CHENNAI INSTITUTE OF TECHNOLOGY

Sarathy Nagar, Kundrathur, Chennai-600069

An Autonomous Institute Approved by AICTE and Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IMPLEMENTATION OF AUDIO AMPLIFICATION USING OP AMP

A Report on Core Course Project

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

By

DEEKSHIKA G P(22EC028)
DHANUSHIYAA P(22EC030)
DHENISHAA V N(22EC031)

Oct / Nov - 2023

CHENNAI INSTITUTE OF TECHNOLOGY CHENNAI-69

Vision of the Institute:

To be an eminent centre for Academia, Industry and Research by imparting knowledge, relevant practices and inculcating human values to address global challenges through novelty and sustainability.

Mission of the Institute:

IM1.To creates next generation leaders by effective teaching learning methodologiesand instill scientific spark in them to meet the global challenges.

IM2.To transform lives through deployment of emerging technology, novelty and sustainability.

IM3.To inculcate human values and ethical principles to cater the societal needs.

IM4.To contributes towards the research ecosystem by providing a suitable, effective platform for interaction between industry, academia and R & D establishments.

Vision of the Department:

To Excel in the emerging areas of Electronics and Communication Engineering by imparting knowledge, relevant practices and inculcating human values to transform the students as potential resources to cater the industrial and societal development through sustainable technology growth.

Mission of the Department:

DM1: To provide strong fundamentals and technical skills through effective teaching learning Methodologies.

DM2: To transform lives of the students by fostering ethical values, creativity and innovation to become Entrepreneurs and establish Start-ups.

DM3: To habituate the students to focus on sustainable solutions to improve the quality of life and welfare of the society.

DM4: To provide an ambience for research through collaborations with industry and academia.

DM5: To inculcate learning of emerging technologies for pursuing higher studies leading to lifelong learning.

CHENNAI INSTITUTE OF TECHNOLOGY

An Autonomous Institute

CHENNAI-69

CERTIFICATE

This is to certify that the "**Core Course Project**" Submitted by **Deekshika G P(22EC028), Dhanushiyaa P(22EC030) and Dhenishaa V N(22EC031)** is a work done by him/her and submitted during **2023-2024** academic year, in partial fulfilment of the requirements for the award of the degree of **BACHELOR OF ENGINEERING** in **DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING,** at Chennai Institute of Technology,Chennai.

Core Course Project Coordinator **Internal Examiner**

Head of the Department **External Examiner**

ACKNOWLEDGEMENT

We express our gratitude to our Chairman **Shri.P.SRIRAM** and all trust members of Chennai institute of technology for providing the facility and opportunity to do this project as a part of our undergraduate course.

We are grateful to our Principal **Dr.A.RAMESH M.E**, **Ph.D.** for providing us the facility and encouragement during the course of our work.

We sincerely thank our Head of the Department, **Dr.G.MOHAN BABU M.E, Ph.D**, Department of Electronics and Communication Engineering for having provided us valuable guidance, resources and timely suggestions throughout our work.

We would like to extend our thanks to our **Faculty coordinators of the Department of Electronics and Communication Engineering**, for their valuable suggestions throughout this project.

We wish to extend our sincere thanks to all **Faculty members of the Department of Electronics and Communication Engineering** for their valuable suggestions and their kind cooperation for the successful completion of our project.

We wish to acknowledge the help received from the **Lab Instructors of the Department of Electronics and Communication Engineering** and others for providing valuable suggestions and for the successful completion of the project.

DEEKSHIKA G P(22EC028)
DHANUSHIYAA P(22EC030)
DHENISHAA V N(22EC031)

PREFACE

We students of Electronics and Communication require to do an Project to enhance our knowledge. The purpose of core course Project is to acquaint the students with practical application of theoretical concept taught to us during our course period.

It was a great opportunity to have close comparison of theoretical concept in practical field. This report may depict deficiencies on our part but still it is an account of our effort.

