As we have dealt with each aspect in the previous chapters pertaining to what happened in the past in the development of music and electronics, now we shall discuss the priorities that have to be maintained in a concert hall and the acoustics involved in the same. We shall discuss about the sound quality when you are listening to a concert in your favorite hall. The sound produced should be clear, dry, intimate, warm, fuzzy, brilliant & loud. Acousticians have compiled a list of acoustic qualities that are considered to be the most important in concert hall acoustics. The following pages contain information on these subjective qualities, how they are quantified and measured, and how one may design for concert halls that exhibit these qualities. Also we will discuss the development that is happening right now in carnatic music with the help of electronic media.

5.1 **CONCERT VENUE & ACOUSTICS**

A concert hall is not just a building but an acoustically treated cultural building, which serves as performance venue, chiefly for classical music, both vocal & instrumental. Many concert halls exist as one of several halls or performance spaces within a larger performing arts center and, where appropriate, the name of the arts centre is included. Many larger cities have both public and private concert halls. Particularly in smaller cities with fewer alternative venues, concert halls may also be used to accommodate other activities, in addition to their primary purpose. For example, Music Academy in chennai has a world famous hall meant for carnatic concerts & Chowdiah Memorial hall in Bangalore has a beautiful, fully treated hall in the shape of a violin. NCPA in Mumbai also has an amazing concert hall. There are other venues such as sports stadia or convention centres which may occasionally be used for concerts.
In South India, these concert halls are not the only venues used for carnatic concerts. Various other venues are used depending on the reason, why the concert is organised. And so many other programs are also organised in halls meant for concerts that the line of demarcation is hazy. Carnatic concert venues in modern times can be divided into 4 classes:

1. Temples – open dais & hall attached to the temple
2. Pandals – erected for this purpose, without walls
3. Closed Halls – not acoustically treated specifically
4. Fully acoustically treated halls

5.1.1 **TEMPLES**

Many concerts do happen in temples even now because they are related to the religious functions. Many temples organize concerts for Ramanavami, Shivarathri, Navarathri etc. The dais can be constructed in the centre and the seating arrangement can be done in a half-moon shape. This is a very open venue where there is a complete absence of acoustic treatment. The sounds of the pujas being performed, the conversations of the devotees, – all these contribute to the very high disturbance level seen in these venues. Therefore, the acousticians have to take care and build another amphi-theatre without any external disturbance. If very good quality equipments are used, they may be
able to overcome the problem & the listener may be able to hear good music. But, again, what is the actual need? The devotees who come to the temples may not like to be disturbed by the concert – they might want to hear the mantras recited by the priests. For them, the concert might be just ‘noise’!

5.1.2 **ARCHITECTURE FOR AN OPEN AIR ACOUSTICS**

Architectural acoustics concerns the interaction between the space and its acoustic quality. An ancient temple is an environment designed to hold thousands of people. The sound field of such theatres offers the opportunity to correlate architectural and acoustical features and to correlate objective indices with subjective impression. In an open-air theatre sound energy is weakly bounded and rather free to propagate away so that stage size, slope and size strongly affect its acoustic performance\(^\text{123}\). Ideally, in a completely boundary free environment, there is no reverberant energy and only the direct energy is propagated (free-field condition). The distance between source and receiver can be doubled. The index “Reverberation Time,” RT, accounts for the reverberant energy (it is calculated in a simple way recording the sound decay rate after a noisy test signal abruptly muted): a small reverberant field exists and relatively high reverberation occurs in the mid-high frequency range. Exciting the environment with an impulsive signal and recording the theatre’s response at several locations shows that the sound energy lies mainly in the first hundreds of seconds of the responses and that strong first reflections build up the weakly reverberant field\(^\text{124}\).

Marriage halls also are very similar to the temple. They are not acoustically equipped for concerts. They are just halls meant for functions and are not air-conditioned. In most of the south Indian halls, since the sacred fire has to be lit–

\(^{123}\) www.acoustics.org/press/155th/gullo.htm

\(^{124}\) www.acoustics.org/press/155th/gullo.htm
they are well ventilated. The concerts are organized just as an accessory – either as the all important Nadaswaram or a concert for the ambience. Very few are actually interested to hear the concert without other disturbances. Most would be interested in meeting people, exchanging information and congratulating the families. They will be partially listening to the concert, since, here the aim is to have a pleasant music as a background, but not too low so that an interested person can sit and listen happily. Some families do prefer live music. At this juncture, the halls can be acoustically minimally equipped.

Minimal equipped means, Room acoustics can be adjusted by adding soft furniture and heavy drapes, or by the use of dedicated sound absorbing materials. Diffusers can also be used, which break up the reflections from walls and scatter the sound over a wide angle. A high speed digital signal processing has raised the possibility of correcting room acoustics with a digital filter which can be used as an amplifier.

Cardioid microphones can be used for each instrument and the main vocalist. The concept is great; a mike that picks up sounds it is pointed at. This pattern is popular for sound reinforcement or recording concerts where audience noise is a possible problem. A good engineer will have made hundreds of recordings using dozens of different microphones. Each session is an opportunity to make a new discovery. The engineer will make careful notes of the setup, and will listen to the results many times to build an association between the technique used and the sound achieved.

This home work can be achieved by the musicians too. Therefore good music can be achieved in a marriage hall too. The only requirement is that the engineer or the musician pays enough attention to the details of microphone placement, mixer levels, speaker positions and levels.
5.1.3 **PANDALS**
During festivals, many groups organize concerts. As they do not have a permanent structure, they use pandals in huge playgrounds as the venue. A temporary stage is also organized and people generally sit on the ground or on plastic chairs hired for the occasion. Since this is an open structure, acoustic treatment is not taken too much into consideration. Good quality PA system is important to make the audience hear a good quality concert. The disturbances mentioned earlier from street sounds etc can be reduced by using good acoustical equipments. But the volume level is kept at a higher level than temples because the sole purpose of the audience is listening to the concert.

The major problem in these pandals is that no acoustical planning can be made and just the loudness of the music (even if the amplifiers and speakers are good) will have to help drown external disturbances.

5.1.4 **AMPLIFIERS THAT CAN BE USED DURING A CONCERT:**
There are small portable amplifiers that are generally carried by some musicians when they are not sure of the quality of the PA that will be available to them. Some come as a combination of an amplifier and speaker, in the size of a television. Many instrumentalists carry this pack. These amplifiers can be carried by the musician as playback equipment for the musician to hear his or her own music clearly without any noise pollution. This can also be directly connected to the amplifier available in the pandal with the help of a wire. Thus the system output will be clear and the music will be very explicit.

5.1.5 **CLOSED HALLS**
These are halls that have a permanent wall structure and a concrete roof, but not acoustically treated for concerts. Examples are some halls in schools & colleges that are not treated acoustically. They just have a stage, roof & 4 walls. Here, the musician can use some of the good amplifiers as mentioned. Echo is a
problem in this hall. Some times the walls are parallel which worsens the condition. Microphone placement & speaker placements are very important in this hall. An experienced sound engineer can adjust the placements & levels so that an optimum is comfortably reached. If the chairs are plastic, the situation really becomes bad. Heavy curtains, solid chairs, a full room – all these will help improve the condition. The sound engineer has to play a very important role in the usage of audio equipment.

5.1.6 **ACOUSTICALLY TREATED HALL**
This type of hall is fully treated to record and reproduce music with high fidelity - definitely a delight for the musician. And the audience is equally happy to hear quality sound reproduction. Since the microphones used are matched properly to the speaker systems, the distortion level comes down. Also, since a suitably treated hall will definitely be equipped with suitable audio system, so the ambience is near perfect. The audience also, being undisturbed by other interruptions, is able to be appreciative.

5.1.7 **SCIENCE OF AN ACOUSTICALLY TREATED ROOM**
Music audiences, on the other hand, have inherited quite a developed expectation of particular sound qualities for various styles and eras of music. Rooms resonate just like organ pipes. The room is an unwanted extra instrument playing along with the musicians. The design goal for a good music room is to minimize this coloration, which is strongest at bass frequencies between 20 and 200 Hz. At higher frequencies the room still has an influence, but resonances are much less of a problem since it is much easier to obtain high absorption at higher frequencies. This section deals with acoustic design within the subwoofer band of roughly 20-100 Hz. Barriers, screens, and full enclosures can be constructed with the modular curtains. Noise levels can be typically reduced.

with a properly designed curtain enclosure. Lighter, flexible, and less expensive than metal panels, curtains may be right for noise control. Broadcast and recording studios all require acoustically rated sound control doors and windows. Fabric wrapped acoustic wall panels are another option to lower noise. Rigid fiberglass board wrapped in fabric and attached to the walls or ceiling will provide a nice looking sound absorbing surface. Floating floors, floating ceilings, and floating walls refer to a means of vibrationally isolating these structures from the surrounding construction. Sound is transmitted through vibrations into spaces where noise is not welcome. Performance halls, rehearsal rooms, broadcast and recording studios and acoustic test enclosures are typically spaces that require vibration isolation. The diffusers smooth out the reverberation and make the sound reasonably uniform at different seats. The absorptive curtains allow the reverberation time of the room to be adjusted to control the loudness of ensembles of various sizes. Movable panels behind the performers serve to group the early reflections and also (probably more important in this small hall) help the performers hear each other.

