amplified by multistage I.F. amplifier and then sent to co-axial cable to the control room (or cable station).
- It is necessary to install 2, 4, 6 or 8 dish antenna units with feed-horn and LNBC to collect signals from different satellites.

![Block diagram of an LNBC](image)

Fig.: Block diagram of an LNBC.

Specifications of LNBC:
1) Input frequency – 3.625 to 4.2 GHz
2) Output frequency – 950 to 1525 MHz
3) Local oscillator frequency – 5150 MHz.
4) Impedance – 75 Ω
Q.3(c) Compare Addictive and subtractive mixing in color TV. [4]

(A) Subtractive Mixing

A sensation of colour is produced by opaque objects or materials when white light falls on them. It is so because any surface does not reflect all the wave lengths of the incident light uniformly. In fact, only some out of these are reflected and the rest get absorbed at the surface of the object. Thus any object is seen in a colour corresponding to the spectrum of radiated light which is not absorbed but instead gets reflected. For example, a red apple absorbs light of all colours except red which it reflects and thus looks red based on such facts special chemical called pigments are used for printing and painting. A yellow pigments absorbs violet, blue, green, orange and red but reflects the remaining yellow. When pigments of two or more colours are mixed they reflects wavelength of only those colours which are common to both and these combine to give the sensation of a new colour.

Making colours by mixing paint pigments is therefore described as “subtractive mixing”. Since each added pigment subtracts more from white light and leaves less to be reflected to the eye.

Additive Mixing

This is another method to produce various colours. When light of two or more different colours are mixed and projected on a white screen, the eye perceives it as a combined colour. In effect the light reflected from the screen seems to the eye as if it is coming from a new source of light which is different from any of the sources actually projected. A white colour is perceived by additive mixing sensations from all the three sets of cones two or more colours obtained either from independent sources or through filters can create a combined sensation of different colour. These (different) colours are created by mixing pure colours and not by subtracting parts from white. This method is normally used in T.Vs.
Q.3(d) List the types of Amplifiers used in cable TV and give their use. [4]

(A) Amplifier
- Amplifier increases strength of the input signal.
- In cable distribution system, the starting point for cable signals is called the head end.
- Here, cable TV company receives programming via. satellite transmission, microwave transmission and local broadcast.
- Those signals are amplified adjusted for level and fed into the trunk lines.

Fig.1(a) : Basic Distribution System for Cable Television.

Fig.1(b) : Trunk Amplifiers Correct for Losses in Cable Run.

Trunk Amplifiers :
- The trunk amplifiers are inserted at regular intervals along the trunk route to make up for cable losses. Figure 1 shows 20-dB amplifier is at the end of a cable run with a loss of 20 dB.
- The decibel unit used for cable signals is dB mV which means 'decibels above 1 mV.
- Amplifiers are placed at regular intervals to keep the signal up to the standard level of 1-3 mV.
Bridging Amplifier :
- A bridging amplifier is for a branch from the main trunk to feed a particular neighbourhood in the cable system.
- The typical gain is 20-40 dB.
- The output is for the branch lines to individual subscribers.
- In many cases the trunk and bridging amplifiers are located in the same weatherproof housing.
- An additional attenuator may be used at the input to the bridging amplifier to balance the signal levels.

Line Amplifiers :
- Long line runs from the bridging amplifier may require that line extender amplifiers be inserted in the branch line to make up for cable losses in that branch.
- Such an amplifier extends the number of drop lines that can be used on branch line. The typical gain for a line amplifier is 20-40 dB.

Specifications :
(i) Frequency response - 45 to 550 MHz.
(ii) Gain - 40 dB,
(iii) Noise - 7 dB.
(iv) Input/Output impedance - 75 Ω.

Q.3(e) What is the advantage of fluorescent display in CD player? [4]
(A) Advantages of Fluorescent display system used in C.D. player :
Vacuum Fluorescent Display (VFD) is a display device used commonly in CD, VCD and DVDE players.