The output of our analysis is summarised in a shape of Industrial Project the content of report shows the details of sequence of these. This is our Core Course Project report which we have prepared for the sake of our Second Year Project. Being an engineer, We should help the society for inventing something new by utilising our knowledge which can help them to solve their problem.

ABSTRACT

This abstract outlines the implementation of an audio amplification system utilizing operational amplifiers (op amps). The objective was to achieve efficient and high-fidelity audio amplification for various applications. We have used this for providing better hearing ability for elderly people.The circuit was developed using op amps in an appropriate configuration to achieve the desired amplification gain. Results demonstrated a successful implementation, showcasing the potential of op amp-based audio amplification for enhancing audio signals in diverse scenarios and we have used ISD1820 for recording features.

In this project we will interface the output from audio amplifier to the ISD1820 for recording and playback.Some people are unlucky to lose their sense of hearing due to ageing issue.They feel trouble to hear the conversations around them.With the recording capability the user can record some crucial conversations or sound and replay it when necessary and also they can even record their do to tasks and follow it.

	Content	
Chapter No	**Title**	**Page No.**
1.	Introduction	9
2.	Problem Statement	11
3.	Problem Objective	11
4.	Component Used	12
5.	Component Description	12
6.	Circuit Diagram	16
7.	Role of Op Amp in Audio Amplifier	17
8.	Conclusion	18
9.	References	19
10.	Result	19
11.	PO &PSO Attainment	20

Introduction

An audio amplifier is a device used to increase the volume of sound with low power so that it can be used in a loudspeaker. It is generally the final step in an audio feedback chain, or the movement of sound from an audio input to an audio output. There are various applications to this technology which include their use in public address systems and concerts. Audio amplifiers can also be of significance for individuals as they are used in sound systems in homes. In fact, the sound cards of personal computers are likely to have audio amplifiers

The first audio amplifier was made in 1906 by a man named Lee De Forest and came in the form of the triode vacuum tube. This particular mechanism evolved from the Audion, which was developed by De Forest. Unlike the triode which has three elements, the Audion only had two and did not amplify sound. Later on during the same year, the triode, a device with the capability of adjusting the movement of electrons from a filament to a plate and thus modulating sound, was invented. It was vital in the invention of the first AM radio.

After World War II, there was a surging of technology because of the advancements developed during the war. The earliest kinds of audio amplifiers were made of vacuum tubes or valves. An example of these is the Williamson amplifier, which was introduced in 1946. At the time, this particular device was considered cutting edge and produced higher quality sound compared to other amplifiers available at the time. The market for sound amplifiers was robust and the valve-type devices can be owned at affordable rates. By the 1960s, gramophones and televisions made valve amplifiers quite popular.

By the 1970s, valve technology was replaced by the silicon transistor. Although valves were not completely wiped out as evidenced by the popularity of the cathode ray tubes, which was used for amplifier applications, silicon transistors became more and more present. Transistors amplify sound by changing the voltage of the audio input through the use of semiconductors. The reasons for the preference of transistors over valves were that they were smaller and thus more energy-efficient. In addition to these, they're also better at reducing distortion levels and were cheaper to make.

Most audio amplifiers in use today are considered to be solid state transistors. An example of this is the bipolar junction transistor, which is has three elements made out of semiconductor materials. Another kind of amplifier used in recent years is the MOSFET or the metal oxide semiconductor field effect transistor. Invented by Julius Edgar Lilienfeld, it was first conceptualized in 1925 and has both digital and analog circuit applications.

Although solid state amplifiers offered convenience and efficiency, they still could not produce the quality of those made of valves. In 1872, Matti Otala discovered the reason behind this: intermodulation distortion (TIM). This particular kind of distortion was caused by the fast increase of voltage in the audio output device. Further research remedied this problem and thus resulted in amplifiers that cancel out the TIM.

PROBLEM STATEMENT

An audio amplifier is a necessity to our everyday life. It has become a tool for entertainment and relaxation. Audio amplifiers are used in computer systems, home music systems, home theater systems and for amplifying sounds from musical instruments such as guitar, organ and other computer related instruments. Because of this a reliable high fidelity audio amplifier should be made easily available. Commercial amplifiers are technologically advanced. Knowledge into the design of such an amplifier should be emphasized. The overall aim of this project is to study and develop a audio amplifier system with voice recording features.