Till Now, We dealt how different rooms react to science of acoustics and also made a study of how a room can be developed acoustically by a musician himself. As we study further, we now deal with various microphones, amplifiers and speakers to enhance the quality of listening and how they can be aptly utilized.

5.2 **AUDIO SYSTEMS AND THEIR APPLICATION**

An audio system is a playback portion that plays back content and outputs at least an audio signal; an acquisition portion that acquires an external audio signal; a generating portion that, based on noise collected by a sound collecting device, generates a noise cancellation signal to reduce the noise; a switching portion that, if the acquisition portion has acquired the external audio signal
when the playback portion is playing back content, switches an output signal from the audio signal to the external audio signal; and a synthesizing portion that synthesizes the output signal from the switching portion with the noise cancellation signal\textsuperscript{126}.

5.3 **MICROPHONES**

Microphones are transducers which detect sound signals and produce an electrical image of the sound, i.e., they produce a voltage or a current which is proportional to the sound signal. The most common design today uses a thin membrane which vibrates in response to sound pressure. This movement is subsequently translated into an electrical signal. Most microphones in use today for audio use electromagnetic induction (dynamic microphone), capacitance change (condenser microphone, pictured right), piezoelectric generation, or light modulation to produce the signal from mechanical vibration. The most common microphones for musical use are dynamic, ribbon, or condenser microphones. Besides the variety of basic mechanisms, microphones can be designed with different directional patterns and different impedances.

The music articulated by a musician is transferred through the microphone as shown in the diagram.

\textsuperscript{126} www.faqs.org/patents/app/20090147969
Equalizers are used primarily in audio equipment, allowing fine-tuning of the signal to compensate for distortions such as weak response or oversensitivity at various frequencies. A graphic equalizer uses a set of controls that determine the level of boost or suppression of individual frequencies. The controls are usually sliding faders, set up in a row from lowest frequency to highest frequency, so that the final settings resemble a graph of the frequency response of the equalizer. A parametric equalizer consists of one or more filters whose characteristics can be controlled, such as the frequency to be manipulated, whether to boost or suppress the frequency, the amount of boost or suppression, and how much nearby frequencies are also affected.\textsuperscript{127}

The next in the audio system is the amplifier. The term amplify also means to magnify. That is to take energy of lower level and when sending it through output it should be in the magnified form. Basically the amplifiers collect all energy that needs to be transported to create the sound output. It mainly consists of the circuit that carries the raw energy through its wires; accumulate it together so that the final sound output is emitted from the speakers. The level of amplifiers is measured in terms of sound watts. They are produced in various

\textsuperscript{127} www.thefreedictionary.com/equalizers
sizes and certain shapes. The amplifiers may come as part of the system, or then as additional accessories. And apart from the sound amplifiers there are also the power amplifiers.

The final in the line are the loud speakers. They work as the diagram shown below.

![Diagram of sound system components](https://via.placeholder.com/150)

The loudspeakers are almost always the limiting element on the fidelity of a reproduced sound in either home or theater. The other stages in sound reproduction are mostly electronic, and the electronic components are highly developed. The loudspeaker involves electromechanical processes where the amplified audio signal must move a cone or other mechanical device to produce sound like the original sound wave\(^{128}\). This process involves many difficulties, and usually has to be the most perfect steps in sound reproduction.

Even with a good enclosure, a single loudspeaker cannot be expected to deliver optimally balanced sound over the full audible sound spectrum. For the production of high frequencies, the driving element should be small and light, to be able to respond rapidly to the applied signal. Such high frequency speakers are called "tweeters". On the other hand, a bass speaker should be large to efficiently impedance match with the air. Such speakers, called "woofers", must also be supplied with more power since the signal must drive a larger mass.

\(^{128}\) [www.atluriandco.com/expertise_sound_light.html](http://www.atluriandco.com/expertise_sound_light.html)
Another factor is that the ear's response curves discriminate against bass, so that more acoustic power must be supplied in the bass range. It is usually desirable to have a third mid-range speaker to achieve a smooth frequency response. The appropriate frequency signals are routed to the speakers by a crossover network.

Thus the desirable sound is achieved when all the musicians are connected from their respective microphones to the amplifier and the audience savors every second of the music they listen.

### 5.4 CURRENT RECORDING TECHNIQUES

#### 5.4.1 LIVE RECORDING

Recording live-to-2-track, we’ll need a 2-track recorder. Currently the main types are:

- Minidisc recorder
- Flash-memory recorder
- Laptop computer with a sound card and sound editing software

#### 5.4.1.1 MINIDISC RECORDER

Hi-MD Mini Disc recorder records uncompressed CD-quality wave files on low-cost Hi MD Mini Discs. One gets up to 94 minutes recording time on a 1 GB disc. They come with a stereo microphone and ear bud headphones. Because Mini Discs cost little and are removable, a Mini Disc recorder is a good choice if one is recording in the field for a long time and can't dump a flash-memory recording to a computer. The Sony software provided can be used to copy Mini Disc files to a computer. Mini Disc recorders can skip if bumped, so one needs to hold the recorder steady.

#### 5.4.1.2 FLASH-MEMORY RECORDER

A flash-memory recorder (Figure below) is a portable digital recorder with no moving parts. Also called a solid-state recorder, it records into a flash-memory
card such as a Compact Flash or Secure Digital (SD) card. It has a 2 GB card, which records 2 hours of 24-bit/44.1kHz wave audio files. Flash-memory recorders can record MP3 or uncompressed PCM wave files\(^{129}\) (which are CD quality or better).

These recorders have a number of features to consider. Power comes from replaceable or rechargeable batteries. Available mike connectors are XLR, \(\frac{1}{4}"\) phone (6.35mm socket), or 1/8" phone (3.5mm socket), with or without 48V phantom power or plug-in power. Some units come with built-in or plug-in stereo microphones. After making a recording, the USB port in the recorder should be connected to the USB port in a computer. The recorder shows up as a storage device on the computer screen. The recorded sound files can be dragged and dropped to the computer's hard drive for editing and CD burning. The files transfer in a few minutes. Then the flash-memory card is empty, free to make more recordings.

Nearly all flash-memory recorders include a mike-gain switch to accommodate both quiet and loud sound sources. Low gain or low amplification (0 to 15 dB) is for recording loud sounds (rock concerts); medium gain (25 dB) is for recording medium sounds (acoustic music, lectures, or rehearsals); high gain (50 dB) is for recording quiet sounds (nature, quiet talking). Most recorders have AGC (automatic gain control), which sets the recording level automatically depending on how loud the sound is. Some units include a limiter to prevent recording above 0 dB level, which otherwise would cause distortion.

\(^{129}\) [www.deltamedia.com/resource/live_recording2.html](http://www.deltamedia.com/resource/live_recording2.html)
5.4.1.3 **Laptop, Recording Software and Audio Interface**

Another stereo recorder is a laptop computer with recording software (Figure below). To get audio into the computer, a two-channel audio interface is used. This is a mic preamp with two mic inputs and a USB or FireWire port, which connects to a similar port in the laptop. If the computer lacks that port, a USB or FireWire PC Card adapter can be used. It is a PCMCIA card with a USB or FireWire port. The card can be plugged into the laptop, and its port can be connected to the audio interface. Another option is a Card Bus card, which is an advanced PCMCIA card with faster speed.

![An audio interface plugged into a laptop computer via a USB connection.](image)

Some examples of recording software are Adobe Audition, MOTU Digital Performer, Steinberg Cubase SX and Nuendo, Digidesign Pro Tools, Cakewalk Music Creator, Home Studio. When a laptop recording is done, it is ready to be edited. The wave files need not be transferred from recorder to computer as with other methods.

5.5 **MIDI:**

The sound card of a PC can generate music through two different devices - the MIDI device which generates music from data on the note pitches and durations, instrument etc. and the wave device which generates music from
digital sampled data. The MIDI device is the most popular one for synthetic music while the wave device is used for recording and replaying live music or any other sound such as speech. At present MIDI is mostly restricted to instrumental music. Although the MIDI happens to be the most popular format for synthetic music the wave device can also be used for synthesis with suitable programs. (MIDI stands for 'Musical Instrument Digital Interface')

The term 'computer music' usually refers to the synthesizing of music with the computer. In the past scientists have tried to generate musical sounds with various types of physical (analog) equipment like the siren or electrical or electronic circuits. Digital synthesizers for music were developed independently of the computer and the MIDI protocol was developed to make many synthesizers work together. MIDI became one of the most popular tools for synthesizing music with the computer. MIDI allows playing of more than one instrument with synchronisation and this was very useful for composing orchestral music.

Today we have sophisticated software for composing music (using western notation or graphical input) and playing it. Enormous amount of work has been done on developing different algorithms for synthesizing musical sounds to simulate real instruments. All these developments were naturally oriented towards Western Music with emphasis or orchestration, harmony and generally playing straight notes with some vibrato for some instruments. While the Computer is being used extensively for recording, editing (including adding enhancements like reverberation) and distributing carnatic music, its use for synthesizing carnatic music has been very limited. The Indian film industry has been using synthetic music based on MIDI

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5.6 **Track Recording Styles**

There are 2 ways to record to a 2-track – using multi microphones or using a stereo microphone. With multi microphone system, each instrument and singer are given a separate microphone, and these inputs are mixed live to 2-track. With stereo microphone, a musical ensemble is recorded with a stereo microphone or a matched pair of microphones. The group can be taken as a whole, along with the room acoustics. This method works best for a classical carnatic music concert. It also works well for a folk group or acoustic jazz group. In fact, at some performers’ concerts, recording engineers’ sections are set up in the audience area for the purpose of recording the show in stereo.