Advantages of Fluorescent Display :
(i) Emits a very bright light with clear contrast.
(ii) Easily support display elements of various colours.
(iii) The light produced by most VFDs contain many colours and can often be filtered to produce a more pure colour such as deep green or deep blue.
(iv) Being rugged, inexpensive.
(v) Easily configured to display a wide variety of customized messages.
(vi) Most VFDs continue to function normally in sub-zero temperatures making them ideal for outdoor devices in cold climates.
(A) **Closed Circuit Television (CCTV)**

- As the name implies, it is a system in which the circuit is closed and all elements are directly connected.
- This is unlike broadcast television where any receiver that is correctly tuned can pick up the signal from the airwaves.
- In the Closed Circuit Television (CCTV) system the video output from a TV camera is fed directly by a co-axial or a low power wireless link to a special type of TV receiver called a monitor which is installed at a remote position so that the picture is produced on the screen of the monitor.
- A TV monitor or a video monitor is as ordinary TV receiver without the RF-IF stages.
- It produces the picture directly from the composite video signal supplied by TV camera.
- When a number of cameras are used for monitoring at different locations, a camera selector switch is used to select the signals from different cameras.
- **CCTV** is a very useful system which finds many applications in education, industry, business, medicine and traffic control.

**Simple CCTV System**

- The simplest system is a camera connected directly to a monitor by a coaxial cable with the power for the camera being provided from the monitor. This is known as line powered camera.
- The next development was to incorporate the outputs from four cameras into the monitor.
- These could be set to sequence automatically through the camera.
- There was even a microphone built into the camera to carry sound and a speaker in the monitor.

![Fig. 1(a): A Basic Line Powered CCTV System.](image)
All the cameras shown above are fixed with fixed focal length lenses.

In many applications the area to be covered would need many fixed cameras. The solution to this is to use cameras fixed to a movable platform.

This platform then be controlled from a remote location.

Cameras may be used indoors or outdoors.

Some systems may contain a combination of both fixed and movable cameras shown in figure through switcher and controller.
Applications of CCTV
(i) Monitoring traffic on a road (or bridge).
(ii) At cricket or football stadiums.
(iii) Production control in factory.
(iv) In hospitals, important surgical operations can be shown to students outside the operation theatre and also a watch can be kept on patients in bed.
(v) Police can use CCTV for traffic control and control of crime and in banks.
(vi) In business houses the CCTV is helpful in observing customers and sales people from remote positions.

Q.4(a) (ii) Draw the block diagram of Audio CD player. [6]

(A) CD Player

![Block Diagram of a CD Player]

**Fig.:** Block Diagram of a CD Player

**CLV v/s CAV**

The CD player is known as a CLV or “Constant Linear Velocity” system.

In a CLV device such as the CD player the rotational speed of the disc player is adjusted with the movement of the reading mechanism on the disc.
surface. This speed is changed to maintain a constant linear velocity, i.e. the
signal on the disc surface always moves at a constant speed of 1.3m per
second under the pickup head.

**Half-Full Memory**
This half-full memory circuit makes the disc to maintain a constant linear
velocity when the reading mechanism moves from outer tracks of the disc to
the inner tracks or from inner tracks to the outer tracks on the disc
surface. This half-full memory is always maintained at a half-full position
and the reading mechanism will remove signal from this memory and process
the audio signals without showing any effect of the disc speed change. Also
the clock signal, which is stored on the CD surface with the data, is used to
maintain a constant linear velocity of the CD play.

**Decoding CD**
During the decoding, the digital data on the disc surface is read by the
decoding circuit and is converted into the analog audio signal required to
drive the speakers and to re-generate the stored music.

**Optical Pick-up**
The audio signals stored on the CD surface as pits and flat areas are first
picked up by the optical pick-up made of lens assembly, prism, photo
detectors and laser diode assembly in the Optical Pickup unit.

**High-Frequency Amplifier**
This signal is very weak so it is amplified by a high-frequency RF-Amplifier
circuit to bring the signal to a proper level. This amplified and filtered high-
frequency (HF) signal contains audio signal as well as synchronization signals
in 14 bit EFM (Eight to Fourteen Modulated) format, this signal is sent to an
EFM demodulator circuit.

