39C
COMPACT DISC FOR AUDIO AND VIDEO RECORDING AND REPRODUCION

39.1 INTRODUCTION

In previous lesson you have learnt about audio and video recordings, as a continous variation of electrical energy obtained from various devices such as microphone, video camera etc. These variations recorded on the magnetic media are called analogue recording. The entertainment world is now going digital. Sophisticated digital technology holds promise for virtually complete fidelity in sound reproduction and superb picture quality in television sets. A number of products based on digital technology such as Compact Disc (CD), digital audio tape (DAT), digital television, and video disc etc. have been developed and are available in the consumer market.

In this chapter you will be introduced to the construction and working of compact disc for audio and video recording. Compact discs encode the music digitally on light reflecting plastic, whereas video disc looks like an ordinary LP (Long play records), but it plays pictures as well as music.

39.2 OBJECTIVES

After Studying this lesson, you will be able to,

- *appreciate the need of a compact disc for superb quality of audio and video prictures.*
- *compare the poperties of compact disc to that of LPs and magnetic tapes.*
- *highlight the advantages of compact disc player and video disc player.*
- *give the construction and working of a compact disc.*
- *differentiate between digital and analogue recording system.*

39.3 TRADITIONAL AUDIO RECORDING AND REPRODUCTION SYSTEM

There are two traditional audio recording systems. One is magnetic tape and the other is phonograph record called Long play (LPs) record. You have learnt about audio recording in magnetic tape in the previous lsesson Conventional records (LPs) have a continous wavy groove in the surface which is an exact reproduction of sound waves originally recorded and are recreated (reproduced) as the stylus/needle moves in these grooves. On the other hand, in audio tape the sound is recorded and recreated by the magnetic media. These traditional systems have some drawbacks :

i) The type of recording traditionally done on LPs and tapes is known as analogue recording, because, the orientation of the magnetic particles in case of tape is proportional to the size of the magnetic field i.e. the amplitude of the sound waves itself. Whereas, the depth of the groove is a direct representation of audio information in case of LPs. Distortions can easily occur in any part of the system between pick up level to the output stage.

ii) In LPs there is a physical contact between the record and the stylus while in case of tapes there is a contact between replay head and tape. The friction between the two, wear out the system over a period of time after repeated use and thus, proper cleaning and maintenance is required to achieve consistent performance.

iii) The speed at which the record and tape move, has to be critically controlled. Any variation in the speed has a direct effect on the reproduction. Wow and flutter are caused due to these variations in speeds.

iv) There is a limit to the size of the magnetic field that can be produced and hence, to the loudness of sound that can be recorded on the tape. This distorting effect, called saturation, happens when all the magnetic particles in a stretch of tape have the same alignment. In addition, the quitest passages that can be recorded have to be louder than the noise background. This is a hiss produced by random orientations of the magnetic particles in the unrecorded tape. Even with the noise reduction circuitry, these constraints mean that the dynamic range of an analogue recording - the difference between its loudest and quitest parts - is limited. Other problems are wow and flutter, small variation in tape speed, which produce unwanted vibration effects.

Now, how to eliminate these drawbacks of conventional recording system to get clean (distortion less) perfect high-fidelity (hi-fi) and stereophonic sound/ music.

One way is to use a compact disc. What is a compact disc? How audio information is encoded in disc? You will study in detail about this magic device in the subsequent sections of the lesson.

39.3.1 Need for a Compact Disc

Compact disc is rigid plastic platter of 4.75 inches (12cm) in diameter. Audio information is encoded and stored in it in the form of digital format. A specially designed player is required to playback the pre-recorded information.

Compact disc eliminated the hisses, pops, and hums that degrades the music on the conventional LPs and magnetic tapes. Wow and Flutter are virtually non existent in a CD player, because a digital recording has been used in compact disc. You avoid hissing or crackling noises that you normally get in cassette recorders or the old LPs. Also you avoid one major problem of normal cassettes where the tape comes out of the track over flowing here and there, making a mess around the play head. In CD system, the play head does not physically touch the rotating disc and, therefore, the life of CD increases many times as compared to cassettes. There is no fear of the songs in the CD being lost or CD jamming in the player. The 1000th play of a compact disc will sound every bit as good as the first one, a feature which LPs and tapes can not claim.

INTEXT QUESTIONS : 39.1

1. *Write the name of any three devices used to listen music ?*

   .....

2. *Why is there a need of compact disc?*

   .....

3. *What does a compact disc offer?*

   .....

4. *What is the diameter of a compact disc?*

   .....

5. *Write any two disadvantages of a compact disc?*

   .....

39.4 CONSTRUCTION OF COMPACT DISC

Fig 39.1 shows the cross section of a compact disc. The disc consists of a reflective evaporated aluminium layer covered by a transparent protective plastic coating. The information layer of a compact disc is an optically flat mirror like surface upon which the microscopic steps 'pits' and 'flats' are raised. The disc contains at least 3 billion pits in spiral track more than five kilometer long, and can record about one hour of continuous music.