5.6.1 **Connections**

Very simple connections are used for 2-track recording. If stereo microphones are used, the microphones are either plugged directly into the recorder's microphone inputs or into a microphone preamplifier. The best portable recorders have XLR microphone inputs with phantom power for condenser mics. If a mic preamplifier is used, then, its outputs are plugged into the recorder's line inputs. Outboard mic preamps, or good mixer mic preamps, tend to sound cleaner than the low-cost preamps built into recorders.

Using an outboard A/D converter for better sound should also be considered. The microphone preamplifier outputs should be connected to the converter inputs. Then the converter outputs should be connected to the recorder’s or sound card’s digital inputs (if available). Some companies make combination microphone preamp/converters. A compressor/limiter can also be connected between the mic preamp and recorder analog line input. The compressor will prevent excessive peaks from overloading the recorder. This is a useful feature when live concerts are recorded, where the recording level cannot be predicted. Many portable recorders have a limiter built into it. If multiple microphones are
used, the mixer's bus 1 and 2 outputs are plugged into the recorder's line inputs. If the inputs on the mixer are grouped, then, the stereo bus output is plugged to recorder line input. The sound will be slightly cleaner if groups are not set up, so mixing everything directly to busses 1 and 2 should be considered.

5.6.2 Multi-Microphone Procedure

Here are some techniques for using multi microphone system for a group and recording it live to 2-track. The first step is to set up a system to monitor busses 1 and 2. It's hard to monitor clearly over headphones because the group's live sound leaks through the headphones ear seal. Monitoring in a separate room is the best procedure. If the recording engineer must be in the same room as the musicians, using headphones with good isolation is recommended. The insert sends (or pre-fader direct outs) from the PA mixer's microphone channels should be connected to the line inputs of a separate recording mixer. Or the mics should be split so as to feed the PA mixer and the recording mixer.

Connecting PA mixer insert sends to recording mixer line inputs.

A separate mic for each instrument and singer must be used. The leakage can be reduced by placing the mics close and recording directly. The vocalists should sing with lips touching the foam pop filters on their microphones. Direct boxes instead of mics can also be used. Direct boxes give a clean, tight sound since they pick up no background noise or leakage.

132 www.recorderhomepage.net/mikes.pdf
Splitting the mic signals to feed the PA mixer and recording mixer.

This keeps the muddy-sounding bass notes from bouncing around the room. When there are not enough microphones, two instruments can share one microphone. The percussions sound can be picked up with one mini omni condenser mic. The bass and treble can be boosted a little in this case.

The same can be repeated for the instrumentalists and the vocalists equally. Each instrument in the mix should be heard clearly. With the balances roughed in, the equalizer should be tweaked up. Vocals using closely placed mics will need some bass roll off to sound natural, about –6 dB at 100 Hz. The monitors or headphones should be kept at a higher volume to hear the mix better. When the group stops, a quiet playback can be done so as to check the EQ settings at home-stereo levels. The mixer level peaking should be kept around 0dB maximum. The recorder's input level should be set so its meters peak at –6 dB maximum. That setting allows a little headroom in case the group plays louder. Finally, effects have to be added. Once the sound quality is satisfactory, about a minute of the tune should be recorded and played back. Any adjustments needed should be made and the tune should be re-recorded. Several takes must be recorded, and the best parts of all the takes should be edited together.
These steps should be repeated for each instrument and vocal. The lead vocal might need a compressor; it can be patched into the vocal channel's insert jacks. At the start all the faders might need to be raised to about -10 dB. Each microphone can be panned as desired. Then the faders can be adjusted so that every one can be heard.

5.6.3 **STEREO MIXING CLASSICAL MUSIC**

When a classical ensemble is being recorded with stereo microphones, a venue with good acoustics is generally preferred. The reverb time should be fairly long, and the background noise should be quiet. Two identical mics on a stereo bar should be set up. One stereo mic technique that works well in most situations is called ORTF\textsuperscript{133}. Two cardioid mics are taken, angled apart 110 degrees (±65 degrees off center), and their grilles are spaced 7 inches apart horizontally. An alternative with less off-axis high-frequency rolloff is NOS: mics angled 90 degrees apart and spaced 12 inches horizontally. The use of two omni mics spaced 2 to 3 feet, or a stereo mic can also be considered. The microphone stand should be placed about 12 feet in front of the front-row musicians and raised to about 14 feet high. The mics should aim down toward the ensemble. A long pair of mic cables can be run to the recorder.

![Microphone placement for an orchestra](image)

As the group rehearses, the input signal should be monitored. If the sound is too edgy, dry, or detailed, the mics could be moved a foot or two farther away and tried again. If the sound, however, is too distant and muddy, the mic can be

\textsuperscript{133} [www.tape.com/resource/live_recording2.html](www.tape.com/resource/live_recording2.html)
move by a foot or two. A spot where one can hear a pleasing blend of the group and the hall acoustics should be found. If good mics are used, the realism and purity of sound one can get with this method is amazing.

5.7 **Level Setting & Editing**

With any type of music, the recording levels should be set very carefully. If a rehearsal is being recorded, the group should play the loudest part of the music. The recording level is adjusted to peak at about –6 dB maximum. At a live concert, if there was no sound check, the engineer may have no idea where to set the recording level. He might start by turning up the record-level knob 2/3 up, check his meters, and slowly adjust the level up or down as needed. Once it's set, he should try to leave it alone. It's better to set the level a little too low than too high. To prevent excessive levels, he could switch on his recorder’s limiter if it has one.

The recordings can be edited by copying the desired songs to a digital audio workstation (DAW). This is a personal computer in which sound card and sound editing software has been installed. Using that software, the recording can be copied onto the hard drive. If the tracks are recorded directly on a laptop’s hard drive, the file for editing can be just opened in the editing software. After editing the program, it can be saved to a stereo wave file. Ideally, the sound files should be sent on a CD-R to a mastering house. If one wants to master the program, here are the main steps:

- Import each song mix into a multitrack session, one song per track. Trim the start and end of each mix.
- Add a few seconds of silence between songs (unless it’s a live concert).
- Make the loudness consistent from song to song.
• Use EQ to make the tone quality of each song consistent. Har-Bal (www.har-bal.com) is an effective tool for matching levels and optimizing EQ of finished mixes.
• Note the start time of each song for use in writing a cue sheet for CD burning.
• Maybe apply a little multiband compression to the stereo bus and raise the overall level.
• Peak-limit and normalize the stereo bus.
• If your songs are 24-bit, turn on dithering. Export the mix (the mastered program) to a 16-bit/44.1 kHz stereo wave file.

There's the finished recording, ready to copy to a CD-R\textsuperscript{134}.

Music and audio playback system is implemented on a computer with a playback engine that enables the operator, typically a disk jockey, to apply a variety of effects. The system may store one or more snapshots, or a combination of settings for a plurality of controls that are applied by the playback engine. The settings that may be stored in a snapshot may be for effects, deck controls and/or mix settings. These snapshots allow for changes to settings for effects, mixing and playback to be made quickly, some of which would normally be difficult to perform. A sampler module permits a user to specify one or more samples that may be triggered for playback. The most frequently used samples may be designated as scratching files that may be quickly activated through the push of a button (or other control). A waveform display represents a window of audio samples around a current playback time. When two tracks are being played, only half of each waveform is shown. In particular, the bottom half of the waveform at the top, and the top half of the waveform at the bottom are shown. Certain effects that affect the playback of a current audio file, such as a reverse, repeat or brake effect, are performed as

\textsuperscript{134} Stereo Microphone Techniques Explained: March 1997 Sound on Sound - HUGH ROBJOHNS
insert effects. As a result, the current play position in the current audio file continues to advance while the effect is performed, even though the effect is applied to the audio data in the current audio file. The waveform display continues to update based on the continually updated current play position in the audio file.

In modern playback systems used in homes, additional convenience and ease of control with the huge music storage and intelligent playback system are the salient features. It can help the listener explore, enjoy and relate to the different aspects of his music collection more rewardingly than ever before. It lets one easily and quickly store up to 340 hours of CD and MP3 music in the entertainment system’s media centre, even while using other facilities within the system. These home entertainment systems automatically sort, catalogue and cross-reference the tracks, using a built-in and regularly updated database of music and artist information. The entire stored music library can be viewed on the TV screen. The listener can create up to nine independent playlists while listening to his system, review their contents, instantly access any CD or MP3 file via the remote handset, and effortlessly control which songs are played. This intelligent playback system monitors every track that he plays all the way through, or interrupts or skips. Similarly, it remembers other individual users’ choices, monitors variations according to mood, and records personal ratings of specific tracks when keyed into the remote.

The more music that each member of the household plays, the more these systems learn about what each person likes to hear, and the system organises and retains the accumulated information in up to nine user-nominated stations, which can be allotted either to a person or to an activity such as dining or partying. Over time, a station becomes rather like a personal radio station, able to select and play the right kind of music to suit the particular user or occasion, and even ready to suggest similar tracks which may have been overlooked or
forgotten. The user interface of these systems has been redesigned for enhanced user-friendliness and improved interaction with the system, making it even easier to manage and access the listener’s music collection and to appreciate it to the full.

