BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

EEE 316 (January 2022)

Power Electronics Laboratory

Final Project Report

Section: A1 Group: 01

Simple Induction Cooker

Course Instructors:

Full Name: Ramit Dutta, Lecturer
Full Name: Jawad-Ul-Islam, Part-Time Lecturer

Signature of Instructor: ______________________________

Academic Honesty Statement:

IMPORTANT! Please carefully read and sign the Academic Honesty Statement, below. Type the student ID and name, and put your signature. ***You will not receive credit for this project experiment unless this statement is signed in the presence of your lab instructor.***

"In signing this statement, We hereby certify that the work on this project is our own and that we have not copied the work of any other students (past or present), and cited all relevant sources while completing this project. We understand that if we fail to honor this agreement, We will each receive a score of ZERO for this project and be subject to failure of this course."

Signature:

____

Full Name: Anudwaipaon Antu
Student ID: 1906001

Signature:

____

Full Name: Junayet Hossain
Student ID: 1906026

Signature:

____

Full Name: Aranya Saha
Student ID: 1906010

Signature:

____

Full Name: Vivek Chowdhury
Student ID: 1906031

Table of Contents

1 Abstract

This project represents the design of a simple DC induction cooker/heater for cooking or any kind of heating application. The objective is to build a circuit that will convert DC to high frequency AC so that it can impose large amount of eddy currents in any type of magnetic material which will convert to heat according to I^2R relation.

2 Introduction

In Bangladesh, almost 90% of the total population depends on natural gas for cooking purpose. But now-a-days natural gas has become inadequate for fulfilling the demand of the population. Besides, price hikes in natural gas also made it difficult for the lower-middle class people to continue cooking using natural gas. If we can lessen the dependency on natural gas for cooking, most of the above problems will be solved. By using electricity as a source of energy for cooking, we can acquire this target. Besides, this type of electrical energy to thermal energy conversion has a higher efficiency rate (tends to 90%). Though electricity problem is also severe in our country, a DC induction stove will work fine as it uses a DC source which is rechargeable.

Our simple DC induction stove has the following features:

- **Portable DC source:** As we will use a DC battery, our induction cooker will be portable and can be carried easily to any place.
- **Emergency Usage:** It can be a life-saving equipment in a particular emergency situation.
- **Cost-effective:** As it is a simpler version, it will be a cost-effective equipment.
- **Compact Size:** It will take less space than any conventional cooker.

3 Design

3.1 Problem Formulation (PO(b))

The problem at hand is to design and develop a simple induction cooker that meets the following key requirements and objectives:

1. **Energy Efficiency:** One of the primary concerns in modern kitchen appliances is energy efficiency. Conventional stovetops and cookers often waste a significant amount of energy through heat dispersion. The objective is to create an induction cooker that maximizes energy efficiency, thereby reducing electricity consumption during cooking.

2. **Safety:** Safety is paramount when dealing with kitchen appliances. The induction cooker should incorporate safety features to prevent accidents, such as overheating, electrical malfunctions, or accidental burns to users.
3. **Cost-Effectiveness:** While incorporating advanced features is desirable, it's important to strike a balance between functionality and cost-effectiveness. The induction cooker should be affordable and accessible to a broad range of consumers without compromising performance and safety.

4. **User-Friendly Interface:** The design should be user-friendly, ensuring that individuals with varying levels of cooking expertise can easily operate the appliance. This includes intuitive control mechanisms, clear temperature settings, and safety indicators.

5. **Durability and Longevity:** Kitchen appliances are subjected to regular wear and tear. The induction cooker should be designed to withstand prolonged use and maintain its performance over time, thus extending its lifespan.

6. **Compatibility:** The induction cooker should be compatible with a wide range of cookware materials, ensuring that users can use their existing pots and pans without limitations.

7. **Environmental Impact:** In today's eco-conscious world, it's essential to consider the environmental impact of household appliances. The project should explore ways to minimize the environmental footprint of the induction cooker, such as using recyclable materials and reducing energy consumption.

8. **Market Demand and Trends:** An analysis of current market trends and consumer demand for induction cookers should be conducted to ensure the project aligns with market expectations and potential for adoption.

By formulating the problem in this manner, we can guide our project towards addressing the specific challenges and objectives that are essential for the successful development of a simple induction cooker.

3.1.1 Identification of Scope

In this section, we define the boundaries and extent of our project to develop a simple induction cooker. The scope encompasses the following aspects:

- **Overall Objective:** The primary goal of this project is to design and create a basic yet efficient induction cooker suitable for household use.

- **Scope Elements:** Within the scope, the project will include the development of a single-burner induction cooker with straightforward controls and safety features.

- **Constraints:** The project is subject to budget constraints, limited time for development, and access to specific resources and components.

