AM TRANSMITTER
TONE CONTROLLER

20EC5203 – ELECTRONIC DESIGN PROJECT-I

A PROJECT REPORT

Submitted by

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in partial fulfillment for the award of the degree

of

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(AUTONOMOUS)

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BONAFIDE CERTIFICATE

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We jointly declare that the project report on "**AM TRANSMITTER", "TONE CONTROLLER"** is the result of original work done by us and best of our knowledge, similar work has not been submitted to "**ANNA UNIVERSITY CHENNAI**" for the requirement of Degree of **BACHELOR OF ENGINEERING**. This project report is submitted on the partial fulfillment of the requirement of the award of Degree of **BACHELOR OF ENGINEERING**.

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LIST OF ABBREVIATIONS

- AM - Amplitude Modulation
- BJT - Bipolar Junction Transistors
- DC - Direct Current
- IC - Integrated Circuit
- LDR - Light Dependent Resistor
- LED - Light Emitting Diode
- PCB - Printed Circuit Board
- RF - Radio Frequency

CHAPTER 1

COMPONENTS

1.1 BREAD BOARD

In electronics, a breadboard is a flexible instrument for circuit construction and prototyping that eliminates the necessity for soldering. It is especially helpful for novices and enthusiasts because it enables users to swiftly insert and connect a variety of electronic components. A rectangular plastic board with many tiny holes joined by metal strips underneath is called a breadboard. In electronics, a breadboard is a flexible instrument for circuit construction and prototyping that eliminates the necessity for soldering. They can introduce parasitic capacitance and resistance, which may affect high-frequency signals. A breadboard allows for easy and quick creation of temporary electronic circuits or to carry out experiments with circuit design.

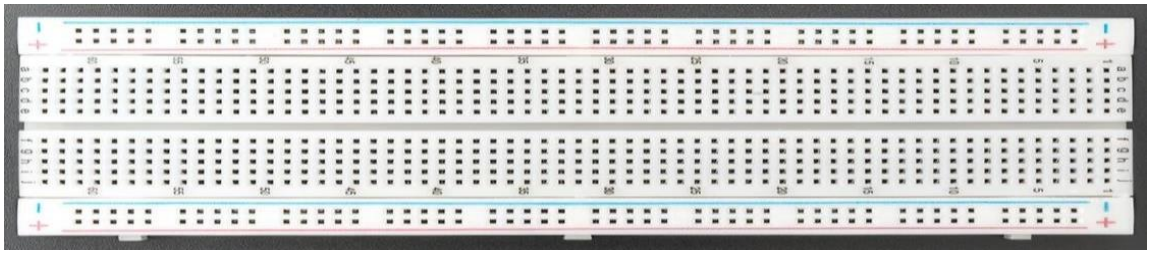

Figure :1.1 Bread board

Their ease of use, combined with the ability to quickly test ideas, makes them invaluable for anyone looking to explore electronics or develop new projects. Whether you're a beginner learning the basics or an experienced engineer testing new concepts, mastering the use of a breadboard can significantly enhance your electronic design process.

1.2 IC 555 TIMER

The 555 timer is a well known timer chip that has been in use for decades if not more. Developed in 1971 by Hans Camenzind it consists of a few simple components and a low cost. A standard 555 timer has a few components are **Two Comparators** - These compare input voltages and control the output state. A **Flip- Flop or Storage Cell** - Sufficient Memory Element which Stores Functionally Output State. **Voltage Divider** – Degenerative voltage reference made of 3 equal resistors of 5K ohm each. **Discharge Transistor** – Node capacitors are discharged and connected to this pin when the event triggers. **Output Stage -** Provides the final output signal.

Figure: 1.2 IC 555 Timer

In addition to their crucial role in rectification processes, diodes exhibit a diverse array of types and applications, contributing significantly to electronic circuits and modern technology. One notable type is the Schottky diode, characterized by its rapid switching speed.

1.3 CONDENSER MICROPHONE

A condenser microphone is an audio device that is very sensitive and has the ability to capture sound with great clarity and detail. It operates on the principle of variable capacitance whereby a diaphragm and a backplate form a capacitor. The sound waves striking the thin diaphragm cause it to vibrate, consequently changing the distance separating the diaphragm and the backplate. These modify the capacitance, which is read out as an electric signal that mimics the sound. Condenser microphones nearly always need an external power source to energize the backplate and any onboard amplifiers, which makes them more suited to subtle nuances and so generally preferred for studio and high-fidelity audio applications.

Figure:1.3 Condenser Microphone

Sound sensitivity levels are much better in these types of microphones hence they are very good for recording the female voice as well as all the other audio details like acoustic instruments and even the surrounding noises. they are more vulnerable than for example dynamic microphones and can be destroyed quite easily due to very loud sounds or simply careless usage. despite these issues, the quality of sound and range of applications they offer makes these microphones a must-have for any audio professional.

1.4 RESISTOR

Resistors are vital passive electrical components that regulate the current flowing through a circuit. They are consistent with Ohm's law. Fixed, variable, and specialized types (thermistors, LDRs) are commercially available in the resistive field. The value of a resistor is measured in ohms (Ω) and is defined by a law of the voltage (V), the current (I), and the resistance (R) in a circuit by an equation V=I×R. In electronic circuits, resistors have key functions as voltage dividers, to condition a signal, and to set the bias points of devices that active as transistors require control over the resistance of individual cells. In the AM Transmitter and Tone Controller project modules, particular resistors, e.g., 390Ω (2), 1kΩ (2), 470Ω (2), and 10kΩ (2), or 100kΩ (2) are used to provide stable circuit operation and accurate operation.

Figure:1.4 Resistor

Resistors are critical to electronics, from simple circuits to complex systems. They are used in devices to stabilize voltage, control current, and as reference. By employing series or parallel arrangements of resistors, the designers can achieve required resistance values with high precision for specific purposes.

1.5 CAPACITOR

A capacitor is an electronic component containing a conducting plate that retains and then discharges electric energy in a circuit. The conductive plates are separated from each other by insulation known as a dielectric. They consist of two conductive plates separated by two dielectric plates. This structure enables capacitors to control voltage and current transfer efficiently. In the AM Transmitter Tone Controller projects, capacitors with sizes of 1000µF/25V (1), 0.001µF (1), 0.1µF (2), 1µF (2), and 10µF/25V (2) are central to the stable operation and noise- free operation.

Figure:1.5 Capacitor

These capacitors are employed at different stages of the circuits. The 1000µF/25V capacitor provides a filtering effect for the power supply, such as by removing ripple and keeping DC voltage constant. Capacitors between 0.001µF and 0.1µF are used as coupling and bypass capacitors to smooth the transition of the signals and block high-frequency noise from interfering the circuit. The 1µF and 10µF capacitors play roles in timing/frequency control, which are essential for the modulation/tone control of the projects.

1.6 ANTENNA

In wireless communication systems for transmit and receive electromagnetic waves, a component, the antenna, performs a dominant role. It in the transmitter performs wireless conversion of electrical signals to radio waves and in the receiver performs the reverse wireless conversion of radio waves to electrical signals, respectively. The antenna converts the electrical signals into the electromagnetic waves for transmission and vice versa for reception and communication are possible within a specific range. Its size and length are essential to achieve maximum performance based on its operating frequency.