Voice recorder module ISD1820 is a multiple message recording/playback device.It can offer a single chip voice recording for few seconds.The challenge is to design a specialized audio amplifier system catered to the unique hearing needs of the elderly population. The design should be user-friendly with easy-to-use controls, ensuring a hassle-free and intuitive experience for seniors. Comfort and ergonomic considerations are crucial, ensuring the device is wearable, lightweight, and non-obtrusive. The objective is to create an audio amplifier that significantly enhances the auditory experience and communication abilities of older adults, enhancing their quality of life.

PROBLEM OBJECTIVE:

The objective is to implement an audio amplification of input audio signals using op amp and record by interfacing ISD1820.

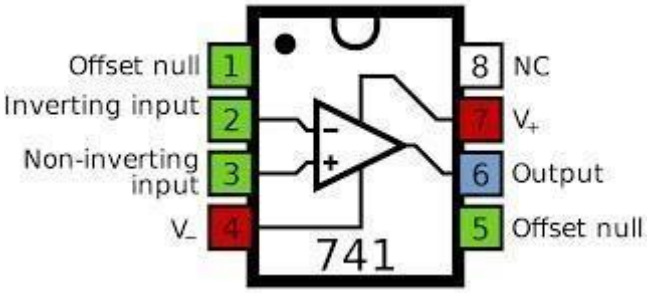
COMPONENTS USED :

- LM 741
- 1K,10K,4.7K,22K Resistors
- Capacitors
- Variable resistor
- Condenser mic
- Breadboard
- ISD 1820 Module
- Jumper wires
- Connecting wires
- Speaker
- Battery 9V
- Transistors NPN and PNP

COMPONENTS DESCRIPTION

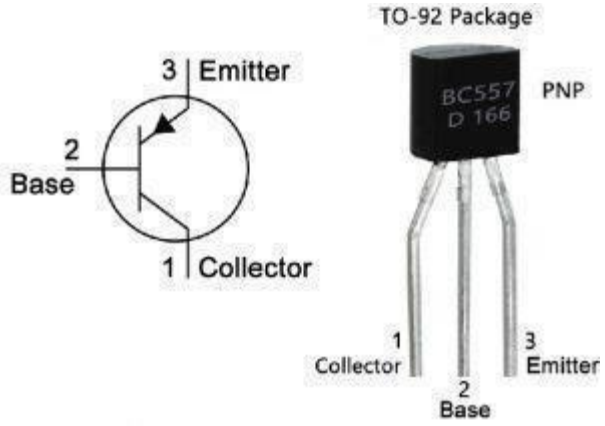
LM 741:

The LM741 series are general-purpose operational amplifiers which feature improved performance over industry standards like the LM709. They are direct, plug-in replacements for the 709C, LM201, MC1439, and 748 in most applications. LM741 can be used as a comparator in order to determine the levels of applied input voltages i.e. either smaller or larger input voltages are applied at its input terminal. Its internal circuitry seems rather complex to novices, since it consists of twenty bipolar transistors, eleven resistors and one compensating capacitor. LM741 Op Amp is a three- stage amplifier; a differential input stage, a single ended high gain stage and a class AB (buffering) stage.



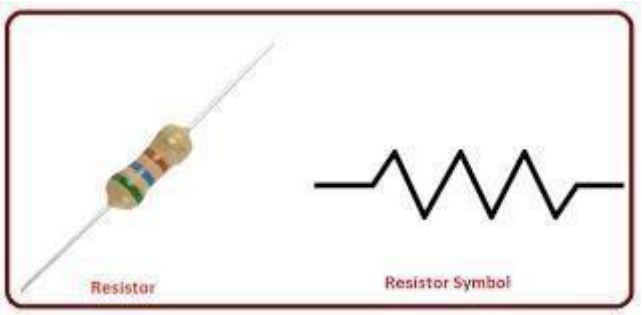
BC 557 :

BC557 is a general-purpose transistor, used like an amplifier or a switch in electronic circuits. Its hFE ratings of this transistor range from 125 to 800 to make the transistor ideal by using like an amplifier within electronic circuits like audio signal amplification. When this transistor is used as a switch for below 100mA loads then it works well. The value of VCE for this transistor is good like -45V. This collector to emitter terminal voltage is used within circuits which require 40V to 45V DC.