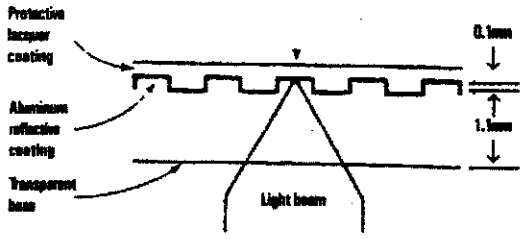

Fig. 39.1 : *Cross section of compact disc*

39.4.1 Process of Manufacturing

The compact disc is created by a mastering and stamping process in a clean room environment. A master disc, composed of glass with a photo sensitive layer, is exposed to laser which garments microscopic pits correspondig to digital bit patterns read from magnetic tape or other data source.

The complete master is used to produce matrices for the injection moulding of plastic disc copies. These copies have metallized surfaces for improved reflectivity. The recorded information, represented by the presence or absence of pits, is read by laser beam in a specially designed player. A protective transparent coating keeps dust on the surface outside of the laser beam's focal plane and permits casual handling. The whole process has been shown in Fig 39.2.

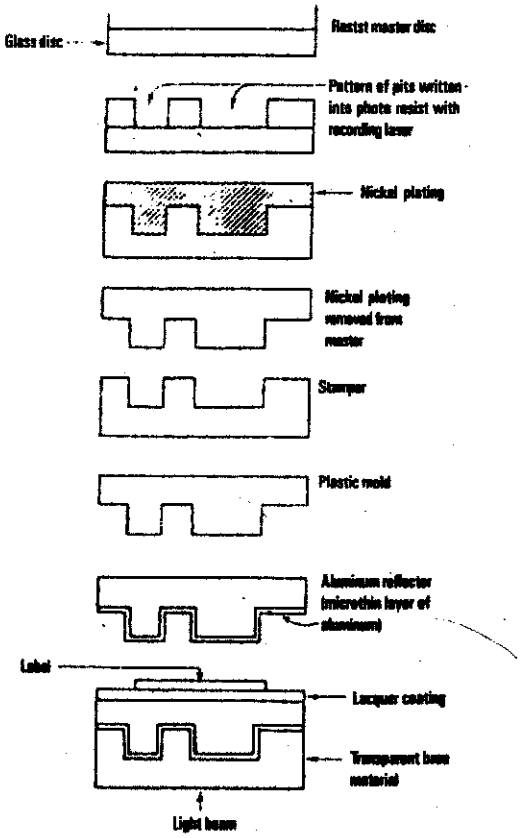

Fig 39.2 : *Steps in the manufacturing process of compact disc*

39.4.2 Structure of CD

Sandwitched by a protective plastic coating, the silver metallic layer in the CD is etched with a spiral track of pits of literally microscopic in size, using laser beam. The Pitch of the spiral is in fact 1.6μm, which makes the microgrooves of a conventional LP look quite big. Figure 39.3 shows a comparison of the grooves in an conventional LP record and the pits of a compact disc.

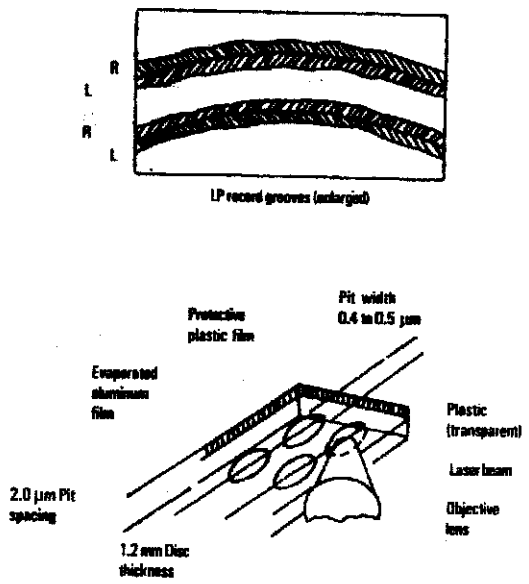

Fig 39.3 :*Comparison of the grooves in a conventional LP record and the pits of a CD*

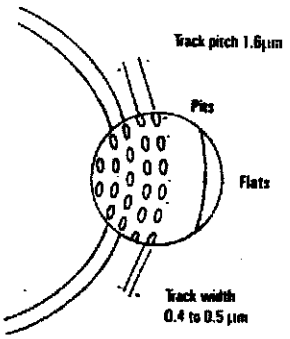

Fig 39.4 : *Magnified view of compact disc tracks*

Figure 39.4 shows a magnified view of a compact disc, the disc is composed of thousands of circular 'tracks' made in a continuous spiral form from the inside to the outside of the disc. The tracks are similar to grooves, instead, CD tracks consist of tiny pits or indentations in the disc material. The width of the pits of 0.4 to 0.5 μm (micro meter) with a depth of 0.1 μm (1μm - 10^{0}m). The distance between the spiral tracks is held constant at 1.6 μm, and is called track pitch.