Figure:1.6 Antenna

In the AM Transmitter an antenna wired in a wire-like manner is used to radiate an external AM-modulated signal toward the environment. Antenna radiated signal can be comfortably received by an AM receiver located within its field of view. Due to its simplicity, efficiency and suitability of integration it is one of the key elements proof of principle of wireless communication.

1.7 PCB

Printed Circuit Board (PCB) is a fundamental infrastructure for the building of electronic circuits, it provides a rigid and organized structure on which the components can be interconnected. It is a non-conductive substrate (e.g., fiberglass, epoxy), with copper tracks etched onto its surface serving as the basis for an electrical grid topology in the shape of tracks. These pathways replace traditional wiring in the sense that they can simplify pathways and remove the risk of failure between components. PCBs can be single- and double-layered, or multi-layered depending on the complexity of the circuit.

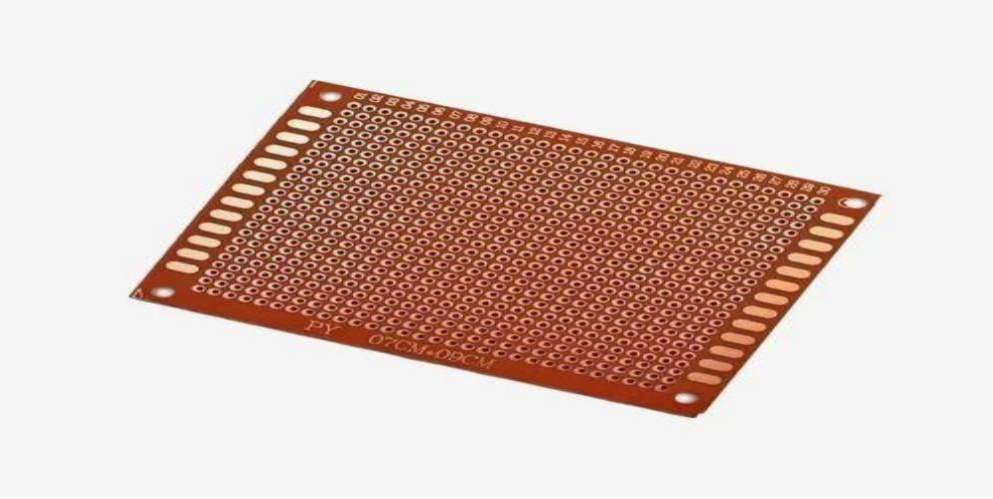

Figure: 1.7 PCB

For projects AM Transmitter and Tone Controller, the PCB is able to provide the function of correctly bonding elements, such as resistors, capacitors, and transistors, to the PCB and electrically connect them. It also minimizes the crosstalk and noise, which in turn increases the overall reliability and circuit performance of the circuits. The reliability and quality of the PCB determine the lifetime of the projects. The significance in ensuring clean and effective circuit design makes it very valuable in electronics.

1.8 POTENTIOMETER

A potentiometer is a variable resistor, from which the resistance can be set manually and, as a result, allows precise control of electrical parameters in a circuit. The typical form is composed of a resistive element and a travelling wiper that changes the overall resistance by laterally wiping across the element. Because of their simplicity and the possibility of generalization, potentiometers are applied quite broadly to volume control, calibration, and equalization of pitch.

Figure: 1.8 Potentiometer

In the "Tone Controller" project, two 100kΩ potentiometers are provided, one to modulate bass and one to modulate treble. Through the use of these potentiometers, the spectrum of the audio signal is continuously varied, hence, providing an experience of better or worse quality as desired or in the surrounding acoustic one. Because of its ease of application and its high accuracy, it is, without any doubt, an indispensable step for the realization of real-time audio personalizing.

1.9 TRANSISTOR (2SC1815)

The 2SC1815 is an adaptable NPN Bipolar Junction Transistor (BJT) that is widely employed in low-power audio circuits. In electronic circuits, it acts as an amplifier, oscillator, or switch and provides very good performance (i.e., high gain and low noise). Operation of the transistor is based on the ability to regulate the magnitude of current flow through the collector and emitter ends of the transistor by varying the magnitude of the base current, and it is appropriate to amplify signal accurately.

Figure:1.9 Transistor (2SC1815)

Among the AM Transmitter and the Tone Controller projects, two 2SC1815 transistors are employed to amplify audio signals and correctly operate circuits. In the transmitter and in the tone controller, they improve the input signal for effective modulation and transmission, and for bass and treble modulation, respectively. The ability of the 2SC1815 to be reliable, efficient, and small in a compact form means that the 2SC1815 is an ideal solution for these low-voltage, high-precision circuits.

1.10 CONNECTING WIRES

Connecting wires areessential for electronic circuits because they serve as bothchannels for electrical signals and actuators for electrical power. Composed usually of conductive bodies (e.g., copper) and insulated with plastic, these wires provide robust interconnect connections between components and prevent shorts. They are provided across lengths, colours, and gauges to suit the specific need of each application, with a view to aid in the circuit organisation and diagnostic processes. Their conductivity permits the propagation of electrical signals between constituents, thus providing the fundamental connections that allow communication and coordination of circuit elements. Apart from their fundamental task in making electrical bonds, wiring wires plays an important part in the topology and layout of circuit boards. Their versatility enables one to make custom signal paths, which can helpizesysnthetic setup of components.

Figure:1.10 Connecting wires

Wire connections are used to make connections between the circuit components (such as resistor, capacitor, and transistor) and the PCB) in the AM Transmitter and Tone Controller projects.

1.11 POWER SUPPLY

One of the most basic elements in any electronic circuit is power supply. It is what provides the energy needed to drive circuit components. It converts electrical power that is always available from a source - for instance, through a battery or mains supply to a form the circuit can use. Power supplies are categorized into AC and DC ones, and DC power supplies are generally found to be very dominant in low-power applications of electronics. They are commonly equipped with voltage regulation to support a stable output, thus providing stable and robust circuit operation. If the power supply has a good design, it can affordably reduce the fluctuations and the noise, which can negatively impact the working of the fragile components.

Figure:1.11 Power Supply

In the AM Transmitter and Tone Controller project circuits, a 9V DC voltage power supply is applied to energize the circuits. Capacitors are inserted across the power supply rails to attenuate noise and to stabilize the voltage.

CHAPTER 2
AM TRANSMITTER

2.1 ABSTRACT

The AM Transmitter Project is an ingenious information collection that has been produced to make and transmit amplitude modulation(AM) signals which are more popular in communication systems like radio broadcasting. The project portrays the principles of amplitude modulation with regards to a high-frequency carrier wave which is modified according to the strength of an input audio signal[1]. A 555 Timer IC, a condenser microphone, resistors, and capacitors have been seamlessly put together to make an operable AM transmitter within the scope of this system[4]. The audio input is picked up by the microphone and from there the corresponding AM signal is formed when the circuit is modulated and processed.