Resistors:

A resistor is an electrical component that limits or regulates the flow of electrical current in an electronic circuit. Resistors can also be used to provide a specific voltage for an active device such as a transistor. In electronic circuits, resistors are predominantly used to lower the flow of current, divide voltages, block transmission signals, and bias active elements.

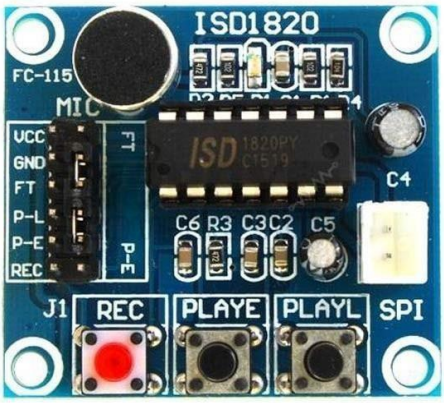


Capacitor:

A capacitor is a two-terminal electrical device that can store energy in the form of an electric charge. It consists of two electrical conductors that are separated by a distance. The space between the conductors may be filled by vacuum or with an insulating material known as a dielectric.In audio amplification applications, capacitors couple the constant DC signals with the rapidly fluctuating voltages that drive speakers to help create a smooth sound. To create a bold and clean sound, larger capacitors work better than smaller ones.

ISD1820:

ISD1820 is a small Voice Recorder and Playback module that can do the multi-segment recording. The user can achieve a high quality of recording (for 8 to
20secs) for each application with the adjustment of the on-board resistor. This Voice Recorder/Playback module is designed with embedded-Flash memory, which can hold data for up to 100 years and erase/record the life cycle up to 100,000.

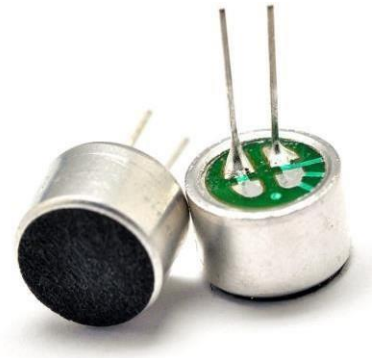


CONDENSER MIC:

A condenser microphone, also known as a capacitor microphone, is a type of microphone that operates on the principle of capacitance. It consists of a diaphragm, which acts as one plate of a capacitor, and a backplate or a fixed plate, acting as the other plate.
These plates are placed close together, forming an electrically charged capacitor.

When sound waves hit the diaphragm, the distance between the diaphragm and the backplate changes, causing variations in the capacitance. These capacitance changes generate an electrical signal that corresponds to the sound waves. This signal is then amplified to produce an audio output.