(This is not to be confused with pits pacing, which is about 2.00 μm from the centerline of one track to the centerline of the next track). The combination of pits and flats (between the pits) is used to reproduce or pacing the digitally recorded information.

Each groove of an analogue LP record contains two signals, one each for the left and right stereo channels which must be simultaneously read and reproduced by conventional turntable pick up (stylus and needle).

The compact disc carries left and right channel information separately with two sets of information aligned successively on the disc. There is a fixed time interval between the two sets of information. The length of a CD's spiral track is about 3.4 miles and the total data capacity is about 780 MB (Mega Bytes). In fact, only one third of the CD's capacity is used to store digitalised sound, the rest is used for error correction, subcodes, interdising, parity checks, synchronization as well as index details which gives the number of tracks and location of tracks on the disc.

There are 2,861,800 bits of non-audio information processed for every second of music - i.e. 10,302,500,000 bits for each hour of music. In all, compact disc can contain a total of just under 20 billion bits - to be more precise 19,919,878,200 bits.

39.6 COMPACT DISC FOR AUDIO RECORDING

39.6.1 Analogue and digital recording systems

There are two methods for recoding sound/audio in a record/disc : analogue and digital. All conventional music reproduction systems, Including tapes as well as LP records, are analogue storage and retrieval systems. An analogue signal, is represented as a continuous flow of electricity (energy) that often functions as an electrical 'copy' of information being signalled. Even the speakers that reproduce sound and human ears which receive it are both analogue. In fact an analogue signal is vulnerable to outside interference and distortions and is affected by nearby spurious signals and fails to clearly represent the information it is carrying and hence, is called 'noisy'.

In contrast to a varying, continuous electrical signals, in digital format we have signals as a string of bits (short for binary digits), i.e., saturated states positioned one after the other in time, in the forms of 'ON' and 'OFF' (1's and 0's) The binary system refers to a number system that uses only two digits 1 and 0. Computer is a digital device and processes numbers, letters, symbols, which are translated into binary code string of 1s and 0s.

In compact disc, the audio is stored in the form of digital signals of 16 bits. You have studied the process of converting sound waves into electrical signals in the previous lesson. These electrical analogue can be used to create a permanent physical equivalent of sound wave-pattern, the undulations or wriggles in the record grooves.

Digital audio makes no attempt to replicate and store the actual shape of the wave form as analogue systems do. Instead of trying to record physical graph (voltage plotted against time), the digital system records a series of measurements of the height of the graph. Electrically '0' and '1' becomes 'off' and 'On'. The Figure (39.5) shows how an electrical wave can be sampled. Sampling is the process of converting a smooth, (continuous) analogue wave form into a series of 1's and 0's to produce a series of values in binary code. Here, if the voltage at a certain point in the wave is measured and found to be 6 volts, this will be encoded in binary as 110, 3 volts will be 011, 5 volts as 101 and so on. The examples use three binary digits 'bits' in each case, which gives a small range of possible values. The largest possible value is only 7 volts. 111 in binary.

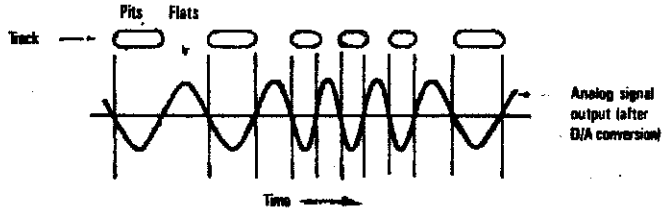

Fig. 39.5 : *Track of pits and flats*

Each sample is encoded with more bits, to increase the accuracy of measurement. In compact disc '16 bit' string is used to encode the given information. So, you have an audio signal in digital form a stream of 'zeros' and 'ones' emerging from the digital output at a 'bit rate of 1.4112 million per second clearly storing this huge information in permanent form is no easy task.

In compact disc, each sample is in 16-bit code/string, which gives a possible 65,536 (2^{16}; 2 to the power 16) values. In other words, each sample is quantized to an accuracy 1 part in 65,536 with a sampling rate of 44,100 per second. This enables the analogue to digital converter to 'plot' audio wave form very precisely, even when they contain frequencies of 20kHz (20,000Hz), which is usually taken as the upper limit of audibility (20Hz - 20kHz).

Digital recording technique has extremely low harmonic and inter modulation distortions, compared to LP records, Wow and Flutter are virtually absent in CD player. One advantage of digital recording is quite obvious, it is possible to insert extra information and manipulation can be done without affecting the original information.