The transmitter uses a 9V power source which makes it easy and convenient to use and transport[2]. The modulated signal can be sent out a limited distance by radio waves through the use of an antenna, making it useful for displaying wireless communication concepts for education or experimentation. This project helps in understanding the important aspects of analog communication practicum like modulation, amplification, and transmission of signals and at the same time the components in electronics that are so basic. It acts as a stepping stone to developing a bandwidth for advanced communication systems as well as practical applications[3].

The AM Transmitter Project demonstrates the appealing aspects of amplitude modulation without losing sight of the elements of analog communication. Audio

can be transmitted without physical connections by the optimal modulation of the signal by the transmitter as well as by the exclusive modulation of the audio input on the amplitude of the high frequency carrier. One of the less expensive electronics used in this project is the 555 Timer IC, the main modulator component. Both real- time audio feedback into the development while modulating sound waves are made possible by the employment of a condenser microphone[5]. The breadboard or PCB base is easy to extend as the target circuit is low price, small and powered by a 9V DC supply. Although antennae serve to spread the modulated signals over a limited range, the resistors and capacitors of the circuit serve to time and ensure efficient signal processing[6].

2.2 INTRODUCTION

Base of contemporary communication systems wireless communication has irreversibly transformed the fundamentals of data sending and data receipt. Amplitude modulation (AM) is one of the most basic and common modulation techniques, used for example in radio transmission and communication networks. The amplitude of a high-frequency carrier signal is modulated directly in terms of the amplitude of an inputted audio signal (according to the AM principle). It is this kind of technology that is, and remains, of fundamental importance in early telecommunications technology because it permits audio information to be carried over long distances. This modulation technique is applied in practice, in the AM Transmitter Project, that seeks to teach the students a practical example of the basics of analog transmission. The project produces the carrier wave using a 555 Timer IC and the input signal produced by a condenser microphone is then modulated. This configuration demonstrates the concepts of signal modulation, propagation, and electronic device coupling. It also illustrates how a simple circuit can be the platform which can be used to realize more complex communication systems.

In this project, it is shown that this simple circuit can be used as a stepping stone for understanding advanced communication networks, thereby being both pedagogically and flexibly informative and expandable. Accessibility and ease of mounting are ensured by the application of passive components such as resistors, capacitors, and the 555 Timer IC. In addition, the modular aspect of the design is conducive to experimentation and customization so that students and enthusiasts can discover the influence of frequency, the quality of the signalling as well as the range of the transmission.

Nevertheless, the role of the AM transmitter has gone considerably beyond academic work. Amplitude modulation has already been used in some real-world applications (shortwave radio communications, emergency communication, air communication, etc). The project allows students to gain practical experience in circuit design, debugging, and wireless communication, as well as to extend their understanding of the conceptual underpinnings of these technologies. If summed together, the AM Transmitter Project is an excellent approach for bridging the gap between idea and real life application. It inspires both the creativity and ingenuity of electronics, and at the same time provides an opportunity to delve into the foundations of communication technology. In this work, the students not only acquire technical skills, but also develop a general insight into the conceptual simplicity and the reality of amplitude modulation, one of the fundamental bricks of present communication systems.

2.3 COMPONENTS USED

- **Antenna(wire-based)** - 1
- **Breadboard** - 1
- **Capacitors** - 1000μF/25V (1), 0.001μF (1)
- **Condenser Microphone** - 1
- **Connecting Wires** - As required
- **Power Supply** - 9V Battery (1)
- **Resistors** - 390Ω (1), 1kΩ (1)
- **555 Timer IC** - 1