**EFM Demodulator**
- The EFM demodulator separates the modulated data and the timing
  signal from the signal received at its input. It also removes the
  additional coupling bits and convert the 14 bit EFM symbol to actual 8 bit
data.
- The amplified and filtered EFM signal from the High-Frequency amplifier is
  also given to the clock regeneration circuit and to the synchronization
detecting and timing circuit. These circuits are used to recover the bit
clock and the sync pattern from the data. The timing signal separated by
this circuit is used to provide timing signal to the system.
ERGO Circuit
Demodulated data from the EFM demodulator is send to an error correction (ERCO) circuit. This demodulated data signal is also send to control and display decoding circuit, which recovers the control and display signals multiplexed into the signal received from the CD.

Interpolation and Muting
This ERCO circuit is mainly used for the task of error detection and correction purpose. Any error found in the incoming data signal is send to the interpolation and muting section by the ERCO circuit. This information is sent with a flag signal indicating the type of action to he performed to correct the error.

The interpolation and muting section uses the following methods to correct any error found in the data stream read from the disc.
- Muting
- Last Word held
- Linear interpolation

Muting
In muting, when an error is detected in the data stream, the player will mute (silence) the sound output so that the undesirable sound is not send to the speaker.

Previous Word Held
When the analog signal is sampled, each sample is given a 16 bit word value. A 16 bit word can have 65,536 different values. Normally an audio signal is a smooth analog wave, so if any data is missing from the data stream read from the disc, it can be assumed that the missing data will be about only 1/65536th different from its previous word. A difference of only 1/65526 is such a small difference that no human being can detect it. So, in this method of “Previous Word Held”, the missing data in a sound stream is filled with the data from the previous word in the stream.
Q.4(a) (iii) Draw the circuit diagram and frequency response of five point graphic equalizer using op-amp.

(A) SINGLE ENDED SUPPLY GRAPHIC EQUALIZER WITH LM 741

Super simple graphic equaliser using single polarity supply

Fig. : Super Simple Graphic Equaliser using Single Polarity Supply

- This circuit is a super simple wired around an OP-Amp LM 741, in a closed loop mode, with a single ended supply.
- The gain of LM 741 varies with the controlled frequency band. There are fix bands controls connected between non-inverting and inverting inputs of LM 741, with their mid terminals connected to different values of condensers which are connected to a rail by passed a filter condenser C₂ and resistor R₄.
- All potentiometers of 100 KΩ linear type either in rotary or side version. Input from pre-amplifier is fed through C₁ to non-inverting Pin No. 3 of IC LM 741. Pin No. 2 (Inv. input) is connected to Pin No. 6 through R₅ as closed loop. The central frequencies of this network is set at 50 Hz, 160 Hz, 500 Hz, 1.5 kHz, 5 kHz, 16 kHz through VR₁, VR₂, VR₃, VR₄, VR₅ and VR₆ respectively.
- The circuit provides adequate boost/cut for normal use. 6V power supply is provided to circuit which is commonly available tape-cum radio, tape deck etc. In case of stereo sound system two such identical circuits can be used for both channels.
Q. 4(b) Attempt any ONE of the following: [6]
Q. 4(b) (i) Explain the circuit of color killer circuit. [6]

(A) Ident and Colour Killer Circuit:

The main function of this circuit is to amplify burst phase ident signal and to generate colour killer bias voltage.

A shown in the circuit diagram, transistor $Q_9$ is tuned collector amplifier whose collector is tuned to 7.8 kHz frequency. Thus, square waveform of frequency 7.8 kHz obtained at the output of phase discriminator is amplified by $Q_9$. The $R_{59}$ and $R_{60}$ provides voltage divider biasing to $Q_9$ whereas $R_{61}$ is an emitter resistance used to stabilize $Q_9$ pt of $Q_9$. Thus after amplification we get 3.5Vp-p signal at the final output.