39.7 COMPACT DISC (CD) PLAYER

One difference between a phonograph and a CD player lies in their pick up mechanisms Phonograph records are played with a needle on top of the record which moves on the table top at the rate of 33 $^1/_3$ or 45 rpm. ***The beginning of the record is at the outside edge, and the needle moves***

onwards as the music is played.

A compact disc is played from the underside with light beam from laser. The beginning of the CD is near the center. The light beam moves outwards towards its edge as the program advances.

The CD player reproduces audio signals by extracting signal information from a disc using a laser optical read out with no physical contact between the disc itself and the signal pick up mechanism. The audio signals stored on CD are in a high density digital format. Conversion of an audio signal into the digital form used for CD (discussed in the previous section) eliminates the problem of signal deterioration (caused either by signal storage techniques or mechanical limitations of analogue play back). As a result, signal transmission and reproduction with the digital format provides exteme accuracy and superior reproduction.

The optical read out uses a laser beam. A laser an acronym for (Light Amplication by Stimulated Emission of Radiation, is a special light source which produces a narrow beam of concentrated, monochromatic coherent light. The laser used in CD players is generated by a small low powered, semi conductor diode, made of aluminium gallium arsenide (AlGaAs) which emits an invisible (790nm) wavelength infra red light. The laser beam is focussed on to the disc by the objective lens, which acts like the lens of a microscope and focusses the laser beam into a spot slightly less than 1μm in diameter. The spot is then used to retrieve the information contained on the disc. The light beam is reflected off the microscopic pits and flats on the underside of the disc. The light reflected by the pits is not as bright as the light reflected by the flat areas. These pit and flats are en coded in accordance with music or other audio. The light reflected from the pits and flats is collected by a photo detector. The amount of reflected light will change corresponding to the zeros and ones (0's and 1's) pattern recorded on the disc The photo detector output will give a serial binary data, from which the 16 bit of each of the sample will be recovered and by using a 16 bit digital to analogue converter, we will get back to the original analogue voice through speaker which we will hear through our ears. The audio signal will be passed through signal processing circuit before being played on the speakers.

The pits and flats representing the digital information are located at 1.1mm from the transparent surface of base of the disc. The light beam passes through the transparent base material to retrieve the information. The rotation of the disc, combined with the pits and flats passing over the light beam, create a series of 'on' and 'off' flashes of light being reflected into the system, thus modulating the light beam.

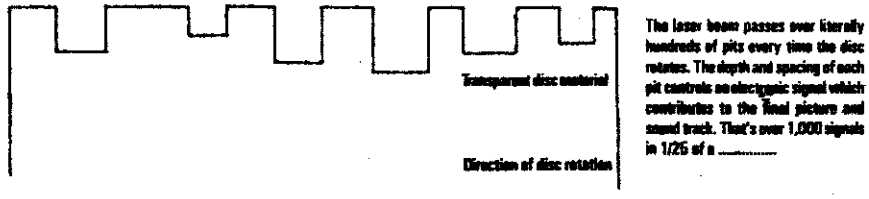

Fig 39.6 : *A track of pits and flats.*

Fig 39.6 Shows a track of pits and flats. Lengths of pits and flats determine the information coutained in the track. The pits and flats can vary in length from a bout Iμm to 3μm (1μm = 10^{-6}m)

Each pit is only three fifth of a micrometer across (about one hundredth of the breadth of your hair). With data so finely spaced on the disc, even a small particle of dust would block large amount of data and cause many problems.

The analogue wave form shown below the pits and flats represents the decoded signal after digital to analogue conversion. The pits reflect less light than the flat area, and the lengths of the two vary to recreate the original signals.

The information density of the CD is 50 to 100 times greater than that of conventional LP records. The CD is scanned by the servo controlled optical pick up at constant linear velocity (CLV) of 1.3 meter per second. To get this scan rate, the rotational speed of the disc is progressively changed from 500 rpm at start upto 200 rpm at the outside edge of the disc. The block diagram of a compact disc player has been shown in Fig 39.7.