2.4 CIRCUIT DIAGRAM

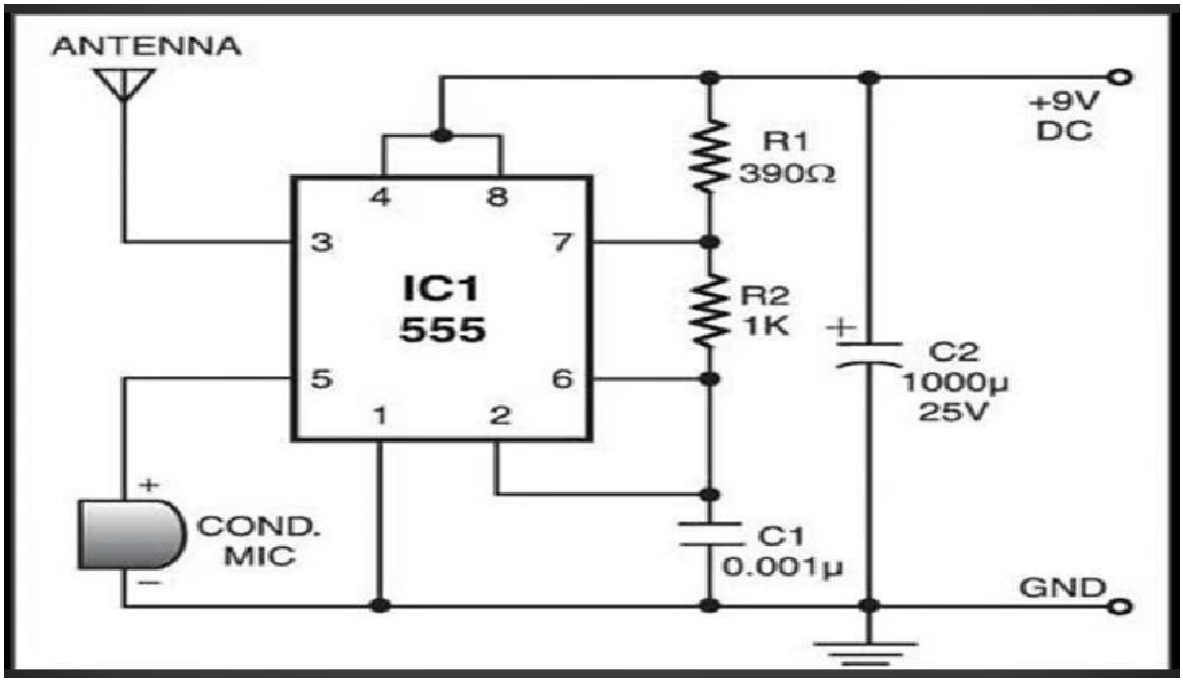

Figure: 2.1 Circuit Diagram of AM Transmitter

2.5 WORKING MODEL

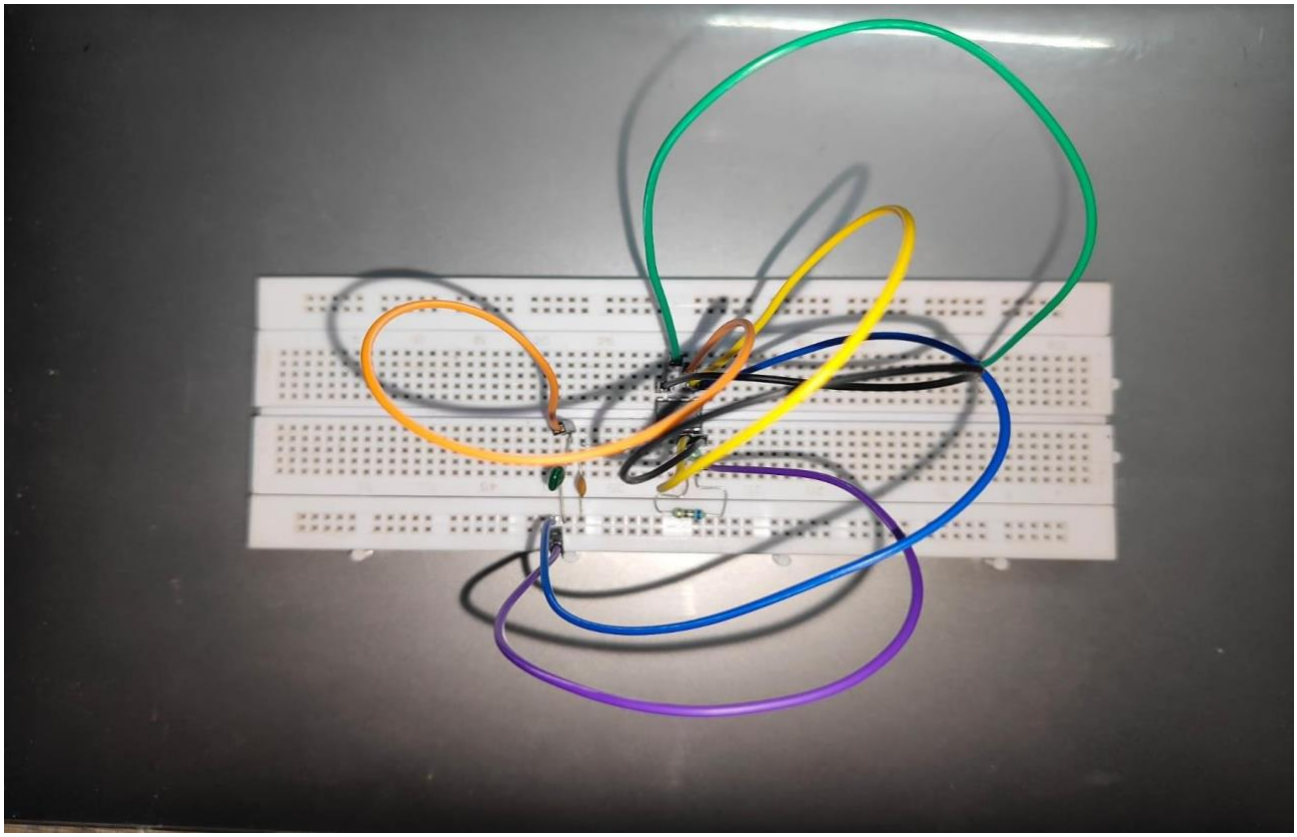

Figure:2.2 Working Model

This AM Transmitter Circuit is a simple and useful application of amplitude modulation effectively illustrates how audio signals are transmitted through the air using a few basic electronic components. The basic component of this circuit, 555 Timer IC works here in the astable mode to create High-Frequency carriers. The carrier signal is essential for not just wireless transmission but also to carry the audio information, which we will explain further. This process starts with a condenser microphone that transmits the sound input as electrical signals corresponding to sonic waves. The amplitude changes in the audio wave are captured as electrical signals. The output from the microphone is fed to the control voltage pin (Pin 5) of the 555 Timer IC, enabling audio signal to diarize carrier

wave amplitude wise refer Figure: 2.1. That is the fundamental concept of amplitude modulation, when the amplitude of a carrier signal with frequency fc varies exactly according to an input audio signal. The carrier wave frequency is defined by the timing components that are surrounding the 555 Timer IC such as R1 (390Ω), R2 (1kΩ) and C1 (0.001μF).

Those components establish the cycles of charging and discharging on the capacitor that connect to the IC, thus establishing the frequency of output. The correct choice of these parameters guarantees that the carrier is within the AM frequency band, which enables transmission and reception by classical AM radios. C1, in particular, is important for filtering out high-frequency noise so that a defined and stable carrier wave can appear. Pin 3 of the 555 Timer IC produces the modulated signal, combining both the carrier wave (the tuned radio frequency signal) and the audio input. The output signal is then connected to an antenna, which is the main part of the AM module that transmits this input signal as an amplitude-modulated fraction. An antenna is another all-important feature of a wireless transmitter with its length and design affecting transmission distance and quality. Higher gain is given by a longer antenna hence, it is useful for short transmission range as found in this circuit. So to make the operation more stable and noise free we are connecting a capacitor (1000μF, 25V) between the 9V DC power supply. This is a filter capacitor that neutralizes rippling at the power supply so that the circuit can function consistently.

The **AM TRANSMITTER** runs on a 9V battery, which provides portability and versatility. This is a good educational tool to work with due to its easy constructibility, portability and working principles of amplitude modulation and wireless transmission. Users can change the values of R1, R2 or C1 to alter

carrier frequency since it is an analogue experiment and experience how changing frequencies affect transmission and reception. This modular design of the circuit also provides scope for further improvement like increasing transmission range, more signal clarity, different modulation techniques, etc. This project gives the idea of working of AM transmitter and its various key aspects like Signal Modulation, frequency generation and interaction between basic electronic components. 555 Timer IC serves as the glue that holds all this together, showing how a single intricate component can handle complex functions. Hiding the microphone in the circuit adds dynamics to the system by making it suitable for real audio transmission that can be heard live as the sound is captured and transmitted immediately.

The resistors and capacitance also create the timing to stabilize things to make everything run well. This AM transmitter is a sensible example of how easy electronic circuits can be used to demonstrate advanced conversation ideas. It bridges the space between theoretical knowledge and realistic utility, supplying college students and hobbyists with a tangible way to recognize the workings of wireless conversation systems. The mission also serves as a stepping stone for exploring greater complex communique technologies, together with frequency modulation or digital conversation. Its compact design and reliance on effortlessly available components make it an handy and price-effective venture for each person interested by gaining knowledge of about electronics and telecommunications refer Figure:2.2. Amplitude modulation has been widely used in emergency alarm systems, aviation communication, and AM radio transmission in the real world. Even though more sophisticated techniques like frequency modulation and virtual verbal interchange have mostly replaced traditional communication architecture in modern times.