(a) Colour Killer: The centre tapped inductor $L_4$ at the collector of $Q_9$ works as an autotransformer and generates 25Vp-p signal at collector of $Q_9$. This signal is given to diode $D_{10}$ and capacitor $C_{30}$. They work as a half wave rectifier with $C$ filter and provides a steady DC level of about 13.5V. Thus whenever the TV receives the composite video signal of colour picture than we get 7.8 kHz signal due to which we get 13.5V steady DC level. This DC level is given to second chroma band pass amplifier and because of this DC level, chroma band pass amplifier turns ON. On the other hand when TV receives monochrome signal then we don’t have 7.83 kHz signal at base of $Q_9$. Hence, the DC level falls to or below 2V and due to this the chroma band pass amplifier turns OFF. Thus, colour killer circuit turns OFF chroma band pass amplifier for monochrom received signal.
Q.4(b) (ii) Explain with the help of circuit diagram, how EHT voltage is generated? [6]

(A) EHT GENERATION

Generation of EHT for Picture Tubes:
In monochrome TV receiver EHT potential generating by overwind on L.O.T. but it is not possible beyond 16 kV because of problems like flash over, high impedance and poor regulation.

So in colour TV to generate EHT upto 25 kV the diode split addition technique is used. It has advantages like greater reliability, small size and low cost.

Figure 1 shows the principle of Diode split addition.

- Three layers of secondary windings are wound on ferroxide core of the L.O.T (Line Output Transformers).
- In actual practice, three sections shown separately and wound one above the other and are thus concentric.
- Each winding is identical to the other and has the same number of turns therefore same voltage induced in each section.
- Every time the flyback-derived input pulse gets applied to the primary winding (not shown here).
- The layers are close to each other, thus inter-layer capacitance exists between each of them (shown by dotted line).
- If a diode is connected between the end of one layer of winding and the start of next, the a.c. voltages induced in each layer can be made to charge up all the inter-layer capacitance to the same voltage.
- Since the capacitances are effectively in series, the total voltage appearing at the output terminal is sum of all the voltages appearing across all of them.
- The three windings are so designed that voltage induced in each layer form the flyback transformer 8.33 kV. This makes total potential equal to 25 kV and forms the EHT supply source.

Anode of 37 cm (14") monochrome picture tube needs 12 kV for good brightness on screen. 51 cm (20") B/W picture tube needs 16 kV.
Fig. 1: Principle of Split Diode Operation to obtain EHT and Focus Anode Potentials for a Colour Picture Tube.

Circuit for generating EHT:

Fig. 2: Simplified Line Output Circuit showing Generation of Supply Voltages Necessary for various Electrodes of a Colour Picture Tube.
• Anode potential \((G_2)\) is obtained for screen grid separately at collector of \(Q_2\).
• This is rectified by \(D_1\) and then filtered by \(C_{10}\). Output dc voltage is 550 to 800 V.
• Any failure of \(G_2\) means no beam current and hence no spot is produced on screen.
• Focus anode \((G_3)\) potential needed is 6.5 kV to 7.5 kV. It is obtained from diode split winding \((D_2, D_3 \text{ and } D_4)\). Each stage produces potential of 8 kV.

Q.5 Attempt the following:

Q.5(a) Explain the Basic principle of LCD TV. [4]

(A) LCD

It is cheaper and needs little power and **so they hold maximum promise for being used as flat panel display.**

Liquid crystals are organic compounds whose physical properties are the same as those of a crystal, but whose behaviour resembles that of a liquid. Hence they are known as liquid crystals. A molecule of a liquid crystal has an elongated rod like shape and its structure is somewhat rigid. Electric conductivity, refractive index and polarization of a light coming out of it depends on the orientation of its crystals. This property of a liquid crystal is used to make the light, passing through it, change its polarization. The liquid crystals adjust themselves parallel or perpendicular to the electric field.

The electric field applied to an LCD cell twists the molecules, the twist being proportional to the signal voltage. The electric field is applied at right angles to the axes of liquid crystals. The LCD element has a thin (about 10 micron thick) liquid crystal sandwiched between two transparent plates. When the voltage applied to the plates varies, the polarization of light passing through the liquid crystal changes. It can change between 0 and 90 degree. The action of an LCD is shown in figure 1(a) and (b).

The polarization of the incident light is random. The vertical polarizer selects only vertically polarized light. In figure 1(a), the LCD crystal causes a shift of 90° in the polarization and hence it becomes horizontally polarized light. The next polarizer is the horizontal polarizer which allows this light to pass and so light comes out of the LCD element.