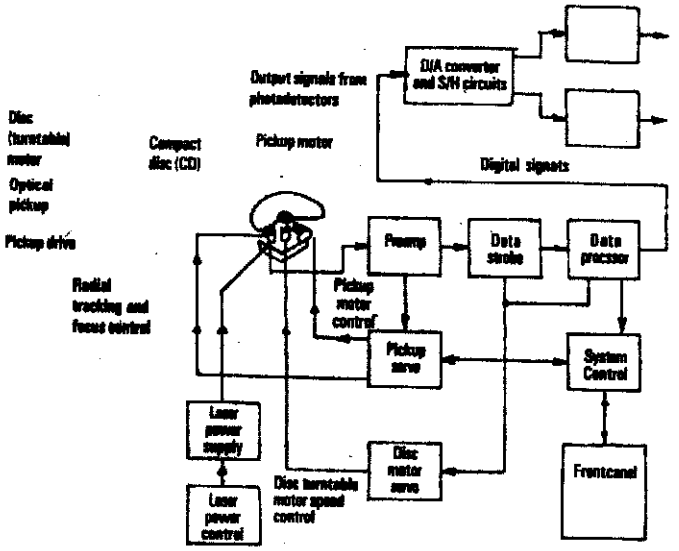

Fig 39.7 : *Block diagram of a typical CD player*

The number of songs in one CD depends upon the duration of each song, but about seven Hindi songs come in one disc which gives one hour of uninterrupted quality sound. The compact disc spuns at a high rate of variable speed between (500 rpm) in the beginning and then upto 200 rpm in the end.

39.5.6 Advantages of Compact Disc

i) Compact disc records are only 12 cm in diameter. They come in two sizes 8 cm and 12 cm diameter. Conventional LPs are 12 inch (12 x 254) = 30cm.

ii) Compact disc offers better sound quality with upto an hour's uninterrupted playing time.

iii) They are infinitely more durable than Vinyl disc (LP's).

iv) There are no grooves in the surface of compact disc and the CD player has no stylus. Hence, there is no physical contact and friction which reduces the life of CDs as in conventional LPs.

v) Compact disc eliminates the hisses, pops and hums that degrade the music on the analogue records and cassette tapes.

vi) Wow and flutter are virtually non existent in a CD player.

vii) Compact disc is made of plastic (polycarbonate which is unbreakable).

viii) Handling a CD presents far less problems than handling analogue records. For example, even if the disc is dirty, the laser beam can still operate properly because the beam is directed at the reflective aluminium layer beneath the surface (rather than at the surface).

Besides these advantages, CDs have a special feature called programming. Any particular section on the disc can be selected for play and other skipped (even replay of some section is possible). They can be programmed for random or shuffle play.

39.5.7 Disadvantages

i) Pre-recorded CDs are available which are costly compared to LPs and audio tapes.

ii) You cannot erase the information inside CD and do a recording with CD player. You can only be able to play back the available limited songs on CD player.

iii) Many LPs contain recording (old classical) music that may never be available in the CD format.

The drawbacks have been rectified by recent technological advancements. Tandy coporation has claimed to have developed the technology to produce the world' first read/write compact disc called THOR-CD (Tandy High Intensity Optical Recordable Compact Disc).

Making erasable disc compatible with CD audio equipment has been difficult because of the way the data information is recorded (digital recording).

iv) The only limitation which persists even after this development, is that all system is digital but the speakers in the present system are still analogue.

INTEXT QUESTIONS - 39.2

1. *Distinguish between the terms analogue and digital?*

   .....

2. *Give two examples of analogue and digital devices?*

   .....

3. *In what form information (audio) is stored in compact disc?*

   .....

4. *Write any two advantages of digital audio recording?*

   .....

5. *Give the range of speed of rotation of compact disc?*

   .....

6. *At what speed LP record rotates in the beginning?*

   .....

39.6 COMPACT DISC FOR VIDEO RECORDING

A video disc looks like an ordinary LP, but it plays pictures as well as music. Unlike video tape systems, it is specifically designed to play pre-recorded programmes, movies, concerts, vocational courses etc. Nowadays, digital video disc (DVD) is the latest in video disc series. (VCR's - magnetic tape) (laser vision - Laser disc) and now digital video disc which is also called Digital Versatile Disc, is capturing the market because, its advantages go beyond picture quality, It will deliver all the sound effects, you have come to expect in a theater. Digital storage is very versatile - text, videos an animation as well as sound can be stored on interactive discs, capturing an entire twelve volumes of encylopedia on a small piece of plastic. 100 years of National Geographic magzine is available in 30 CD's.

39.6.1. Limitations of Traditional Video Recording Media: Video Home Systems (VHS)-Magnetic tape.

Video recording on magnetic media has certain shortcomings such as,

1. picture quality is poor and audio quality is also not satisfactory
2. dropouts, flicker and distortions are common in the magnetic tape
3. there is a direct contact between magnetic tape and video head, as a result the quality of picture and audio is degraded after repeated use.
4. frequent head cleaning is necessary to minimize scratching and tracking problems.

39.6.2 Need of Video Disc

Just as the audio CD eliminates the hisses, pops and hums, which degrade the music on analogue records LPs, cassette tapes]; the video disc eliminates the dropouts, flickers and distortions that are common on analogue Video Home Systems VCR, VCPs ; tape recordings]. Video disc need not be used solely for the storage of sound and pictures. It has capacity to store large amount of text or mixture of text, sound, graphics and moving pictures. This together with random access and other capabilities of this system, has led to information storage, retrieval and transfer. Why can't you store the video images and sound on compact disc? Why there is a need for seperate video disc?