2.6 BLOCK DIAGRAM

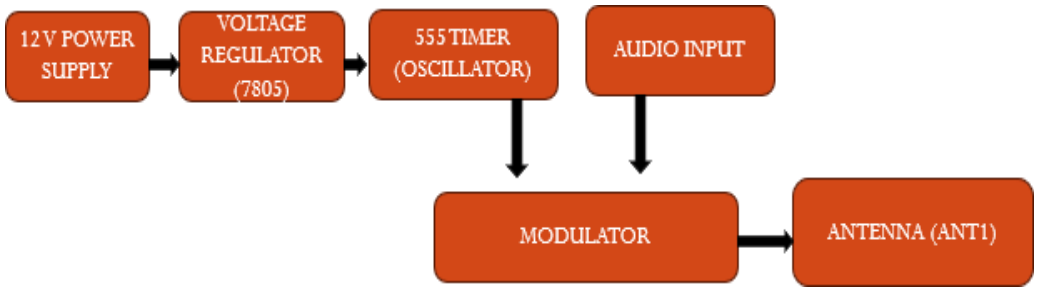

Figure:2.3 Block Diagram

An AM transmitter circuit block diagram shows the necessary stages to modulate and transmit an audio signal without wires. This is a simple but functional open hardware design aimed at teaching or experimental use. There are five basic components in the transmitter which include a power supply, voltage regulator, 555 Timer oscillator, modulator and antenna. The necessary work of the entire amplitude modulation and transmission process is done by these blocks. The first block of the system is 12V Power Supply that supply voltages to run circuit elements. The power supply guarantees that the voltage supplied to all stages is stable, and this step is fundamental for the stable operation of the circuit. On the other hand, the lower and more stable voltage is indeed required by most of the components in this circuit. This is where the Voltage Regulator (7805) comes into

play. The 7805HW [L7805] regules voltage from 12V to a stable 5V and pretects sensitive components from possible damage due to fluctuation or over-voltage condition. In addition, the voltage regulator filters out noise and keeps the circuit functioning by providing a clean, stable supply.

The next section is a 555 Timer configured in astable mode which generates the carrier wave. At this stage, the 555 Timer generates a continuous pulse signal at a predefined frequency usually within AM range. This will be the carrier signal that we will use to modulate with audio input. The external timing resistors and capacitors connected to the 555 Timer determine the frequency of the carrier wave. That carrier signal is the essential element of wireless transmission, as it enables the far away propagation of audio program. Note: Audio Input block feeds the audio signal to the system.

The information to be transmitted is represented in the form of signal that can capture through a MIC or all other sources. And the audio input is a low- frequency signal which means that we can never transmit such frequency directly on longer distance so we need to use modulation principle here. Now this is where Modulator block comes into the play. The modulator mixes the high-frequency carrier wave produced by the 555 Timer with a low-frequency audio signal In AM, the amplitude of the carrier signal is varying proportional to the instantaneous amplitude of audio. This process of modulation embeds the audio information in the carrier wave, allowing for it to be sent as an airborne signal.

At last, the modulated signal input to Antenna (ANT1), which is the final block of the system. The antenna transmits the modulated signal as electromagnetic waves, such that it can be detected by an AM radio receiver tuned to the same

carrier wave frequency. Antenna length and design has a lot to do with the transmission distance of range of system. The energy is made to radiate with the help of a well-designed antenna, and no strong signal loss will happen.

The block diagram demonstrates how signals flow through the various stages, ensuring that all will function correctly within the transmitter. The whole interaction is initiated by the power supply, supplying energy, and this will be conditioned by voltage regulator so that 555 Timer oscillator will receive stable input. This not only generates the carrier wave but also does hold a frequency stability which is vital for modulation and transmission. The audio input — usually a dynamic or condenser microphone — feeds live sound signals into the circuit. The modulator then needs to combine these signals with a carrier wave which is difficult work as these signals are weak. A modulator that assured the precise modulation of the carrier wave amplitude corresponding to the input audio signal continues to give faithful transmission of sound. Lastly, an antenna is responsible for radiating the modulated signal with such great efficiency while introducing as minimal distortion to it whilst transmitting. So each block is a vital chain in the loop and they make up a neat package that can convey audio waves wirelessly over short to medium distances.

This Block diagram representation of a basic essential AM transmitter. For instance, the combination of power supply, voltage regulator, 555 Timer, modulator and antenna shows concept behind amplitude modulation and wireless transmission. Flexible opened structure also allows users to adjust different blocks for different purposes like tuning the carrier frequency or implementing way to increase transmission distance.

2.7 ADVANTAGES

- **Easy to build:** The AM transmitter circuit is easy, specifically with the 555 Timer IC, so it can be an ideal project for students or beginners to learn about amplitude modulation and wireless transmission.
- **Cheap :** The Components used like resistors, capacitors & 555 Timer IC are also cheap which makes the system economical.
- **Real-time audio transmission:** AM allows for easy modulation and transmission of audio signals over considerable distance with minimal complexity.
- **Modifiability:** AM signals can be received by a variety of common AM radio receivers, ensuring widespread accessibility.
- **Portability**: AM transmitter can effectively transmit real time audio signals, making them useful in applications like public announcements.
- **Educational Value**: The design can be adapted or enhanced with additional stages to increase the transmission range or Improve audio quality.

2.8 APPLICATION

- Radio Broadcasting
- Wireless Audio Transmission
- Remote-Control Applications
- Public Announcement Systems
- Amateur Radio Communication
- Educational Demonstrations in Electronics
- Low-Power Localized Broadcasting

CHAPTER 3

TONE CONTROLLER

3.1 ABSTRACT

The aim of this project is the design and implementation of an electronically controlled tone control circuit using bipolar junction transistors (BJT) to enable modification of audio signals for improved quality[9]y. The design concept of the circuit was aimed at allowing the user to control and balance bass, central voice, and treble centers to allow for better acoustic experience across several feasible uses[7]. The circuit also employs BJTs for signal amplification and tone modification; thus, it provides a different approach to the designs that used op amps, choosing cost, simplicity, and small overall size over complexity of construction and bulk.

To shape the frequencies, the tone control circuit makes use of and combines active filters with a number of gain stages. Users can control the circuit's active elements such that specific frequency bands can be tuned up or down depending on user requirements, by adjusting the potentiometers[6]. There capacity of lowers, midrange, and higher frequencies control was made definite by the usage of capacitors and resistors in the circuit with BJT transistors. Such an approach significantly improved the circuit usability and distortion of the signal was also minimal with the output being of high quality, that is, no change was made on the audio source.

This design is specific for a wide frequency response to serve different areas of audio applications including a home theatre, a portable system and a musical instrument[8].

strength of the circuit as it can work with a variety of audio signal levels with no severe impacts on the performance. The construction is low profile and ensures integration in audio devices, thus suitable for stand alone and embedded system applications.

While constructing this tone control circuit, components were not only considered in terms of the design but their supply and cost were also factored. The circuit is therefore reliable and easy to assemble as any hobbyist can fix it using readily available BJTs and passive components such as capacitors and resistors even with little resources. Also, the significantly simple and functional design does not require specialists tools or elaborated technical skills, increasing the ranges of appropriate target audience even more. This allows the circuit to be used in education and primary sound systems as it gives a good introduction to the realm of analog audio processing[10].

Various types of tests and verifications have systematically been conducted to evaluate the transfer characteristics of the control circuit. Practical test and simulation have shown that it ablility to handle different forms of input signals has been maintained without overloading and subsequent failure. The circuit is conceived to operate with relatively low power and has a relatively wide range of input voltage which increases its flexibility. Additionally, detailed descriptions and assembly instructions, diagrams of designed PCBs and layout designs, have been accomplished to enable further modification of the design for different applications. Due to the available documents, the project's objectives are met – the tone control circuit is practical and interesting for the audience familiar with analog electronics.