In figure 1(b) the LCD crystal causes no shift in the polarization. So the light coming out of the liquid remains vertically polarized, which is stopped
by the horizontal polarizer. Thus, no light will come out of the LCD element. Consequently the transparency of the LCD pixel element will depend on the degree of shift in polarization. It will have different intensity within two limits of full light to zero light. Relationship between signal-voltage and transparency of the cell is linear.

![Diagram of liquid crystal molecules]

**Fig. 1:** (a) Orientation of liquid crystal molecules to allow light in the output  
(b) Orientation of liquid crystal molecules to block light.

In a practical system, 100 000-400 000 pixels of LCDs are arranged in a rectangular matrix. Each pixel is controlled individually by its built-in thin film transistor. It can be opened or closed or driven to any point between the two extremes to produce the original pattern of light intensity on the screen.

Pocket TV receivers, electronic toys and lap-top computer monitors are widely using LCD display panels because of their obvious advantages of low power, small weight, compactness and high reliability. LCDs have also been developed as large size flat TV panels.

**Q.5(b) Draw and explain with block diagram working of dB meter.**

**(A) dB Meter**

**Principle:**

The logarithmic term is applied to an electronic voltmeter when the current or voltage produced in the indicating instrument by an applied voltage is proportional to the logarithm of applied voltage.

- Such a characteristics leads to a linear decibel scale for the indicating instruments and finds many applications in electronics.
- The reading on the meter scale is calibrated in decibels and hence the instrument is called a dB voltmeter or simply dB meter.
Block Diagram and Working Principle of dB

Block Diagram:

![Block Diagram of dB Meter](image)

**Fig.1 :** Block Diagram of dB Meter.

**Working:**

- The RF signal to be measured is connected to the input of high impedance input circuit through a RF connector, whose input impedance is 75 Ω.
- The range selector switch selects the band and range of its frequencies to be tuned.
- The logarithmic amplifier is connected to the differential amplified whose signal output deflects the dB scale in the dB meter.
- To obtain logarithmic characteristics, the meter use a diode in feedback loop of an op-amp.

dB is the unit for losses and gains. Note that you can express the amplifier gain and attenuation in regular decibels because these values are voltages ratios without any reference.

Cable signal voltages are always measured across the same 75 Ω impedance voltage levels are expressed in decibels. The reference used for CATV is 1 mV across 75 Ω. With this reference, the units are indicated as 'dB mV'.

This reference is an arbitrary value but 1 mV happens to be just about the minimum signal voltage measured across 75 Ω that a receiver needs for a noise free picture. Across 300 Ω, the minimum is 2 mV.

For example: Signal voltage can be converted to dB mV units by the formula:

$$dBmV = 20 \log \frac{mV}{1mV}$$

Because the denominator is 1 mV for the reference simply find the logarithm of the signal level in -milivolts and multiply by 20. For example, to convert a 10 mV signal level,

$$dB mV = 20 \log 10$$
$$= 20 \times 1$$
$$= 20$$

The dB mV method is easy to use in calculation because its logarithmic units can be added or subtracted for voltage gain and losses.
Consider an amplifier with voltage gain of 10, driving a cable with an attenuation factor of 0.5 as shown in figure 2. In (a) the voltage gain of 10 is multiplied by the 1 mV signal input to get a 10-mV output. The cable reduces the signal level by one half thus the final output is $10 \times 0.5 = 5$ mV.

The 5 mV signal output corresponds to 14 dB mV because,
$$\text{dB mV} = 20 \log 5 = 20 (0.7) = 14$$

All values are indicated in dB mV. For a given, add dB mV for a loss subtract dB mV. The values in b are as follows.
- 0 dB mV is the input signal level of 1 mV.
- 20 dB is the amplifier gain 10.
- −6 dB mV is the cable attenuation of 0.5.

The end result for the signal level at the output is $0 + 20 - 6 = 14$ dB mV.