39.6.3 Types of Video Discs and Players

There are two main types of video discs :

a) Contact video disc (CVD)

b) Non-contact (Optical) Video disc

It is the latter which is considered to be of the greater general importance in information technology, while a third type- the optical digital disc (DVD) - is likely to be improtant in mass storage of information.

a) Contact Video Disc : CVD System today is 'capacitive', i.e. the electrical signal to be read from the disc is determined by its ability to store electricity at each point. Although, it would, in theory, be possible to design a capacitive system where the stylus and disc did not come in contact, in practice, it would be expensive. For the system to act as a capacitor, the video disc must contain conductive material on it, or the stylus must be coated with non-conductive material so that the disc and the stylus do not 'short' out on contact.

b) Optical Video Disc : The basic principle is always that the tracks on the discs are monitered by optical laser beams. In most information, applications, as opposed to entertainment the industrial format optical disc is generally regarded as most suitable (because of its ability to present still pictures, hold frames of text and provide rapid access to any frame). Video discs can be used for storage of television pictures and sound, sound only, or for digital storage of data, or all these in combination. The Philips/MCA disc for example, has 54,000 frames per side. But each television frame is fairly limited in the amount of information it can store. For television frames i.e. 6,000 - 7,000 pages per side of a disc is not comparable . Single frame cannot, therefore, be used to store complete page of text for viewing on domestic television receiver screen. Video disc can be used to store information in digital form. In these cases the storage of a single side is approximately 10^{10} bits or roughly 1 million pages of 1250 characters, which is vastly more text than what can be used in a direct, television - campatible way.

c) Optical Digital Video Disc (DVD) : Optical video disc have the digital information (Video + audio) encoded on a standard video signal. The storage

capacity of these discs is likely to be between 10^{10} and 10^{11} bits. The new DVD system uses the same technology as found in existing audio CD and CD-ROM (Compact disc read only memory) players. A single DVD standard for both video disc and CD-ROM application has been tried out. Another requirement was for the future DVD drives to read today's CD-ROM discs. Today's CD-ROM disc can hold about 650 MB of information (1 MB = 10^6 bites.)

39.6.4 Manufacturing of Video Discs

The process of manufacturing compact video discs carries essentially the same steps as those discussed for compact disc with a slight change. Since, the video disc has a large storage capacity due to the facility to record on both sides of the discs. The block diagram will help you to understand the process involved.

Video disc looks like an ordinary LP, but it can record information on both sides and plays pictures as well as music. A semiconductor laser scans millions of tiny pits and craters on the surface of a persper coated tinface disc and turns them into hi-fi sound and quality vision. You can play it forward and backwards at almost any speed you like upto 1,500rpm. For the sake of comparision, it may be noted that compact disc audio rotates between (200-500 rpm).

39.6.5 The Video-Disc Player

The video disc player is a very specialized form of photograph or record player. A video disc player plays a prerecorded video disc carrying both picture and sound through any standard TV set. The picture can be either black and white or coloured. The sound can be monaural on all players and stereo on some players (and even two channels independent or bilingual on some players).

The player circuit converts picture and sound information recorded on the disc into electrical signals (discussed in lesson 38) that modulates a radio frequency (RF) unit (also known as VHF modulator). The output of RF unit in the player is applied to the TV set.

The video disc spins at a high rate of speed compared with the conventional audio records and uses either an optical or capacitance pickup instead of the conventional stylus and needle. Typically, the video disc is played on both sides and has a playing time of 30 minutes per side with standard play. An extended play video disc is capable of storing one hour of information per side.

The advantage of using a disc as an information carrier over video tape is that disc can provide immediate access to any part of the program. Probably of greatest importance to the user is the low cost, which is made possible by using a production process similar to that of audio records. Also, both the video display and audio reproduction of a video disc are generally far superior to any video tape or cassette.

The disadvantage of the video discs compared to video tape or video cassettes is that the user can not record on the video disc, can only play back prerecorded one.

39.6.5 Similarities in Video Disc Systems

Common to all video disc systems, is a process in which a programme (originally recorded on the magnetic tape) is recorded on to a master metal disc. The metal master is then used to mass production of plastic discs which are played.

- The three video disc systems use a plastic disc rotating on a turn table.
- In all systems, the players pick up information represented by changes on the disc surface and converts the information on to signals for play back on a TV set.
- All systems use frequency modulation (FM) for both the video and audio signals.
- Each disc also has a spiral track to carry the information, rather than a series of circular tracks.
- All the three systems can step up the pick up backwards and forward one or more track width for repeat play or rapid search.
- All the three video disc systems can play upto two hours per disc.

39.6.6 Differences in Video Disc System

Inspite of basic similarities, the systems differ not only in the pick up techniques (optical versus capacitive) but also in the format in which the information is encoded and in the method by which information is tracked on the disc (like analogue or digital record techniques).