To sum up, the tone control circuitry based on BJT transistor is an effective and appropriate device for the enhancement of the audio signal processing for a

number of applications. It is a good solution for avid and professional audio users as well as even for teachers due the perfect mix of price, performance and ease of use. In order to successfully accomplish the aim to create simple and intuitive audio processing technologies, this design overcomes many minor problems such as existing devices signal distortion and limited frequency ranging. In practical terms for educational purposes, home stereos, portable products or any others, this analogue bayou circuit can use microphone/ audio signals for a proof working example of analog electronic device.

3.2 INTRODUCTION

Today, a big factor affecting the user's experience is a high quality of sound. This moment is important whether it is used for entertainment or communication and in professional audio systems. Tone control circuits were created in response to the desire to adjust and manage sound according to customer needs. These circuits facilitate sound output adjustment through bass and treble modifications. Using BJTs in tone controller circuits offers audio engineering practical and wide applications. This enables individuals to tailor their sound to suit various acoustic settings or their personal preference on the day. A tone controller circuit is part of an audio system, and it controls the treated signal and makes it user-friendly. Similar to the above, since the sensitivity of the human being to the sound quality is significant, treble, and bass sound adjustment allows users to control sound in a way that meets their requirements. Bass frequencies bring detail in the background, treble bring details forward, and midrange fix the most important – the voice and the rest out of a signal to maximize control of the tones.

The functioning of a tone control BJT can be said to be predominantly active in that the tone control consists of active filters that can boost or cut specific ranges of frequencies. In contrast to passive filters that use resistors and a capacitor for the frequency balance, active filters employ the use of BJTs to enhance and craft the audio signal to be precise. Such circuits, together with potentiometers, enable the audiometer to be adjusted on the audio spectrum in real time. This quality allows tone controllers to be used in almost all systems: from simple audio to complex multimillion sound systems. As an example, low and high frequencies may be balanced with the tone controller in many home theaters so that the sound effects are more effective. Furthermore, BJT-based tone controllers are suitable for use in school projects because they do not require too much technical expertise. These circuits can be used by students

and hobbies to demonstrate signal amplification, frequency filtering, and impedance matching, among several basic principles of audio signal processing.

The applications of tone controllers with BJT elements are not only of practical significance, rather they have a larger purpose. They are the basics of audio engineering, literally demonstrating how electronic devices can shape and reproduce sound waves in a desired manner. The concepts that are provided by these types of circuits abstract these circuits from the basic level to higher systems like graphic equalizers, parametrical equalizers and digital sound processors. Such systems elevate the basic concepts of audio tone control, offering better accuracy and range of features needed for such specific industries as recording, live audio and broadcasting. It follows that an understanding of the basics of tone controllers with bipolar junction transistors brings one closer to the understanding of the general ideas of audio signal processing and the range of its applications.

In addition to functionality, the design of a BJT-based tone controller emphasizes simplicity and cost-effectiveness. BJTs, along with resistors, capacitors, and potentiometers, are readily available and affordable, making the circuit accessible to a wide range of users. Despite its straightforward design, the BJT-based tone controller delivers high-quality sound with minimal distortion, ensuring audio fidelity. Potentiometers play a key role in allowing users to adjust frequency bands intuitively and in real-time, enhancing user interaction. Furthermore, BJT circuits are compatible with single or dual power supplies, offering flexibility in integration with various audio systems and ensuring stable operation across diverse applications.

The design of a BJT-based tone controller is scalable and can be tailored to meet specific requirements. For example, additional filter stages can be added to provide control over a broader range of frequency bands. Alternatively, advanced BJTs can be utilized to improve signal-to-noise ratio and achieve higher gain. These modifications

allow the tone controller to adapt to more demanding audio applications, from personal audio setups to professional sound systems. The adaptability and scalability of BJT- based tone controllers underscore their versatility and value in audio engineering.

A BJT-based tone controller is an indispensable element in audio engineering, enabling precise and efficient adjustment of sound quality. Its practicality, simplicity, and adaptability make it a key component in a wide range of audio systems. Whether used for personal, professional, or educational purposes, this circuit exemplifies the intersection of electronics and acoustics, showcasing how technology enhances the way we perceive and interact with sound. Beyond its foundational role in audio processing, the BJT-based tone controller opens the door to advanced, innovative sound technologies, offering endless possibilities for creativity and development in the field of audio engineering.

3.3 COMPONENTS USED

- **Battery** - 9V (1)
- **Capacitor** - 0.1µF (2), 1µF (2), 10µF/25V (2)
- **Connecting Wires** - As required
- **Potentiometer** - 100kΩ (2) (1 for Bass, 1 for Treble control)
- **Resistor** - 470Ω (2), 10kΩ (2), 100kΩ (2)
- **Transistor** - 2SC1815 (2)