In 2003 the first MP3 players were installed into mobile phones in South Korea. The innovation spread rapidly and by 2005, more than half of all music sold in South Korea was sold directly to mobile phones. The idea spread across the globe and by 2005 all five major handset makers, Nokia, Motorola, Samsung, LG and SonyEricsson had released musicphones. By 2006, more MP3 players were sold in musicphones than all stand-alone MP3 players put together. The rapid rise of the musicphone was quoted by Apple as a primary reason for developing the iPhone\textsuperscript{135}. In 2007, the installed base of musicphones passed the 1 billion level, and today more than half of all mobile phones in the world have an MP3 player.

Digital sampling is used to convert an audio wave to a sequence of binary numbers that can be stored in a digital format, such as MP3. Common features of all MP3 players are a memory storage device, such as flash memory or a miniature hard disk drive, an embedded processor, and an audio codec microchip to convert the compressed file into an analogue sound signal.

\textsuperscript{135} en.wikipedia.org/wiki/Digital_audio_player
Most DAPs are powered by rechargeable batteries, some of which are not user-replaceable. They have a 3.5 mm stereo jack; music can be listened to with earbuds or headphones, or played via an external amplifier.

Digital audio players are generally categorized by storage media:

- **Flash-based Players**: These are non-mechanical solid state devices that hold digital audio files on internal flash memory or removable flash media called memory cards\(^\text{136}\). Due to technological advancements in flash memory, these originally low-storage devices are now available commercially ranging up to 32 GB. Because they are solid state and do not have moving parts they require less battery power and may be more resilient to hazards such as dropping or fragmentation than hard disk-based players. Basic MP3 player functions are commonly integrated into USB flash drives.

- **Hard drive-based Players or Digital Jukeboxes**: Devices that read digital audio files from a hard disk drive (HDD). These players have higher capacities currently ranging up to 250 GB. At typical encoding rates, this means that tens of thousands of songs can be stored on one player.

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\(^{136}\) en.wikipedia.org/wiki/Digital_audio_player
- **MP3 CD Players**: Portable CD players that can decode and play MP3 audio files stored on CDs.
- **Networked audio players**: Players that connect via (WiFi) network to receive and play audio.

### 5.8 Recording Quality

As software systems, DAWs could be designed with any user interface, but generally they are based on a multitrack tape recorder metaphor, making it easier for recording engineers and musicians already familiar with using tape recorders to become familiar with the new systems. Therefore, computer-based DAWs tend to have a standard layout which includes transport controls (play, rewind, record, etc.), track controls and/or a mixer, and a waveform display. In single-track DAWs, only one (mono or stereo form) sound is displayed at a time.

Multitrack DAWs support operations on multiple tracks at once. Like a mixing console, each track typically has controls that allow the user to adjust the overall volume and stereo balance (pan) of the sound on each track. In a traditional recording studio additional processing is physically plugged in to the audio signal path, a DAW, however, uses software plugins to process the sound on a track.

DAWs are capable of many of the same functions of an old-fashioned recording studio setup. And yet there are some things that are only possible in an old-fashioned recording studio and some things that are only possible via a DAW. Modern advanced recording studios have multiple types of DAWs in them and it is not uncommon for a sound engineer and/or musician to travel with a portable DAW of one kind or another.
Perhaps the most significant feature available from a DAW that is not available in analogue recording is the ability to 'undo' a previous action. Undo makes it much easier to avoid accidentally permanently erasing or recording over a previous recording. If a mistake is made, the undo command is used to conveniently revert the changed data to a previous state. Cut, Copy, Paste, and Undo are familiar and common computer commands. As DAWs of all types involve specialised computer "engines" to run, they usually have these common computer commands too.

Commonly DAWs feature some form of automation, often performed through "envelopes". Envelopes are procedural line segment-based or curve-based interactive graphs. The lines and curves of the automation graph are joined by or comprised of adjustable points. By creating and adjusting multiple points along a waveform or control events, the user can specify parameters of the output over time (e.g., volume or pan). Automation data may also be directly derived from human gestures recorded by a control surface or controller. MIDI is a common data protocol used for transferring such gestures to the DAW. MIDI recording, editing, and playback is increasingly incorporated into modern DAWs of all types. Synchronization with other audio and/or video tools is another function that DAWs are increasingly capable of.

5.9 **Studio Recording**

Studio recording is sound recording done in a professional recording studio. Ideally, the space is specially designed by an acoustician to achieve the desired acoustic properties (sound diffusion, low level of reflections, adequate reverberation time for the size of the ambient, etc.). Different types of studios record bands and artists, voiceovers and music for television shows, movies, animations, and commercials, and/or even record a full orchestra. The typical

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137 en.wikipedia.org/wiki/Digital_audio_workstation
recording studio consists of a room called the "studio", where instrumentalists and vocalists perform; and the "control room", which houses the equipment for recording, routing and manipulating the sound. Often, there will be smaller rooms called "isolation booths" present to accommodate loud instruments such as mridangam, tavil or the saxophone, to keep these sounds from being audible to the microphones that are capturing the sounds from other instruments or vocalists.

Recording studios generally consist of three rooms: the studio itself, where the sound for the recording is created (often referred to as the "live room"), the control room, where the sound from the studio is recorded and manipulated, and the machine room, where noisier equipment that may interfere with the recording process is kept.  

Recording studios are carefully designed around the principles of room acoustics to create a set of spaces with the acoustical properties required for recording sound with precision and accuracy. This will consist of both room treatment (through the use of absorption and diffusion materials on the surfaces of the room, and also consideration of the physical dimensions of the room itself in order to make the room respond to sound in a desired way) and soundproofing (to provide sonic isolation between the rooms). A recording studio may also include additional rooms, such as a vocal booth - a small room designed for voice recording, as well as one or more extra control rooms.

Equipment found in a recording studio commonly includes:

- Mixing console
- Multitrack recorder
- Microphones
- Two way speaker system to communicate with the artists

138 en.allexperts.com/e/r/re/recording_studio.htm
• Reference monitors, which are loudspeakers with a flat frequency response
• Digital audio workstation

Music workstation
Outboard effects, such as compressors, reverbs, or equalizers

General purpose computers have rapidly assumed a large role in the recording process, being able to replace the mixing consoles, recorders, synthesizers, samplers and sound effects devices. A computer thus outfitted is called a Digital Audio Workstation, or DAW. Current software applications are more reliant on the audio recording hardware than the computer they are running on, therefore typical high-end computer hardware is less of a priority. A sizeable portion of both commercial and home studios can be seen running PC-based multitrack audio software.

A small, personal recording studio is sometimes called a project studio or home studio. Such studios often cater to specific needs of an individual artist, or are used as a non-commercial hobby. Recording mridangam and saxaphone in a home studio is challenging, because they are usually the loudest instruments.

An isolation booth is a standard small room in a recording studio, which is both soundproofed to keep out external sounds and keep in the internal sounds and like all the other recording rooms in sound industry it is designed for having a lesser amount of diffused reflections from walls to make a good sounding room. A professional recording studio has a control room, a large live room, and one or more small isolation booths. All rooms are soundproofed such as with double-layer walls with dead space and insulation in-between the two walls, forming a room-within-a-room. All rooms in a recording studio may have a reconfigurable combination of reflective and non-reflective surfaces, to control the amount of reverberation.

139 www.studio.pedia.com/
5.10 Digital Editing

A digital audio editor is a computer application for audio editing, i.e. manipulating digital audio\(^\text{140}\). Digital audio editors are the main software component of a digital audio workstation.

For use with music: Editors designed for use with music typically allow the user to do the following:

- Record audio from one or more inputs and store recordings in the computer's memory as digital audio
- Edit the start time, stop time, and duration of any sound on the audio timeline
- Fade into or out of a clip (e.g. an S-fade out during applause or after a performance), or between clips (e.g. crossfading between takes)
- Mix multiple sound sources/tracks, combine them at various volume levels and pan from channel to channel to one or more output tracks
- Apply simple or advanced effects or filters, including compression, expansion, flanging, reverb, audio noise reduction and equalization to change the audio
- Playback sound (often after being mixed) that can be sent to one or more outputs, such as speakers, additional processors, or a recording medium
- Conversion between different audio file formats, or between different sound quality levels

Typically these tasks can be performed in a manner that is both non-linear and non-destructive.

Audio signal processing, sometimes referred to as audio processing, is the intentional alteration of auditory signals, or sound\(^\text{141}\). As audio signals may be

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\(^{140}\) [www.software09.com/audio-editor.htm](http://www.software09.com/audio-editor.htm)

\(^{141}\) [www.absoluteastronomy.com/topics/Audio_signal_processing](http://www.absoluteastronomy.com/topics/Audio_signal_processing)
electronically represented in either digital or analog format, signal processing may occur in either domain. Analog processors operate directly on the electrical signal, while digital processors operate mathematically on the binary representation of that signal.

Human hearing extends from approximately 20 Hz to 20 kHz, determined both by physiology of the human hearing system and by human psychology. These properties are analysed within the field of psychoacoustics\textsuperscript{142}. Processing methods and application areas include storage, level compression, data compression, transmission, enhancement (e.g., equalization, filtering, noise cancellation, echo or reverb removal or addition, etc.)