Q.5(c) Explain why Vertical Synch Pulse is serrated? [4]

(A) Necessity of Serrated Pulses:
As we known that vertical sync pulse time period is 160μsec, thus it occupies 2.5 to 3 times the horizontal line period. We purposely keep the width of vertical sync pulse more so that it is easy to distinguish the V sync pulse and H sync pulse at the receiver. As we known that the vertical sync pulse is available during the vertical retrace time and during this time even though the beam is blank we have to keep the horizontal oscillator ON for the proper synchronization. It means that during the vertical sync pulse time period of 160μsec we must make available horizontal for proper triggering of horizontal oscillator. To achieved this serrations are made in the vertical sync pulse. The serrated pulses are basically narrow slots in the vertical sync pulse at half line interval (every 32μsec). The width of each slots is 4.7μsec. during this slot the amplitude of vertical sync pulse.
Q. 5(d) Explain the need of Synchronizing and Blanking pulses in TV. [4]

(A) Composite video signal consists:

(a) Video signals: Video signal is nothing but the actual picture information.

(b) Blanking pulses: These pulses are required to make retrace invisible.

There are two types of Blanking pulses

(i) Horizontal blanking pulses
(ii) Vertical blanking pulses.

They are used to blank horizontal and vertical blanking pulses respectively.

(c) Synchronizing pulses: These pulses are required to synchronize the scanning at transmitter end with receiver end. There are two types of synchronizing pulses.

(i) Horizontal synch. pulses: They are transmitted after every line. They are separated at the receiver end and given to the horizontal deflection coils.

(ii) Vertical Synch. pulses: They are transmitted after one field. They are also separated at the receiver end and given to the vertical deflection coil.

Q. 6 Attempt any FOUR of the following: [16]

Q. 6(a) Give Band I and Band III Allocation for TV. [4]

(A) Television Broadcast Channels

<table>
<thead>
<tr>
<th>Band</th>
<th>Channel No.</th>
<th>Frequency Range</th>
<th>Picture Carrier Frequency (MHz)</th>
<th>Sound Carrier Frequency (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1</td>
<td>40 – 47 (not used)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(41–68 MHz)</td>
<td>2</td>
<td>47 – 54</td>
<td>48.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>54 – 61</td>
<td>55.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>61 – 68</td>
<td>62.25</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>5</td>
<td>174 – 181</td>
<td>175.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>181 – 195</td>
<td>182.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>188 – 195</td>
<td>189.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
<td>195 – 202</td>
<td>196.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9</td>
<td>202 – 209</td>
<td>203.25</td>
</tr>
</tbody>
</table>
In the UHF bands while the channel width remains the same at 7 MHz, a band gap of 1 MHz is allowed between adjacent channels to prevent any mutual interference.

Q. 6(b) Explain Interlace Scanning used in TV.

(A) Interlace Scanning

In Interlace scanning alternate lines are scanned. When the beam reaches the bottom of the picture frame, it quickly returns to the top to scan those lines that were missed in the previous scanning. Thus total number of lines are divided into two groups called ‘fields’. Each field is scanned alternately. This method of scanning is known as interlaced scanning. This reduces flicker to an acceptable level since the area of the screen is covered at twice the rate.

In 625 line monochrome system, for successful interlaced scanning the 625 lines of each frame or picture are divided into sets of 312.5 lines. To achieve this the horizontal sweep oscillator is made to work at a frequency of 15625 Hz. (312.5 × 50 = 15625) to scan the same number of lines per frame.
(15625/25 = 625 lines). Now vertical sweep circuit is run at a frequency of 50 Hz instead of 25 Hz. First field ends in a half line and second field commences at middle of the line on the top of the target plate or screen. Now the beam is able to scan the remaining 312.5 lines during downward journey.

Note:
In the American T.V. system, a field frequency of 60 was adopted i.e., instead of 50 times in India the whole frame was scanned 60 times, as the supply frequency is 60 Hz in USA. This brings the total number of lines scanned per second \((525 \times (60/2) = 15750)\) lines.

**Scanning period**

Now the duration of horizontal lines if 64 \(\mu S\) \([t = 1/f = 1/15625]\). Out of which the active line period i.e., trace period is 52 \(\mu S\) and the remaining 12 \(\mu S\) is the blanking period. During blanking period the beam returns back to left for next trace.

Similarly with field frequency at 50 Hz, the duration vertical trace and retrace is 20 ms \((t = 1/50)\) out of this 20 ms. 18720 ms is used for trace and 1.280 ms is taken by vertical retrace period.