3.4 CIRCUIT DIAGRAM

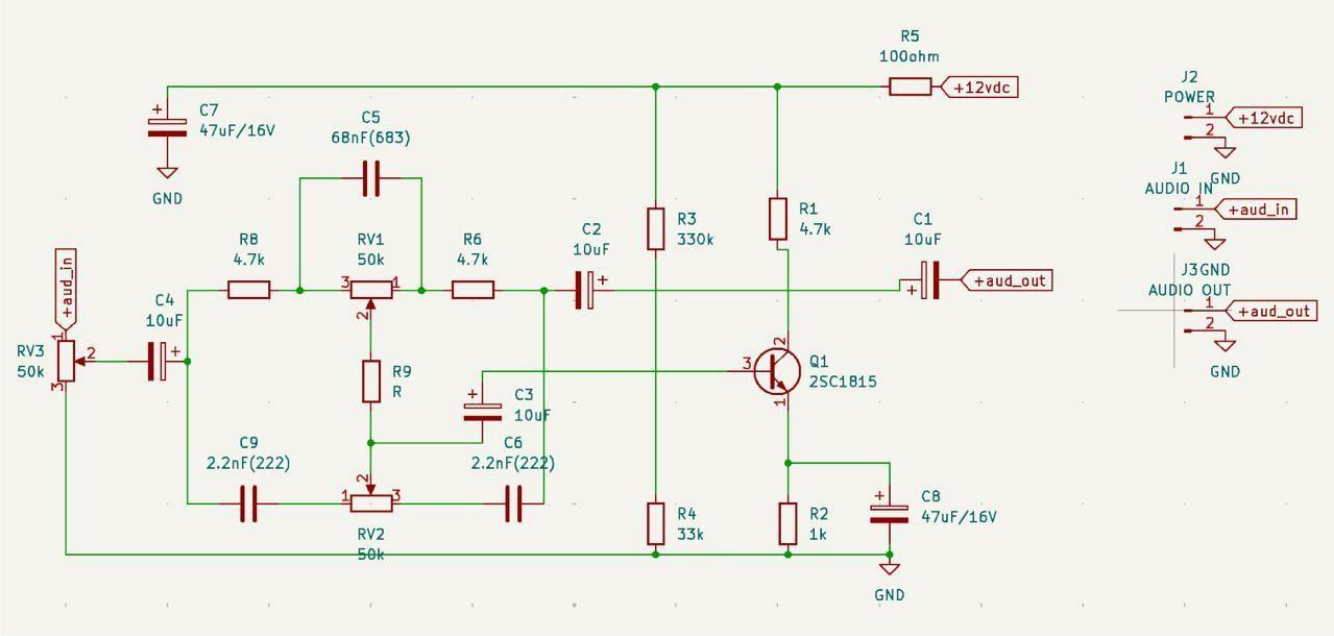

Figure:3.1 Circuit Diagram

3.5 WORKING MODEL

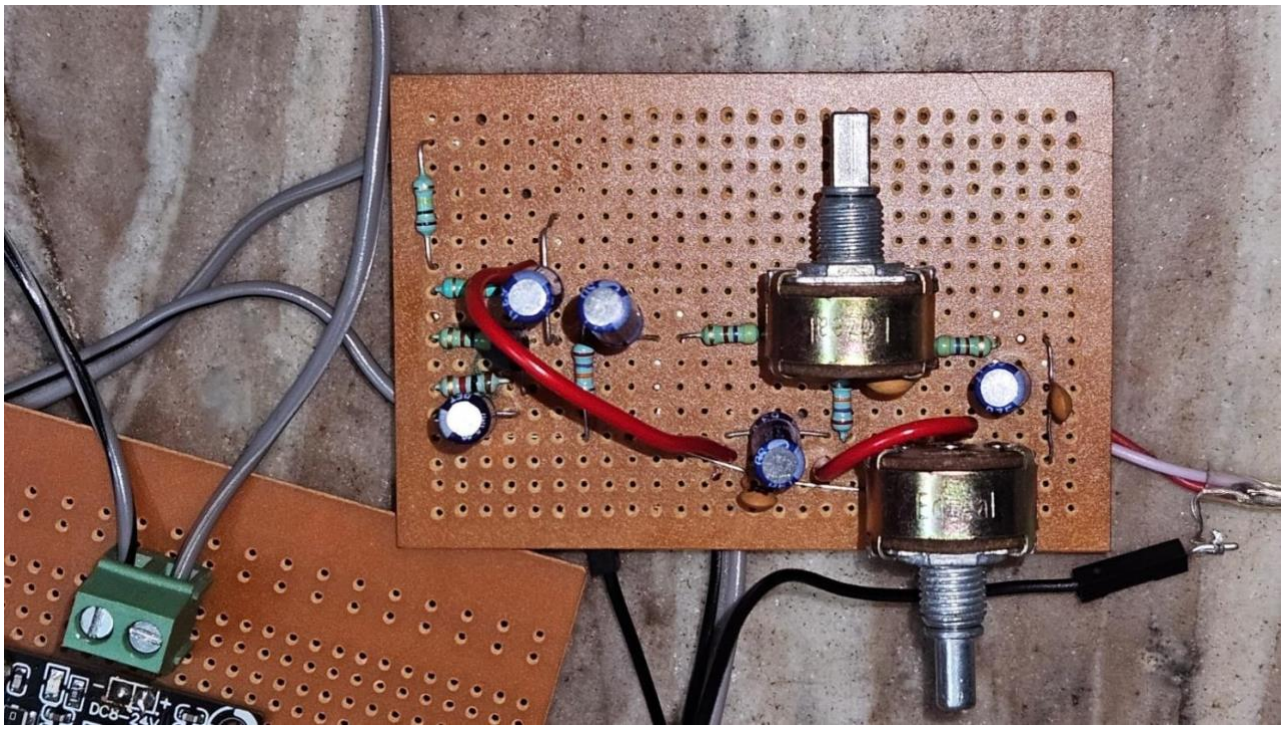

Figure:3.2 Working Model

The active tone control circuit with 2SC1815 transistors can be used to perform operations as an audio signal processing system to change the bass and treble frequencies of an input audio signal.Potentiometers in this circuit will allow the user to change his low and high frequency ranges so that there would always be accurate control over the audio tone. A detailed explanation of the circuit working principle is given below refer Figure:3.1 for blockdiagram. The circuit begins with the audio input signal, which can be obtained from a microphone, a musical instrument, or a playback device. The input signal is then passed to the first stage of the circuit where it encounters the pre-filtering network. The filtering network, comprising resistors and capacitors, separates the input into individual frequency components. The higher frequency components are passed to the treble control stage and low frequency components are sent to the bass control.

The center of this tone control circuit consists of the active filter type both sorts of elements : passive and active. The passive components-thus the cut-off frequencies for the variations in low and high resonances- are resistors and capacitors, and the 2SC1815 transistors serve as active elements, introducing amplification in compensation for the signal loss associated with filtering at the same time. The treble control stage is focused to affect higher frequencies within the audio signal. A high-pass filter is created with capacitors and resistors that allow frequencies above a threshold level to pass through while the rest are attenuated. By providing control over the threshold through the treble control potentiometer, the user can ultimately shift the filter's behavior to either boost or attenuate the high frequencies by turning the potentiometer. This circuit is often very effective in boosting the strength and clarity of the sound, thus strengthening vocals and high-pitched instruments.

The bass control stage acts on the low frequencies of the signal at the input. It uses a low-pass filter and lets through signals of frequency that fall below a cutoff value while attenuating signals at higher frequencies. Similar to the treble control, the bass control employs a potentiometer to alter the circuit's resistance so that the user can boost or attenuate the low frequencies. This adjustment serves the great purpose of adding depth and richness to the by emphasizing the low-pitched instruments, such as drums and bass guitars. This amplifies the treble and bass signals through the 2SC1815 transistors. Since transistors are wired in common emitter configuration, and the transistors provide more than enough gain, the signal strength is preserved even after filtering. Every transistor amplifies its band separately, which means that each frequency part of the audio signal will be preserved while providing flexibility for adjustment.

After the adjustments in bass and treble signals, the combined output is sent to the output stage of the circuit. The output taken through this circuit is the processed version of the original audio signal with desired adjustments made in tone by the user. This output is generally given across an audio amplifier or a speaker system wherein it is reproduced as sound. The circuit ensures that the tonal characteristics of the audio are retained and amplified with every listening experience becoming rich and perfectible. The circuit is powered by a 9V DC supply, which renders it portable and permits integration with existing audio equipment. A capacitor is placed across the power supply to filter out noise and ripple, which prevents interference with the circuit's normal operation. Proper grounding minimizes hum and ensures stable performance.

This tone control circuit exhibits a high degree of versatility. It can be modified to incorporate additional features. For example, a midrange control stage could be added to allow more precise adjustment of audio frequencies. Moreover, Refer Figure 3.2 it can be scaled for professional applications, integrated into a graphic equalizer, or even a mixing console. Therefore, this circuit of active tone control with 2SC1815 transistors is practical and efficient in adjusting the audio tones. Combining filtering and amplification stages, the circuit can be expected to provide precise control over bass and treble frequencies with preserved signal clarity and strength. The simplicity and function based design makes the circuit very suitable for demonstrating the principles of audio processing and electronic circuit design. The circuit can be functional and adaptable, offering room for further development toward specific audio needs.