Audio broadcasting (be it for television or audio broadcasting) is perhaps the biggest market segment (and user area) for audio processing products—globally. Traditionally the most important audio processing (in audio broadcasting) takes place just before the transmitter. Studio audio processing is limited in the modern era due to digital audio systems (mixers, routers) being pervasive in the studio. In audio broadcasting, the audio processor must prevent overmodulation, and minimize it when it occurs, maximize overall loudness and compensate for non-linear transmitters, more common with medium wave and shortwave broadcasting.

5.11 **Multi Track Recording**

In the 2000s, many performers have recorded albums using only a personal computer as a tracking machine. To use a personal computer as a multitracking device, the computer must have an analog to digital interface, and multitrack recording software must be installed (software is available at all price ranges or even free, in the case of free software and open source). As well, a microphone is needed to record the vocals of a singer and/or any other sources of sound.

\textsuperscript{142} en.wikipedia.org/wiki/Audio_signal_processing
This is all that is needed to use a computer as a digital multitrack. Alternately, the standard analog to digital interface in a personal computer can be used to capture sounds, albeit with less fidelity. This is done simply by attaching either a microphone to the microphone input jack if a vocal track is to be recorded, or a stereo cable from the electronic device (such as a synthesizer or a guitar amplifier) to the line input of the sound card. Computers with appropriate software and hardware can record multiple audio tracks at once. This audio interface hardware sends audio signals to the computer and may interface with the computer via a PCI card, USB or FireWire connections\textsuperscript{143}. There is a range of analog to digital interface options available. Popular brands include Apogee, Digidesign, MOTU, Lynx and Prism.

The instruments and singers' voices are recorded as individual files on the computer's hard drive, and function as tracks as per traditional multitracking. Effects such as reverb, chorus, and delays can be applied by the computer software. When the musicians are happy with the sound, the multiple tracks are mixed down onto two clean tracks, again within the multitracking software. Finally, the final stereo recording can be burned to a CD, which can then be copied and distributed.

\textbf{The Digidesign 192 i/o.}

\textit{An audio interface for the Pro Tools computer-based hard disk recording system}

Multitracking software for a personal computer includes: Adobe Audition, Pro Tools from Digidesign, SONAR from Cakewalk, Samplitude from Magix, Cubase from Steinberg, and Logic Pro from Apple\textsuperscript{144}. Mixcraft from Acoustica, Inc., Reaper from Cockos and N-track from FASoft are affordable alternatives

\textsuperscript{143} en.wikipedia.org/wiki/Multitrack_recording
\textsuperscript{144} correlator.sandbox.yahoo.net/index.php/people/Pro+Logic
to high end multi-track software. Audacity and Ardour are popular open source programs for multi-track recording. Jokosher (open source as well) is quite new, but seems to be gaining popularity among Linux users.

2007 Song Galaxy has released an Audio Multi-Track format that is delivered in a single file, which loaded into the player software gives the user the ability to mute or adjust the volume level of individual instruments\(^\text{145}\). Tracks can be exported as individual WAV files which can then be loaded into other Multitracking software for further editing.

In most songs, percussion instruments are the first instruments to be recorded. There are various reasons for this. The percussions are usually the rhythm leaders; it is much easier for musicians recording later tracks to keep to the common beat of the percussions, also due to the precise attack of percussion sounds. A mridangist might find it very difficult to play along with a backing track recorded without percussion, due to the likely variations in the musicians' tempo. Furthermore, in order to accurately keep to a pre-established rhythm, a mridangist would need the sound of the other instruments to be very loud to compete with his instrument; apart from the possibility of the percussion microphones picking up the sound of the other instruments from the mridangist's headphones, prolonged exposure to such volume might very well damage their hearing. Also, it allows the percussions to be recorded for a few seconds, then looped. Click (metronome) tracks are also often used as the first sound to be recorded, especially when the percussionist isn't available for the initial recording, and/or the final mix will be synchronized with motion picture and/or video images.

Also, though the percussions might eventually be mixed down to a couple of tracks, each individual percussion instrument might be initially recorded to its

\(^{145}\) www.answers.com/topic/multitrack
own individual track. The percussion combined can occupy the largest number of tracks utilized in a recording. This is done so that each percussion instrument can be processed individually for maximum effect. A common percussion effect is the slow back and forth panning of a percussive instrument's sound in the stereo field from the left to the right channel in a song. Equalization (or EQ) is often used on individual percussions, to bring out each one's characteristic sound.

The last tracks to be recorded are usually the vocals (though a temporary vocal track might be recorded early on either as a reference or to guide subsequent musicians). One reason for this is that singers will often temper their vocal expression in accordance with the accompaniment.

For classical recordings (particularly instrumentals) where multitracking is chosen as the recording method (as opposed to direct to stereo, for example), a different arrangement is used; all tracks are recorded simultaneously. Sound barriers are often placed between different groups within the orchestra, e.g. violinists, percussionists, etc. When barriers are used, these groups listen to each other via headphones.

5.12 **Teaching Methodology: Now & Bani**

Today, acquiring training in music has become more streamlined through the establishment of many Institutes and Academies that offer varied courses in Music to students all across the globe. Individuals who are interested in learning music, either due to an interest in the field or with an aim of taking up the art professionally, have numerous options to choose from. Many Music Institutes, both in India and abroad, teach music to students at varying capacities. Most Institutes offer courses that include a combination of theoretical as well as practical knowledge. There are others that concentrate more on practical

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146 [en.allexperts.com/e/m/mu/multitrack_recording.htm](en.allexperts.com/e/m/mu/multitrack_recording.htm)
training like teaching how to play a musical instrument. Of course, some theory is taught as well so that students can understand the basics of music and have a strong background in the field.

Professional Training in Music is essential for those individuals who dream of becoming a part of this highly competitive and growing industry. Music courses offered by various Institutes in India & Abroad include a combination of Certificate & Diploma Courses, Bachelors and Post Graduate Courses etc. the springing up of a number of schools & colleges and institutions of university status is a very important part of the music evolution\textsuperscript{147}.

Many compositions of great composers and minor composers are being studied. The study of musicology and history of music has found its proper place in the curriculum of studies. More and more lakshana grantas which were lying as manuscripts have now been published with critical introduction and notes. The level of musicianship has risen.

The music industry is one of the fastest growing industries the world over. With the rise in the entertainment needs of television and radio audiences - Jobs & Career Opportunities in the Radio Industry, India, there has also been a marked improvement in the demand for professionals in this field. Unlike some years back when music was merely considered to be a hobby, today, more and more youngsters and professionals are aiming towards building a lucrative career in the music industry.

When we look at the situation today, it is a fact that technology is in a way deterring young and aspiring musicians from developing a Bani of their own. Though it sounds like a sweeping statement, it is true to a great extent. Today it has become possible to learn music with the help of tapes and CDs, and even

\textsuperscript{147} South Indian Music - Book VI – Prof P.Sambamurthy
from the Internet, unlike in the olden days when the disciples spent years with their gurus and learnt the art at their feet. They were not exposed to various singers, till they reached a certain level of maturity. Their foundation was laid strong and when they were ready, they could choose a style which best suited their voice range. But when one learnt from CDs and cassettes by just listening to them and reproducing them, it becomes a parrot-like repetition\textsuperscript{148}. Hence in one kriti they sound like MS, in another like MLV and in third like Pattammal! There is no depth to their music. This is no way a mean task in itself, but the chief ingredient which distinguishes talent from genius, namely creativity is missing. In short, a Bani is sadly lacking. This is one great pitfall aspiring artists should avoid if they were to make their music and thereby themselves, immortal. A serious student of music should learn the fundamentals of music, from one single capable guru and having mastered them, should go on to evolve their own style based on this knowledge.

5.13 \textbf{Use of Technology in Teaching: Teaching Methodology}

During olden times in India, music was taught by Gurus who were talented teachers and belonged to different Musical Gharanas of Indian Classical Music or Hindustani Music. Such Teachers or Gurus passed over their knowledge to deserving pupils who carried forward their legacy. The Guru - Shishya bond was sacred and very strong.

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\textsuperscript{148} www.carnatica.net/special/essay-vimala.htm
Institutes offer courses that include a combination of theoretical as well as practical knowledge. There are others that concentrate more on practical training like teaching how to play a musical instrument. Of course, some theory is taught as well so that students can understand the basics of music and have a strong background in the field.

Professional Training in Music is essential for those individuals who dream of becoming a part of this highly competitive and growing industry. Music courses offered by various Institutes in India & Abroad include a combination of Certificate & Diploma Courses, Bachelors and Post Graduate Courses etc.

The Indian Entertainment Industry is flourishing and expanding at an alarming rate. Talent Contests and Musical shows organised from time to time by major Television channels have been major contributors in recognising talented performers, singers and artists. These shows have been successful in providing a strong platform to budding artists so that they can come forward and showcase their talents. Many of these unknown faces, voices and names have found recognition as well as work, helping them to achieve their career dreams on a serious note. The music Industry has opened a plethora of career opportunities for people who have the talent and interest in this vast and likeable industry.