Now as horizontal sweep is continuous, during vertical retrace period i.e., when beam moves from bottom to top. During that time 20 horizontal sweep occurs and so 20 lines are scanned. Therefore, total 40 lines are blanked out.
Q.6(c) Explain what do you mean by color TV is compatible with block and white TV.

(A) The basic working colour picture contents the information about brightness and the colour of the picture.

We first invented the Black and White TV and then we designed colour TV. While designing the colour TV it is necessary that colour TV should be compatible with Black and White TV. It means that if we apply composite video signal of monochrome TV the colour TV should be able to produce Black and White picture from monochrome signal without any modification in receiving circuitry. When this happen we say that colour TV is compatible with Black and White TV. Similarly when we apply composite video signal of colour picture to the Black and White TV then it reproduces a picture this is known as reverse compatibility.

To achieve complete compatibility the composite colour signal must meet the following requirements.
1) It should occupy same bandwidth as the monochrome signal.
2) The location of picture and sound carrier frequency should remain the same.
3) The colour signal should have same luminance information as would a monochrome signal transmitting the same scene.
4) The deflection and sync signals should remain same as in monochrome signal.
5) The colour signal should contain colour information together with require signals to allow it to be decoded.
6) The colour TV signal must be decode such a way that it does not affect picture reproduce on screen of monochrome receiver.

Q.6(d) Compare NTSC, PAL and SECAM color system.

(A) Comparison between Three Colour Systems

<table>
<thead>
<tr>
<th>System Standard</th>
<th>NTSC</th>
<th>PAL</th>
<th>SECAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Type of chrominance</td>
<td>AM</td>
<td>AM</td>
<td>FM</td>
</tr>
<tr>
<td>2) Line Frequency/Hz</td>
<td>15734.264</td>
<td>15625</td>
<td>15625</td>
</tr>
<tr>
<td>3) Field Frequency/Hz</td>
<td>60</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>
| 4) Colour Subcarrier frequency MHz | 3.58 | 4.43 | $f_R = 4.41$
|                               |      |     | $f_B = 4.25$ |
| 5) Phase of burst | $180^\circ$ | $\pm 135^\circ$ | – |
Q.6(e) Explain CD pick up assembly. [4]

(A) CD PICKUP

The optical pickup unit comes as a single unit and the complete unit need to be replaced when any problem occur to this unit. The pick-up assembly basically consist of

- A low power laser diode to illuminate the CD tracks
- Lens and prism arrangement to direct the laser beam to the CD surface and to direct the reflected laser beam towards photo-diode array
- A photo-diode array to obtain data, focus and tracking signal from the reflected laser beam
- Focus and Tracking coils to focus the laser beam to the CD surface and to move the assembly to proper track across the disc surface.

Some optical units do not contain the tracking coil, for ex. the single-beam radial tracking assembly, this is explained in later sections.

Fig. 1: Single-Beam Radial Tracking Arrangement of Optical Pick-Up Unit
In the optical pick-up unit, the laser diode emits laser beam from a small point into an elliptical or conical distribution. This beam is passed through various prism and lens to form a very small diameter light beam on the disc surface at the center of the track.

The objective lens is controlled by the tracking and focusing coil to keep the beam focused on the CD and to keep the condensed beam at the center of the track. This laser beam is reflected back by the flat area and the pits on the disc surface. This reflected beam is applied to a group of a group of photo-diodes through objective lens, collimator lens, and some prism arrangement.

These photo-diodes induce voltage according to the reflected beam falling on it. Focus error and tracking error voltage generated by this photo-diode array is applied to the tracking and focusing coil to control the objective lens and data signal generated by this photo-diode array is sent to an amplifier to amplify the data signals picked up from the disc. Finally the output from the amplifier is processed to produce the audio signal stored on the disc surface.

Fig.2: Optical Arrangement in a Single-Beam Radial Tracking Pick-Up Assembly

In a CD player the following type of optical assemblies are used.

- Single-beam radial tracking,
- Single-beam linear/straight line tracking,
- Three-beam linear/straight line tracking.