3.6 BLOCK DIAGRAM

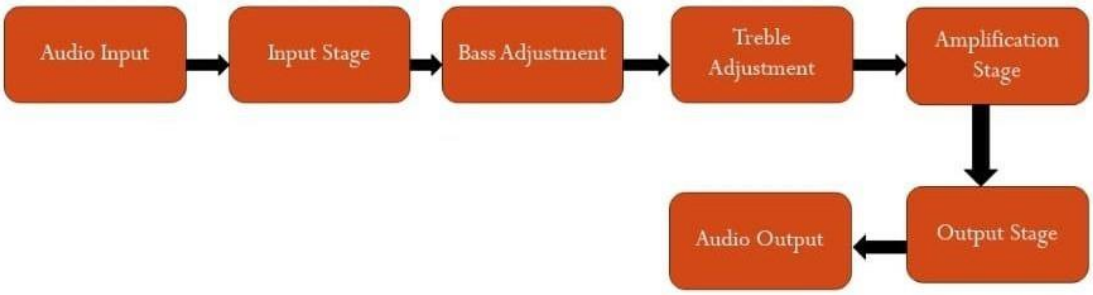

Figure:3.3 Block Diagram

This block diagram illustrates the flow of operations in a tone controller circuit, highlighting key stages responsible for processing and shaping audio signals. The process begins with the Audio Input, where an external audio signal, such as from a microphone or music player, is fed into the circuit. This input signal typically contains a wide range of frequencies that need to be tailored for optimal listening or playback quality. The audio signal is unprocessed at this stage, containing the raw combination of bass, midrange, and treble frequencies. The input serves as the foundation for subsequent filtering and adjustment stages in the circuit.

The signal is then directed to the Input Stage, which prepares it for further processing. In this stage, basic signal conditioning is performed, which may include impedance matching and noise suppression. Components such as resistors and capacitors are used to stabilize the input signal, ensuring it is properly formatted for the tone control adjustments that follow. The input stage is critical for maintaining signal integrity and ensuring minimal distortion throughout the circuit. It also prevents external interference from affecting the

quality of the audio signal.

Once stabilized, the signal is passed to the Bass Adjustment stage, which focuses on the lower frequencies of the audio spectrum. This stage employs low-pass filters to isolate and control the bass frequencies. Variable resistors (potentiometers) allow users to adjust the intensity of these frequencies, either boosting or attenuating the bass depending on their preference. This adjustment is particularly important in creating a fuller and richer sound, especially for genres like electronic music or movie soundtracks, where bass plays a prominent role. Proper handling of the bass frequencies ensures depth and body in the audio output.

Following bass adjustment, the signal moves to the Treble Adjustment stage, which manipulates the higher frequencies. Treble frequencies contribute brightness, clarity, and detail to the audio signal, particularly for instruments like cymbals or vocals. High-pass filters are used in this stage to isolate and fine- tune the treble range, with potentiometers providing user-controlled adjustments. Balancing treble frequencies ensures that the audio output is crisp and clear without sounding harsh or distorted, enhancing the overall listening experience. Together with the bass adjustment, this stage allows for comprehensive frequency customization.

The processed signal is then sent to the Amplification Stage, which boosts its which manipulates the higher frequencies. Treble frequencies contribute brightness, clarity, and detail to the audio signal, particularly for instruments like cymbals or vocals. High-pass filters are used in this stage to isolate and fine-tune the treble range, with potentiometers providing user- controlled adjustments. Balancing treble frequencies ensures that the audio output is crisp and clear without sounding harsh or distorted, enhancing the overall listening experience. Together with the bass adjustment, this stage allows for comprehensive frequency customization.

Finally, the signal reaches the Output Stage, where it is prepared for delivery to the external audio system or speaker. The output stage ensures compatibility with the connected load and maintains the signal's fidelity. It acts as the final buffer between the tone controller and the audio output device, safeguarding against signal loss or degradation. At this point, the user receives a customized audio signal, shaped and enhanced according to their preferences through the earlier stages. The combination of these stages provides a flexible, user-friendly solution for real-time audio signal processing.

3.7 ADVANTAGES

- **Customizable Sound Output:** The tone controller circuit using BJTs provides fine-tuning of bass, treble, and midrange frequencies, enabling users to adjust the sound to their specific preferences effectively.
- **Enhanced Audio Quality:** By leveraging the precision of BJTs in amplification and frequency filtering, the circuit ensures improved clarity and richness in the audio signal for superior sound reproduction.
- **Stereo Channel Preservation:** The circuit maintains the integrity of left and right audio channels, preserving stereo sound quality and ensuring a balanced listening experience.
- **Wide Compatibility:** The design is versatile and can be easily integrated into various audio systems, including home theaters, car audio setups, and standalone audio amplifiers.
- **Compact and Cost-Efficient Design:** Utilizing BJTs along with passive components, the circuit achieves a low-power, compact, and cost- effective implementation suitable for a wide range of applications.

3.8 APPLICATIONS

- Home audio systems
- Car audio systems
- Public address systems
- Recording studios
- Live sound reinforcement
- Music production equipment
- Portable speaker systems

CHAPTER 4

CONCLUSION

The AM Transmitter and Tone Controller modules are awesome examples of creative and accurate electronics and communication engineering. The AM transmitter module is a great example of basic modulation methods, efficiently and reliably transmitting audio signals over a carrier wave. Thanks to the strong and easy circuitry structure, the transmitter is capable of maintaining a stable signal, which provides the basis for understanding the concept of wireless communication systems. The diverse nature and flexibleness of it to different frequencies make it the right tool in broadcasting, wireless data transfer, and communication networks, which are the real-world applications.

The "Tone Controller" module symbolizes the peak of the audio system, the possibility of fine (usually/bass, and high) or equalizing control over the frequency bands. This module provides the best possible audio output both for professional and personal audio systems. Its competence to modulate and tweak sound frequencies not only makes the experience richer but also shows the practical side of audio signal processing concepts. The tone controller's condensed and functional design, along with easy controls, makes it a significant plus for sound engineering, multimedia applications, and even music tracks.

These two modules show how basic components can be used to create innovative engineering solutions. The AM transmitter module highlights the importance of communication systems in modern technology. The tone controller module shows the importance of refined signal processing in audio engineering. These projects are a way to learn core engineering concepts and also encourage innovation and creativity.

These projects are a means to grasp core engineering concepts and also nurture innovation and creativity. Apart from that, the two features are the contributors to the greater consciousness of eco-friendly, money- saving, and handy engineering. Through the use of commonly available materials and simple but yet effective circuit design, the two components are both embodiments of the idea of practicality and adaptability. This approach is a great way for hobbyists and learners to get started. It meets industry requirements for scalable and replicable designs.

This combined offering signifies the art of electronics working hand in hand with function. From the AM transmitter for its representation of communication systems in modern technology to the tone controller that highlights how critical a refinement signal processing chain is to an audio system, these modules taken together is the initial effort towards bridging of theory and practice. This combined offering signifies the art of electronics working hand in hand with function. From the AM transmitter for its representation of communication systems in modern technology to the tone controller that highlights how critical a refinement signal processing chain is to an audio system, these modules taken together is the initial effort towards bridging of theory and practice.

These projects show us just how much technology can do to solve problems. They can be reliable, energy efficient, and environmentally friendly, which is a great way to learn about the basics of electronics and signal processing. These principles are essential for future innovations in communication systems and audio technologies. These projects help modern engineering evolve and make a more connected and acoustically enriched world.

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