Other differences include disc size, material rotation speed, and signal processing/protection schemes.

39.6.7. Principle of working of Video Disc Player

The optical video disc is played from the bottom with a light from laser source. The beginning of the LV video disc is near the center, and the beam scans outward towards the edge as the program advances.

The light beam is focussed onto the bottom of the video disc through an objective lens. The lens is located in the player under the video disc. As the video disc is played from beginning to end, the objective lens moves from near the center of the video disc to the outside edge. The beam actually refects off the microscopic pits beneath the bottom surface of the video disc. The pits are coded in accordance with the picture and sound information. The use of such an optical system allows many important playback features, such as forward and reverse

play, slow or fast motion, and stopped motion (still picture).

An optical pick up 'reads' the reflection of a tiny spot of light shining on the rotating disc. The character of reflection changes, depending on whether the beam falls on a pit formed on a reflecting layer or on a flat surface. This on-off reflection is captured by a photo-detector, which produces a string of on-off electrical signals that correspond to the zero's and one's of digital code. The digital data is then ***converted into analogue audio or video siganls***. But DVD goes a step beyond CDs, taking advantage of recent technological advances to squeeze upto 488 minutes of full motion video data on the same 120 mm diameter disc that strained to hold 70 minutes of audio data just 15 years ago.

The most important hardware development in DVD player is a new generation laser. Current CD players use infrared laser with a wavelength of 780 nm (nanometer 10^{-9}m) or about one hundredth of the width of the human hair. The lasers in the new Video disc player will have wave length of 635 nanometer. The narrower wavelength means laser beam can focus on pits that are roughly half the size of the pits on current audio CD.

The improvement over the 1.6 μm track pitch of conventional audio CD's adds up. The length of a CD's spiral track is about 3.4 miles, and the total data capacity is about 780 megabites.

Tracks on the new DVD disc will be about 7.4 miles long and will hold more than 4.7 gigabytes of data per side, that is, enough room to store 133 minutes of full motion video per side.

TABLE 39.1 :

Comparison between the parameters of audio CD & DVD

Characteristics	Audio CD	DVD (Tentative)
Disc Diameter	120mm (4.7 inches)	120mm
Disc thickness	1.2mm	0.6mm x 2 = (1.2mm)
Minimum pit length	0.83μm	0.4μm
Capacity Playing Time		
(i) Single side	780MB; 74 Min	4.7 GB; 133 min.
Dual layer		8.5 GB; 244 min.
(ii) Double side		9.4 GB; 266 min.
Dual layer		17 GB; 488 min.

High quality sound is another feature of the promises of DVD. DVD will have a lot of room for extra data, allowing more multiple language and sub title tracks. Users will be able to choose whether to listen the original movie dialogue with or without subtitles or a dubbed version. Thfs feature appeals to disc makers who will be able to put a number of languages on one disc, saving

manufacturing and handling expenses. But one feature will be missing from DVD model i.e. the ability to record.

39.6.7 Advantages and disadvantages of Video Disc

Compared to paper, microfilm and magnetic media, the video disc has the following **advantages** -

1. High storage capacity - on both sides of the disc.
2. A durable storage media - no contact with the head, since information (Video + Audio) is scanned by laser beam.
3. Unaffected by dirt and scratches and can consequently be handled casually.
4. The availiability of the relative inexpensive player which can operate under computer controll and can quickly access specified video images.
5. The materials from which the discs are prepared are less expensive than those of VCRs or conventional films.
6. The disc itself is light and compact and can be easily stored and transported.
7. Some but not, all types of discs have the further advantage of random access to various parts of the disc (in contrast to tapes and video cassettes).
8. Digital Video Disc or Digital Versatile disc (DVD) has put down the VHS and laser video disks by providing:
   - Colours deeper and brighter
   - Edges sharper
   - Details crisper
   - The DVD pictures also noticeably better than laser disc.
   - Studio quality video images
   - Theater like sound
9. With a video tape recorder, favourable TV programmes can be recorded as they happen to be played over and over later. Pre-recorded tapes (movies, concerts, phonography etc.) can also be bought, but these are expensive as they have to be recorded individually on 'real time'. Prerecorded compact video discs are mass produced and are, therefore, far cheaper than tapes.

Video disc has a **disadvantage** also that is the disc system currently available cannot record information. Only prerecorded disc available can be played through a specially designed laser scanned optical pick up system as in compact audio disc.

INTEXT QUESTIONS - 39.3

1. *What is the full from of DVD?*

   .....

2. *Why digital optical disc is preferred over contact and optical disc (analogue)*

   .....

3. *What are the advantages of a DVD system?*

   .....

4. *Compare the specifications of compact audio disc with that of DVD?*

   .....

5. *How DVDs put VHS to shame?*

   .....