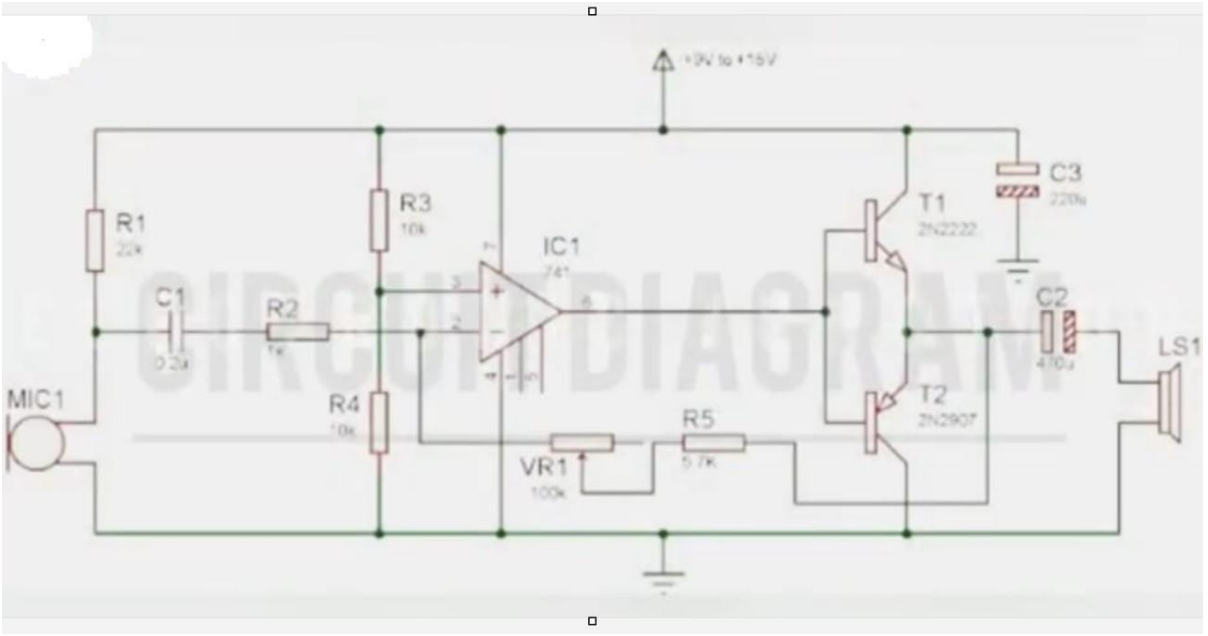
Condenser microphones are known for their sensitivity and accuracy in capturing a wide range of frequencies, making them suitable for recording vocals, acoustic instruments, and capturing detailed audio in a studio setting. They typically require a power source, known as phantom power, to charge the capacitor and operate effectively. Condenser microphones are available in various types, including large-diaphragm condenser microphones for studio recording and small-diaphragm condenser microphones for capturing instruments and high-frequency sounds.



SPEAKER:

A speaker in an audio amplifier is a crucial component responsible for converting electrical signals into sound waves that can be heard by the human ear. It is the final stage in the amplification process, where the amplified electrical signals are transformed into audible sound.

CIRCUIT DIAGRAM:



ROLE OF OP AMP IN AUDIO AMPLIFIER:

1. Amplification:

Op amps are known for their high gain capabilities. In an audio amplifier, an op amp is used to amplify the weak electrical audio signal received from a microphone, musical instrument, or other sources. The high gain ensures the audio signal is significantly amplified to a level suitable for driving speakers or headphones.

2. Voltage Amplification:

Op amps are designed to amplify the voltage difference between their two input terminals. In an audio amplifier, the voltage difference represents the audio signal, and the op amp amplifies this voltage to produce a larger signal for driving the output.

3. Input Stage:

In an audio amplifier circuit, the op amp often serves as the input stage. The audio signal is typically fed into the non-inverting or inverting input of the op amp, which then amplifies the signal.

4. Feedback Mechanism:

Op amps use feedback loops, such as negative feedback, to stabilize and control their amplification. In audio amplifiers, feedback mechanisms help achieve precise amplification levels and maintain stability in the circuit.

5. Signal Conditioning:

Op amps can be used to implement various signal conditioning operations, including filtering, equalization, and tone control. These operations help shape the audio signal to match the desired output characteristics and optimize the sound quality.

6. Summing Amplification:

Op amps can be employed in summing amplifiers, allowing multiple audio signals to be combined and amplified simultaneously. This is useful in mixing audio inputs, such as in a recording studio or a live sound setup.

7. Phase Shifting and Phase Compensation:

Op amps can be used to introduce phase shifts or provide phase compensation in audio amplifiers, which is critical to ensure proper alignment and coherence of the audio signals.