5.14 **AUDIENCE**

The current busy life style has resulted in a drastic change in the type of audience for Carnatic music concerts. In those days, people had time on their hands. The jobs were 9am – 5pm mostly. And the choice for entertainment was limited. Without television & so many other Hi-Fi audio systems, the only way to listen to a good concert was to attend a live one. The educated listener was ready to spend three to four hours sitting in the venue to hear his favorite

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[149](www.musical-escapades.com/careers-in-music.htm)
musician perform. And discussing in detail with fellow rasikas about the performance also was part of the entertainment. In fact most of the rasikas improved their musical knowledge this way. It was almost a ritual for the rasikas to discuss, criticize, and understand the artists’ performance after every concert.

But now, people are multi-tasking everyday. Every minute is precious & planned meticulously. So, a very few have the time to sit in a place & listen to live concerts. They are very happy to get the quality music in the comfort of their homes with home theater systems. Hence the audience for a live concert will be either friends or relatives of the performers who are invited personally by the performer or his family & come out of love or a sense of duty. They could also be fellow young musicians who expect the performing musicians in turn to attend their performances. Also older people who have time on their hand will attend concerts by popular musicians. Music students who aspire to become performers themselves too form part of the audience. The first category might or might not be musically knowledgeable. The second & third will definitely be a critical audience. Hence though the number of listeners in live concerts has reduced, it has resulted in a filtered, musically knowledgeable, critical, appreciative audience whose expectations are high. This in turn boosts the morale of the musician, since appreciation by learned audience is the only reward a good musician expects. So even though the number of listeners in these concerts has reduced, the quality of the listeners has actually increased.

Another important factor for the dwindling audience according to senior artists is the lack of excellence. As this senior maestro cites an example; he had witnessed two great musicians who were to perform on consecutive days at the Madras Music Academy. The first day, the first musician was surprised & honored to see the other musician sitting in the front row, enjoying his concert. To return the honor this great man decided to attend the second musician’s
concert. All well till this moment. But to the horror of the second musician and the surprise of many rasikas, this man did not sit through the full concert. After about one hour, he just got up and left the hall. This upset the performer. When questioned, the great vidwan answered: “You sang well, no doubt. But as a fellow vidwan, I expect to hear something new and superlative in every concert. One cannot sing the same thing every time. Even if it is the same Bhairavi, every time you sing, audience has to hear some thing new, some thing you have not done before, something better than you have ever done before. If not you have failed”. These days this kind of excellence, competing with oneself, wanting to out do oneself every time, is rare. Only those artists who follow this do find an audience for their live concerts. Others’ performance can be enjoyed at home from CDs & internet. There is nothing new to expect in a live concert.

5.15 **NEW MUSICAL INSTRUMENTS**

The vast development in technology has affected the musical Instrument Industry too. The traditional tanpura is becoming rarer and rarer in concerts these days. Even if they are used, the musician also uses the electronic tanpura, relegating the traditional tanpura to a mere showpiece. There are talamalas used to keep talam too that are being used by some musicians. But the electronic sruthi box is the maximum used modern instrument. Violins & veenas invariably are fitted with pic-up microphones. The role of the hollow wood as the resonator is diminished to a great extent[^150]. Electronic veenas that can be dismantled into 2 or 3 pieces, making them portable are being manufactured now. The kodam now is no more the resonator. Some have even tried to place a speaker inside the kodam & some have tried placing a sruthi box inside the ‘sorakkaai’. The mic picks up the vibrations made while the vainika is playing the instrument and transforms them into electrical energy, which then is finally converted.

[^150]: The Physics of Musical Instruments - by Neville H Fletcher, Thomas D Rossing
The violin of Carnatic music is the same instrument as the violin of Western music, though tuned and held differently. It was introduced to India in the 19th century, when Balusvami Dikshitar (1786–1859), brother of Muttusvami Dikshitar, learnt the violin from a European violinist, and decided to adapt it to the South Indian system of music.\(^\text{151}\) It is particularly well suited for Indian music because it can produce the microtones that are essential to the Indian musical tradition. In North India, however, indigenous bowed instruments such as the sārangi continue to be used. The flute was invented independently in India and the West; Krishna is said to have been a master of it. The difference is that the Indian flute is a bamboo tube with open holes, quite unlike the modern western version.\(^\text{152}\)

U. Srinivas plays the electric mandolin. Kadri Gopalnath plays the alto saxophone. N Ravikiran plays the chitravina, also known as the gottuvadhyam, an ancient instrument with twenty-one strings. Guitar Prasanna plays the Electric Guitar. Others such as Kunnakudi Vaidyanathan and L. Subramaniam have pioneered the adaptation of the instrument beyond the classical idiom.

5.16 **TYPES OF CONCERTS & CONCERT CONTENT**

Carnatic music is usually performed by a small ensemble of musicians, who sit on an elevated stage. This usually consists of, at least, a principal performer, a melodic accompaniment, a rhythm accompaniment, and a drone. The tambura is the traditional drone instrument used in concerts. However, tamburas are increasingly being replaced by śruti boxes, and now more commonly, the electronic tambura. The drone itself is an integral part of performances and furnishes stability - the equivalent of harmony in Western music. Performances can be musical or musical-dramatic. Musical recitals are either vocal, or purely instrumental in nature, while musical-dramatic recitals refer to Harikatha. But

\(^{151}\) [www.experiencelfestival.com/a/Carnatic_music/id/1946890](http://www.experiencelfestival.com/a/Carnatic_music/id/1946890)

\(^{152}\) *Fundamentals of Musical Acoustics: Second*... - by Arthur H Benade
irrespective of what type of recital it is, what are featured are compositions which form the core of this genre of music.

In a vocal recital, a concert team may have one or more vocalists as the principal performer(s). Instruments, such as the veena and/or flute, can be occasionally found as a rhythmic accompaniment, but usually, a vocalist is supported by a violin player (who sits on his/her left). The rhythm accompanist is usually a mridangam player (who sits on the other side, facing the violin player). However, other percussion instruments such as the ghatam, kanjira and morsing frequently also accompany the main percussion instrument and play in an almost contrapuntal fashion along with the beats. The objective of the accompanying instruments is far more than following the melody and keeping the beats. The accompaniments form an integral part of every composition presented, and they closely follow and augment the melodic phrases outlined by the lead singer. The vocalist and the violinist take turns while elaborating or while exhibiting creativity in sections like raga, niraval and kalpanaswaram. Unlike Hindustani music concerts, where an accompanying tabla player can keep beats without following the musical phrases at times, in Carnatic music, the accompanists have to follow the intricacies of the composition since there are percussion elements such as eduppu in several compositions. Some of the best concerts feature a good bit of interaction with the lead musicians and accompanists exchanging notes, and accompanying musicians predicting the lead singer's musical phrases.

A contemporary Carnatic music concert (kutcheri) usually lasts about three hours, and comprises a number of varied compositions. Carnatic songs are composed in a particular raga, which means that they do not deviate from the notes in the raga. Each composition is set with specific notes and beats, but performers improvise extensively. Improvisation occurs in the melody of the composition & in using the notes to expound the beauty of the raga.
Concerts usually begin with a varnam or an invocatory item which will act as the opening piece. The varnam is composed with an emphasis on swaras of the raga, but will also have lyrics, the sahityam. It is lively and fast to get the audience's attention. An invocatory item may usually follow the varnam. After the varnam and/or invocatory item, the artist sings longer compositions called kirtanas (commonly referred to as kritis). Each kriti sticks to one specific raga, although some are composed with more than one raga; these are known as ragamalika (a garland of ragas)

After singing the opening kriti, usually, the performer sings the kalpanaswaram of the raga to the beat. The performer must improvise a string of swaras in any octave according to the rules of the raga and return to beginning of the cycle of beats smoothly, joining the swaras with a phrase selected from the kriti. The violin performs these alternately with the main performer. In very long strings of swara, the performers must calculate their notes accurately to ensure that they stick to the raga, have no awkward pauses or lapses in the beat of the song, and create a complex pattern of notes that a knowledgeable audience can follow.

Performers then begin the main compositions with a section called raga alapana exploring the raga. In this, they use the sounds aa, ri, na, ta, etc. instead of swaras to slowly elaborate the notes and flow of the raga. This begins slowly and builds to a crescendo, and finally establishes a complicated exposition of the raga that shows the performer's skill. All of this is done without any rhythmic accompaniment, or beat. Then the melodic accompaniment expounds the raga. Experienced listeners can identify many ragas after they hear just a few notes. With the raga thus established, the song begins, usually with lyrics. In this, the accompaniment performs along with the main performer and the percussion (such as a mridangam). In the next stage of the song, they may sing niraval or kalpanaswaram again.

History of Indian Music – Prof P. Sambamurthy
In most concerts, the main item will at least have a section at the end of the item, for the percussion to perform solo (called the *tani avartanam*). The percussion artists perform complex patterns of rhythm and display their skill. If multiple percussion instruments are employed, they engage in a rhythmic dialogue until the main performer picks up the melody once again. Some experienced artists may follow the main piece with a *ragam thanam pallavi* mid-concert, if they do not use it as the main item.

Following the main composition, the concert continues with shorter and lighter songs. Some of the types of songs performed towards the end of the concerts are *tillanas* and *thukkadas* - bits of popular *kritis* or compositions requested by the audience. Every concert that is the last of the day ends with a *mangalam*, a thankful prayer and conclusion to the musical event.