6. *What are the disadvantages of Video disc system?*

   .....

39.7 WHAT YOU HAVE LEARNT

- A compact disc is only 12cm (4.7 inch) in diameter and it offers better sound quality with zero wow and flutter.
- Handling a compact disc presents no problem as they are immune to scratches, dirt and grease.
- Compact disc-Records do not wear out, have ultra hi-fi, and near perfect stereo sound.
- Compact disc encode the music digitally on light reflecting plastic.
- Audio compact disc eliminates the hisses, pops and hums that degrade the music on the analogue records and cassette tapes.
- The digital video disc (DVD), or digital versatile disc, eliminates the dropouts, flickers and distortions that are common on analogue VHS tape recording.
- The digital video disc (DVD) will bring studio quality video images and theatre like sound into the home.
- Colours are deeper and brighter, edges sharper, details, cripsper. The DVD picture is also noticeably better than optical laser disk.
- High quality sound is another feature of the promises of DVD besides superb picture quality.

TERMINAL QUESTIONS

1. What is the difference between a compact disc and the disc used in computer work?
2. Justify the need of a compact disc?
3. What are the advantages of a compact disc over traditional audio recording/ play back devices?
4. Give the construction, process of manufacture and working of a compact disc.
5. What are the differences between CD player and conventional long play record player or phonograph?
6. Why audio frequencies are not indicated in the electro-magnetic spectrum?
7. What are the drawbacks in the traditional LP sound recording system? How these are eliminated in the compact disc recording system?
8. Compare the specifications of a compact disc and Long play record phonograph.
9. Describe the full form of the following VHS, VTR, DVD, CD, dB.
10. What qualities do you prefer to select CD and DVD?
11. How compact disc is prepared?
12. Define bit? In how many bits the audio is encoded in disc?
13. What is the wavelength of laser used in a CD player?
14. From where does the LP record start and where does it end?
15. Where is the beginning and end of a compact disc?
16. What is the range of audiable frequencies?
17. In which format audio is recorded on LP record and in compact discs?
18. Write the names of the two types of video discs?
19. Why digital recording is preferred over its analogue counter part in Video disc?
20. In the/latest new video disc player (DVD) which laser and of what wavelength is being used?
21. How much information a today's CD-ROM disc can hold (store)?

CHECK YOUR ANSWERS

Intext Questions - 39.1

1. (1) Radio/transistor receiver (2) Tape recorder/player (3) Phonogram/LP Record Player
2. Because the compact disc promises pure perfect (ultra high-fidelity), and stereo sound at home.

3. A compact disc offers better sound quality for upto an hour's uninterrupted playing time. It eliminates the hisses, pops and hums that degrade the music on the conventional records and cassette tapes, wow and flutter are virtually non-existance in CD player.
4. It is only 4.75 inch in diameter (very smal compared to LP record which is 12 inches).
5. One cannot erase and record audio on a compact disc of its own as is done in audio tapes. You can only play the prerecorded disc available. Secondly, it is very costly compared to audio cassettes. Many LPs contain recording (old classical) music that may never be abailable in CD format.

Intext Question -39.2

1. Analogue means continuous variation of currents/voltage of sound waves in the electrical form.

   Digital means representation of information by combinations of discrete binary units (0's and 1's)
2. Telephone, human voice, ears, speakers are all analogue devices. Digital devices include - computers, digital audio tapes (DAT), digital cameras etc.
3. Digital format in the form of 1's and 0's.
4. There is no harmonic and intermodulation distortions, Free from wow and flutter. Free from hisses, pops and hums.
5. 200 rpm to 500 rpm. 500 rpm in the begining to 200 rpm in the end.

Intext Questions - 39.3

1. The full form of DVD is Digital Video Disc or Digital Versetile Disc.
2. a) More space to store extra data.
   b) Motion picture + sound both can be recorded simultaneously.
   c) Visuals, text, and audio information can be stored on compact disc.
   d) Digital encoded information has low harmonic and intermodulation distortions.
3. Advantages include
   i) Easy to handle and store than tape cartridges.
   ii) It playes music as well as picture.
   iii) High-fidelity sound and perfect stereo system.
   iv) Sufficient space to store extra information.
   v) Colours are deeper and brighter.
   vi) Edges sharper.

vii) Details crisper.

viii) Studio quality video images and theatre like sound.

4.

Compact Disc	DVD
(i) 4.75 inch (12cm) Size	(i) 12 inch (30cm)
(ii) Store audio	(ii) Store audio & video
(iii) Capacity to store inforamtion is less	(iii) Capacity to store information and handle digital data is large.
(iv) Single side recording	(iv) Both sides recording.

5. DVDs puts VHS to shame by providing

- colours deeper and brighter
- edges sharper
- details crisper
- studio quality video images
- Theatre like sound.

6. You cannot record/erase the stored information of your own. It is costly.