8. Driver Stage:

Op amps are often used as driver stages in audio amplifier circuits, where they provide the necessary current and voltage to drive speakers or headphones, ensuring the audio signal is transmitted effectively to the output devices.

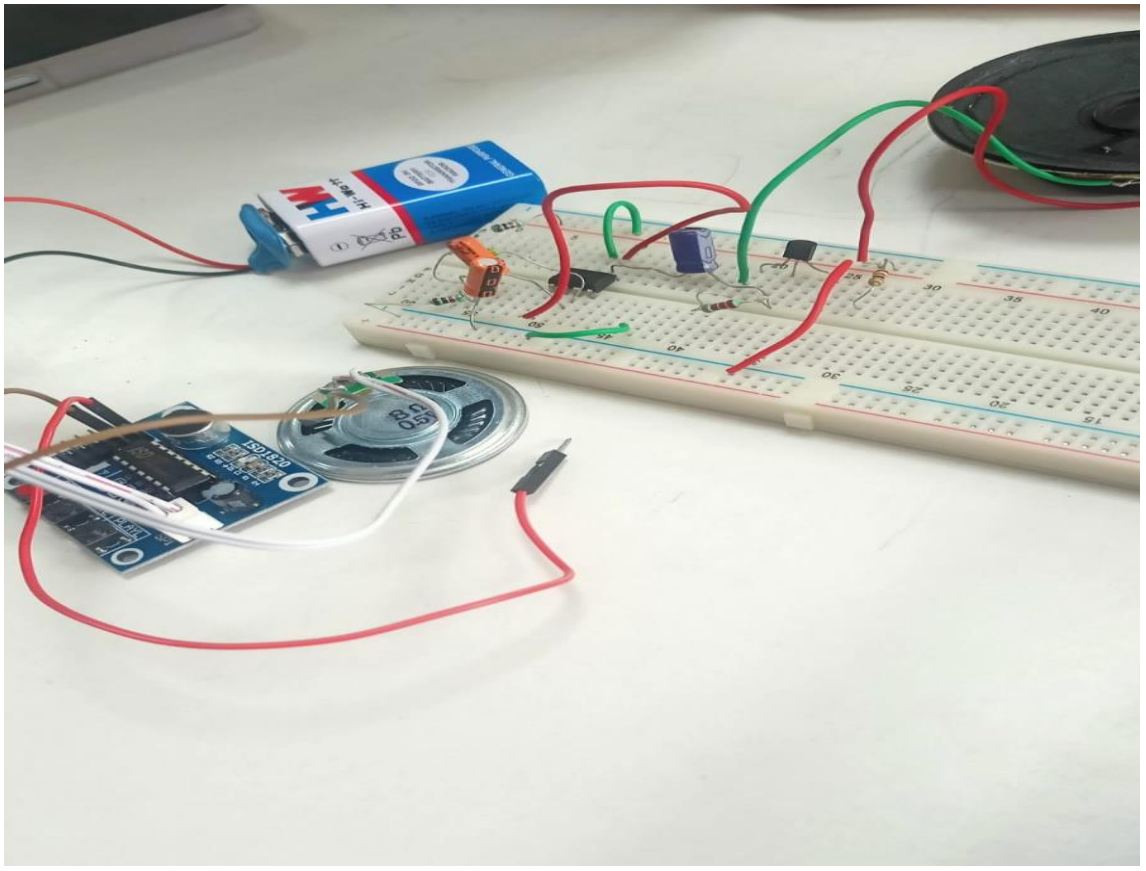
CONCLUSION:

In conclusion, the implementation of audio amplification using an operational amplifier (op amp) for the elderly has demonstrated its potential to significantly enhance their auditory experiences. The carefully designed op amp circuitry effectively amplified audio signals, catering to the specific hearing requirements and preferences of elderly individuals. By considering factors like gain control, frequency response, and ease of use, we have tailored the solution to suit their needs. This amplification technology has the potential to improve communication, engagement with multimedia, and overall enjoyment of sound for elderly individuals, thereby contributing to a better quality of life and a more inclusive environment. Future iterations and refinements of this technology should continue to prioritize accessibility, ease of operation, and user-friendly interfaces to ensure its widespread adoption and effectiveness among the elderly population.