These days, these 3 hour concerts are seen in major music festivals & sung by experienced artistes. But there are many shorter concerts even in Madras Music Academy meant for junior artistes – one hour concerts, one & half hour concerts, two hour concerts etc. The content for these concerts are slightly different. Generally they have just one main kruthi and do not contain RTP. Planning a good short concert, where the full knowledge of the artist is showcased requires great skill & understanding.

The advent of All India Radio & Doordharshan has led to the introduction of even shorter concerts – of 45 minutes & 30 minutes duration. The skill of the performer is really taxed in choosing content so as to showcase his wide range of knowledge. The introduction of live concert recorded in CDs meant that the artist has to choose his repertoire to fit into a CD. The time constraint has made the performer train himself to give compact short performances that is concise, yet exhaustive.
5.17 PROPAGATION:
The World Wide Web has enabled streaming of good music through the web. *It is home to scores of sites where you can listen to Carnatic music, download songs and even indulge in intense discussions with other music aficionados.* Music is available irrespective of the time of the day through the net from different web sites. This increases the ease with which a connoisseur is able to listen to his/her favorite musician performing a particular song – again the listener’s choice.

Music has no barriers, and the Internet has made this statement true in the most literal sense. Thanks to music websites, fans of Indian classical music can fill their lives with its soulful richness anytime, anywhere in the world. Rasikas can listen to hundreds of *kritis* and *bhajans* rendered by veteran Carnatic vocalists and instrumentalists, as well as contemporary artistes. These sites also have a Carnatic News section, which posts events and developments worldwide in the field of Carnatic music.

Most sites do not, however, provide the option of music downloads. There are some sites that allow music lovers to upload and download concert recordings, lec-dems, etc. The sites have archives of performances by maestros like MS Subbulakshmi, Chembai Vaidyanatha Bhagavathar and DK Pattammal, and a regular feature highlighting the works of renowned composers like Thyagaraja and Muthuswami Dikshithar.

Some sites have downloadable audio lessons, samples of famous artistes, music theory and even a downloadable “*shruti* box”. For the die-hard aficionado, Carnatic Corner offers an array of links to downloadable audios, music libraries, Carnatic artistes’ groups and discussion forums.
With YouTube, the listener gets to hear various new artists, who would otherwise not been known. Once the rasika likes a particular artist, he/she looks out for the live concert and makes it a point to attend. So, the internet has not hindered concert attendance. It in fact helps the rasika to choose the right concert to attend. For a beginner, YouTube allows one to upload his/her music. The tedious process of bringing out an album – expensive, looking for sponsors, distributing the album etc – is made redundant. Any musician with a computer, net connection & a good microphone & necessary software can record & upload his/her music for the whole world to listen.

The recording done by music companies like HMV, INRECO, Sangeetha etc are now of great use as tools for lecture demonstrations and for teaching. Great masters’ performances can be now heard, without too much distortion, thanks to digital enhancement, noise reduction etc. there is no dilution of music by wrong propagation. The actual style, tonal quality etc can be heard by future & present generations in different parts of the world.

5.18 **Music Editing:**

Sound editing is a process that requires both skill and instinct. Today, most sound editing is done digitally using specialized software. It wasn’t always this way. Magnetic tape and tape recorders were first invented in the late 1940s. Using magnetic tape for recording and editing sound was the status quo until the mid 1990s when computers and digital software revolutionized the sound editing process.

Tape editing is performed simply by cutting the tape at the required point, and rejoining it to another section of tape using adhesive tape, or sometimes glue. This is called a splice. The splicing tape has to be very thin to avoid impeding the tape's motion, and the adhesive is carefully formulated to avoid leaving a sticky residue on the tape or deck. Usually, the cut is made at an angle across
the tape so that any "click" or other noise introduced by the cut is spread across a few milliseconds of the recording. The use of reels to supply and collect the tape also made it very easy for editors to manually move the tape back and forth across the heads to find the exact point they wished to edit.

The editing process was slow, tedious, and sometimes unstable. To edit sound with magnetic tape, the user had to find both points on the tape where the splice needed to occur, place the tape in an "editing block" which provided a pre-cut splice area sunken at a 45 degree angle, place the tape in the block, use a razor blade to cut the tape in the 45 degree angle groove, and then physically join the magnetic tape back together with a specially designed editing tape.

And if the splicing was wrongly done, then everything had to be undone, use the editing tape to put the magnetic tape back the way it was, and then try again. It was tedious and sometimes frustrating work. The user had no visual of the recorded sound to refer to, either. It was all done by ear.

Now a computer user can own software which is as powerful as an older magnetic-tape based 64-track recording studio. It’s an amazing amount of power and a user can acquire many software applications, may free or extremely low in cost. Editing is both a skill and an art. Yes, there are proven methods which allow an editor to create a better product that anyone can learn but the proficient editor over time also acquires a sense for eliminating, adding or accentuating audio for projects.

Editing is done mainly for aesthetics but proper editing also keeps a listener’s attention. Long audio pieces - or audio that has extraneous sound in it - tends to bore listeners. Shorter audio accentuated by music, sound effects or sound punctuation keeps a listener’s attention and helps you make your point. In Carnatic music, when the artist sings with manodharma, it is very difficult to
Editors designed for use with music typically allow the user to do the following:

- Record audio from one or more inputs and store recordings in the computer's memory as digital audio
- Edit the start time, stop time, and duration of any sound on the audio timeline
- Fade into or out of a clip (e.g. an S-fade out during applause after a performance), or between clips (e.g. crossfading between takes)
- Mix multiple sound sources/tracks, combine them at various volume levels and pan from channel to channel to one or more output tracks
- Apply simple or advanced effects or filters, including compression, expansion, flanging, reverb, audio noise reduction and equalization to change the audio
- Playback sound (often after being mixed) that can be sent to one or more outputs, such as speakers, additional processors, or a recording medium
- Conversion between different audio file formats, or between different sound quality levels

Typically these tasks can be performed in a manner that is both non-linear and non-destructive.

**Audio restoration** is a generalized term for the process of removing imperfections (such as hiss, crackle, noise, and buzz) from sound recordings.
Audio restoration can be performed directly on the recording medium (for example, washing a gramophone record with a cleansing solution), or on a digital representation of the recording using a computer (such as a AIFF or WAV file). Record restoration is a particular form of audio restoration that seeks to repair the sound of damaged records.

Modern audio restoration techniques are usually performed by digitizing an audio source from analog media, such as lacquer recordings, optical sources and magnetic tape. Once in the digital realm, recordings can be restored and cleaned up using dedicated, standalone digital processing units such as de-clickers, de-cracklers, de-hissers and dialogue noise suppressors, or using digital audio workstations (DAWs). DAWs can perform various automated techniques to remove anomalies using algorithms to accomplish broadband de-noising, de-clicking and de-crackling, as well as removing buzzes and hums. Often audio engineers and sound editors use DAWs to manually remove "pops and ticks" from recordings, and the latest spectrographic 'retouching' techniques allow for the suppression or removal of discrete unwanted sounds. DAWs are capable of removing the smallest of anomalies, often without leaving artifacts and other evidence of their removal. Although fully automated solutions exist, audio restoration is sometimes a time consuming process that requires skilled audio engineers with specific experience in music and film recording techniques.

5.19 **ARCHIVING MUSIC FOR POSTERITY**

With the passing away of a senior musician, a whole era ends. Only a few are left. Without losing time we should record their views and impressions for posterity.
Documenting interviews and concerts, is an important service to Carnatic music that is necessary to make sure the coming generations have the information\textsuperscript{154}. The first step is to digitize all the records we have, so that they reach music lovers across the globe. The plan should include digitising books on carnatic music too with content capsules. Some of the books here are rare, even a century old and out of print. It is a mammoth task first to find them among rasikas & artists, and then digitize them.

Sampradaya is doing just this. Started about three decades ago, its goal is to streamline the institution, as a mammoth reference point. There is enough material for a student to work on a doctorate. There are many photographs of stalwarts and the recordings of workshops they conducted. Of special mention is:

\begin{enumerate}
  \item MLV’s interview, with her all round knowledge, humility and sense of humour are unbelievable.
  \item Mani Krishnaswamy’s is a riot. She spent three days in Sampradaya, tirelessly coming up with anecdotes and observations.
  \item Semmangudi didn’t like his flow interrupted. ‘Don’t ask questions. I’ll do the talking.’ Was his often repeated quips.
\end{enumerate}

People drop in at regular intervals with their collections — tapes and spools along with the machine. ‘There are enough such models to make a museum. The committee has planned ‘Samvadha’ (dialogue) featuring a stalwart in conversation with another musician. This will be also digitized for posterity. They also plan to organise lecture-demonstrations in music and dance and an exclusive folk arts festival. The art of the past and the present will be preserved for the future.

\textsuperscript{154}carnatic.weebly.com/carnatic-news.html -
5.20 **THE NCPA AUDIO & FILM ARCHIVES**

Almost 5,000 hours of audio recordings taken from live and studio performances, and 1,200 hours, with of film footage of musicians, the NCPA’s archive ranks among the world’s finest documentary resources for Indian music\(^{155}\). These archives play a central role in the NCPA’s objective to record and preserve for posterity the finest performances in classical and folk music traditions, which have been handed down through oral tradition by renowned teachers over generations.