REFERENCE:

1. https://www.ee-diary.com/2021/12/how-to-design-powerful-audio-amplifier.html
2. https://www.watelectronics.com/audio-amplifier-circuit-working-and-applications
3. https://www.scribd.com/doc/53707383/Project-Report
4. https://www.myclassbook.org/2017/03/audio-amplifier-using-op-amp.html
5. https://iopscience.iop.org/article/10.1088/1757-899X/318/1/012035
6. https://www.ablic.com/en/semicon/products/analog/opamp/intro/
7. https://en.wikipedia.org/wiki/Operational_amplifier
8. https://rcciit.org/students_projects/projects/ece/2018/GR23.pdf

RESULT



PO & PSO Attainment

PO.No	Graduate Attribute	Attained	Justification
PO 1	**Engineering knowledge**	Yes	Engineering knowledge justifies its value through practical problem-solving abilities, technical expertise, and its significant impact on society's progress, innovation, and well-being.
PO 2	**Problem analysis**	Yes	Problem analysis is essential as it lays the foundation for effective decision-making, identifying root causes, and devising optimal solutions, leading to successful outcomes.
PO 3	**Design/Development of solutions**	Yes	Design and development of solutions are justified by their ability to address complex challenges effectively, improve efficiency, and enhance the overall quality of life through innovative and practical implementations.
PO 4	**Conduct investigations of complex problems**	Yes	Conducting investigations of complex problems is essential to uncover underlying causes, inform effective solutions, and ensure informed decision-making in various fields, driving progress and mitigating risks.

PO 5	**Modern Tool usage**	Yes	Modern tool usage is justified by its efficiency and effectiveness in streamlining processes, enhancing productivity, and staying competitive in an ever-evolving technological landscape.
PO 6	**The Engineer and society**	Yes	Engineers benefit society by designing and implementing innovative solutions that improve infrastructure, technology, and quality of life while considering environmental sustainability for a more resilient and eco-friendly future.
PO 7	**Environment and Sustainability**	Yes	Engineers benefit society by designing and implementing innovative solutions that improve infrastructure, technology, and quality of life while considering environmental sustainability for a more resilient and eco-friendly future.
PO 8	**Ethics**	Yes	Ethics justifies moral principles that guide human behavior, fostering trust, integrity, and fairness while ensuring responsible decisionmaking and mutual respect in all aspects of life.
PO 9	**Individual and team work**	Yes	Individual work justifies personal accountability and expertise, while teamwork fosters collaboration and synergy, leading to diverse perspectives and more effective problem-solving.

PO 10	**Communication**	Yes	Communication justifies its importance by facilitating effective exchange of ideas, information, and emotions, fostering understanding, collaboration, and building strong interpersonal connections.

PO 11	**Project management and finance**	Yes	Project management ensures efficient execution of tasks, optimal resource allocation, and timely completion of projects, leading to successful outcomes. Finance plays a crucial role in allocating funds, managing budgets, and making informed decisions, ensuring financial stability and sustainable growth
PO 12	**Life-long learning**	Yes	professional growth, keeping individuals adaptable and relevant in a rapidly changing world, while fostering a deeper understanding and appreciation of the complexities of life

PSO.No	Graduate Attribute	Attained	Justification
PSO 1	To analyze, design and develop solutions by applying the concepts of Robotics for societal and industrial needs.		Adapting emerging technologies in Communication Engineering enables the creation of innovative, high-quality solutions that stay ahead of industry trends and meet evolving user needs. This approach fosters efficient, effective, and cutting-edge communication systems.
PSO 2	To create innovative ideas and solutions for real time problems in Manufacturing sector by adapting the automation tools and technologies.		By leveraging Embedded & IoT tools, innovation in industrial and domestic Automation becomes attainable, facilitating real-time problem-solving and empowering efficient, connected, and automated systems for enhanced productivity and convenience.

* * * * THANK YOU * * * *