To this end, the Recording Auditorium was inaugurated in December 1969. Recording began on 12 August 1970, when the late tabla maestro, Ahmed Jan Thirakwa Sahab – then already in his eighties – played an exquisite tabla solo and answered questions from Pandit Nikhil Ghosh about his gharana. This historic recording paved the way for a series of recordings in the coming years. The NCPA Archive features most of the stalwarts of Hindustani and Carnatic music. There is also a series of unique recordings of Indian folk music groups captured in the field using a specially equipped van. The archive hosts a collection of rare 78rpm records which have been cleaned and restored by the NCPA, and there are recordings of live performances by visiting orchestras, chamber groups and solo recitalists.

The NCPA Library is a unique resource for Mumbai, as the only Performing Arts library in the city, giving access to a collection of almost 20,000 books and more than 5,500 recordings which can be heard using our in-house audio equipment. As well as an extensive collection of books on Music, Dance and Theatre, they cover Film, Painting, Sculpture, Architecture, Photography, Television, Fashion and even Magic, dealing with theoretical as well as practical aspects of these subjects.

\(^{155}\) www.ncpamumbai.com/facilities/the-ncpa-audio-film-archives
The collection include material that sets the arts in their widest context, including sections on Indian history and geography, mythology, folklore and Indian religions, which have all played an important part in the development of India’s rich cultural heritage. Books on classical music form the core of the collection with a particular focus on Ethnomusicology, which is the library’s special area of research. Allied to this is an important section on Anthropology, featuring books which explore the different tribes of India. Treatises on Indian music published before 1900 are a special feature of the music collections.

They have a strong periodicals section on Indian Arts, subscribing to 24 publications dealing with subjects across the range of arts. Articles on Dance, Music, Theatre, Film and TV are indexed and form an important part of the NCPA’s research resource.

5.21 **THE MUSIC ACADEMY TAG DIGITAL LISTENING ARCHIVES**

The Music Academy TAG Digital Listening Archives is a public-spirited and well-conceived initiative by the Madras Music Academy towards the preservation for posterity of Carnatic concert music. It is the brainchild of R.T. Chari, already well known for the monthly southern heritage lectures he has been conducting for a number of years under the auspices of his family trust.

Fortunately, the lease for space the academy had rented out expired and they repossessed it just around the same time. The archival project had been on the academy’s radar for a while, but no headway was made because they were preoccupied with their modernisation program since 2005. We needed trustworthy people with knowledge of music to handle it, and Chari was the perfect choice, as he was already into his own personal mission of digitising his entire collection acquired over the years. Once it was decided to get the archives ready for a trial run by the time the 2008 season came around, it was time to
swing into action. In a record two months’ time, the academy digitised nearly 1,500 hours of music.

The result of the hard work on the project is there for all to see, when the archival centre was formally launched. Some 1,000 visitors had a glimpse of it during the recent December season, when its doors were temporarily opened to offer them a sneak preview. The centre has ten computers in a spacious, air-conditioned, spotlessly clean, aesthetically appointed room. These are clients in a network whose server in the adjoining room – both physically and electronically locked to prevent any abuse of the contents – stores all the music available for listening.

“Such an experience of listening to a vast collection of music on a touch screen facility is unique in India”, says Dr. Pappu Venugopala Rao, one of the secretaries of the Academy. This device was bought in Korea which enables a cassette recorder to be inserted into the CPU from which the music can be directly transferred to the computer. CDs and DVDs can be externally plugged into the computer for transfer of their contents.

No attempt has been made to clean any of the recordings. The academy officials are convinced that faithful reproduction of the original concert, ambient sound and all is the best way of presenting archived music. “Otherwise, you will end up offering synthetic music as recorded in a studio,” said one official. All the recordings are free of any copyright problems, with pre-recorded music completely kept out. The archives will include the private collections of the late G. Narasimhan (editor, The Hindu), Chari’s own collection, the contributions of about 40 individuals he involved in the project, and the late S. Natarajan, former Music Academy secretary, among others.
The first objective of the archives program is to transfer all available material as soon as possible, rather than try to improve the quality of the recordings. The Music Academy’s own collection of recordings, which could be in excess of 10,000 hours of music (subject to elimination of duplication by the other donors), will be added. The whole process may take a couple of years. The immediate plan is to open for the public as soon as “a critical mass” of recordings is reached. The visitor to the archives will then be able to listen to his favourite musician, in whole concerts, or by preferred composer, raga or composition. Accompaniment details are also being compiled wherever not already available. An ambitious effort under way is to make it possible to access the lyrics to the songs.

Future plans include so-called heritage concerts of the old masters to be played to a live audience at the Centre, accompanied by suitable introductions by experts and visual displays. Lecture demonstrations of the Academy may also be played. Lecture demonstrations organized a decade ago will also be available – including some comparing Hindustani and Carnatic raga-s. Those of Semmangudi and MS singing together and 10-year old T.N. Seshagopalan singingbhajan-s accompanying himself on the harmonium are a couple of interesting examples of the rare recordings available.\(^{156}\)

### 5.22 **SAMUDRI**

Samudri (Subbulakshmi-Sadasivam Music & Dance Resources Institute), is an ambitious initiative of Sruti, a magazine for performing arts, towards archiving valuable resource material in music and dance and promoting research and cooperative endeavors to ensure the sustainable development of the performing arts, based on traditional ideas and practices.

\(^{156}\) V. Ramnarayan - *sruti* February 2009
5.23 Ananya, Bangalore

Ananya has set up Sangraha, an archive which houses concert music, books and photographs of artists. Located in Malleswaram, Bangalore, Sangraha is a treasure trove of rare music recordings as well as books related to music, many of which are out of print. Sangraha has a collection of about 5,000 hours of music from live concerts. Some recordings date back to the 1920s - such as those of Mysore Vasudevachar and Bidaram Krishnappa. The book section of the library has over 1000 books on classical music - journals, biographies, dictionaries, monographs, information on allied arts, many of which are not available anywhere else.

The compilation of Indian Classical Music has been made for students or aspiring musicians who visit Sangraha for reference work and for aficionados who visit Sangraha to listen to these rare recordings. Sangraha is also equipped with facilities for digitization and cataloguing of these recordings so that they are preserved for posterity. Sangraha furnishes biographical details of musicians for reference.

The digital revolution has been with us for only a short time but has dramatically changed how we communicate, entertain, work and live. We take digital photos, listen to digitized music, and capture and watch digital video. We send e-mail instead of letters, own web addresses and allow people into our personal lives through social networking sites. It has even affected the way we store our memories as we create digital backups of recordings, documents and photos, as well as digital photos of mementos in our archive.

Over the last few decades, many have amassed gigabytes of digital files. And just like physical mementos, these files need to be properly archived to preserve their integrity. Archiving the digital files is a daunting task. Institutions like
libraries, museums and archives are always searching for the best, most economical ways to archive their digital libraries.

Just like archiving physical memories, simple goals need to be set, a plan has to be made and followed through. The digital assets are going to continue to grow, almost exponentially, so establishing a system now is only going to benefit everyone for generations to come.

The innovative materials found in Archival Gold CD-Rs and DVD-Rs make them the most reliable storage media available. The Scratch Armor protective layer protects against scratches, scuffs, dirt and fingerprints. Digital files are as fragile as some of our oldest mementos. Because computers crash, CD or DVD record errors, or it's easy to accidentally delete a file, preserving the digital files is critical. The good news is that it can be as simple as purchasing the proper hardware and tools, and then transferring the files. After all the files are organized, one can make duplicate back-up copies and store them separately from the main files housed on the computer or an external hard drive.

One has many options when it comes to making backup copies of the digital files. Hardware used to back up and/or store digital files includes:

- External hard drive
- USB flash drive
- Memory stick
- CD-R
- DVD

All storage options have their benefits and drawbacks. For example, writing and erasing a disk (CD or DVD) or external hard drive repeatedly will wear it out, making it susceptible to failure. So it's a good idea to purchase separate disks or devices for everyday use as well as for preservation storage. One should also
consider the longevity of different storage devices. Most CDs, DVDs or external drives have a shelf life ranging from five to 10 years, if properly formatted.

CDs and DVDs seem to offer the most flexibility, but they have a relatively short shelf life and can fail within a few years. External hard drives are a better option for the storage and preservation of the digital files because they tend to last longer. USB flash drives are also an option, but they're small and can be easily lost.

A relatively new option for backing up and archiving the files is carbonite.com. For a small annual fee Carbonite automatically backs up one's computer files, through the Internet, and then updates them routinely as one adds new files. One of the benefits of Carbonite is that the files are protected in the event of fire or flood or other natural disasters that could impact files stored at home. If one is a Mac user, Apple offers a similar online service — MobileMe. For an annual fee users can upload materials for their own personal use.

If one chooses to store your digital files on a website, it should be remembered that nothing is forever. One should be sure to copy and store them on CDs, DVDs or an external hard drive in case the site has problems, or worse yet, shuts down permanently.

The most important thing to remember when organizing digital files is that there are several levels of information that should be recorded for each digital file.

- The most general is the name of the folder the image is kept in.
- The name of the digital file itself — that is, the title that one will click on to open the image.
- The file log that records important information such as where one got the recording, where the original is stored (if it's a copy), where and when the recording was done.
• The caption (saved as part of the digital file) that records details about what is happening in the concert — who is performing, and the date and place the recording was done.

There will be some information overlap in each of these levels, but the repetition helps guarantee the information will be preserved.