- **Target Audience:** The target audience for this simple induction cooker consists of homeowners and individuals seeking an affordable and easy-to-use cooking appliance.

3.1.2 Literature Review

This section reviews existing literature and research related to simple induction cookers to provide context and guide our project. Key points to include:

- **History of Induction Cookers:** An overview of the historical development of induction cookers and their evolution in domestic kitchens.

- **Features in Simple Induction Cookers**: A review of existing designs and features in basic induction cookers, emphasizing simplicity, energy efficiency, and safety.

- **Energy Efficiency Standards:** Discussion of energy efficiency standards and regulations applicable to induction cookers in domestic settings.

- **User Preferences:** Insights into user preferences, such as ease of use and safety considerations, based on previous studies and consumer feedback.

- **Challenges in Simplicity:** Identification of challenges faced when designing simple induction cookers and gaps in the existing market offerings.

3.1.3 Formulation of Problem

This section reiterates the specific problem and objectives for our simple induction cooker project:

- **Problem Statement:** The project aims to address the need for an uncomplicated, cost-effective, and energy-efficient induction cooker suitable for household cooking.

- **Objectives:** The primary objectives include the design and development of a single-burner induction cooker that prioritizes energy efficiency, safety, affordability, ease of use, and compatibility with standard cookware.

3.1.4 Analysis

In this section, we conduct a thorough analysis related to our simple induction cooker project:

- **Data Analysis:** We will perform energy consumption tests, analyze user feedback on similar products, and review market trends to inform our design choices.

- **Design Options:** We will evaluate different design options, materials, and safety mechanisms to meet our objectives.

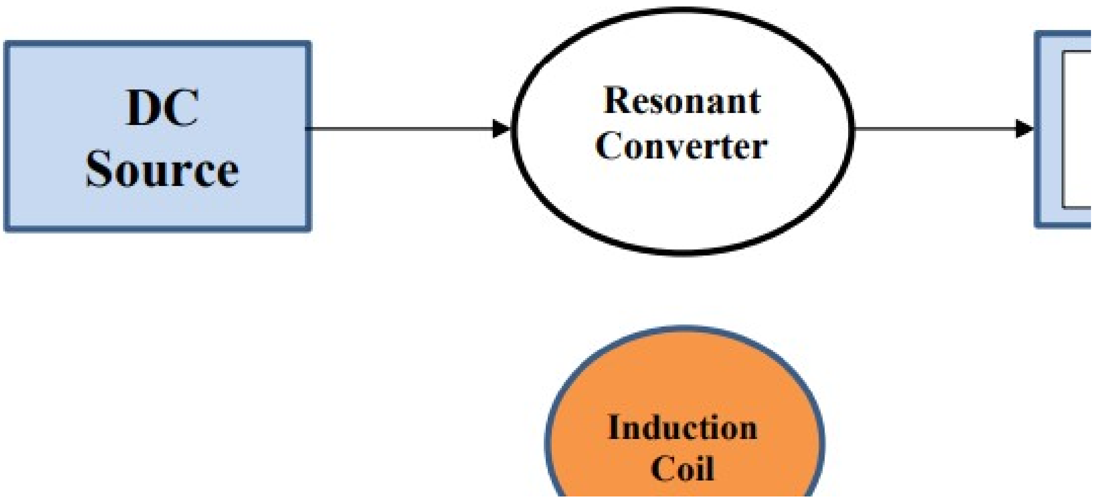
- **Comparison with Objectives:** We will compare the results of our analysis with the project's objectives, ensuring that our design aligns with our intended goals.

- **Trade-offs and Decisions:** We will discuss any trade-offs made during the design process and the reasons behind these decisions.
- **Risks and Uncertainties:** Identify potential risks or uncertainties that may impact the successful development of our simple induction cooker and outline mitigation strategies.

3.2 Design Method (PO(a))

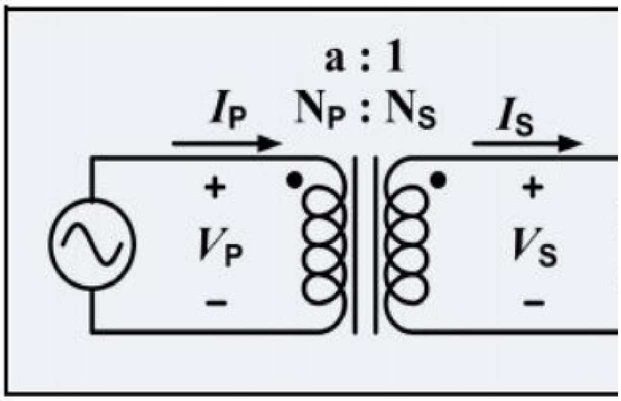
In order to design a simple induction cooker, we need to apply the basic theory of resonant converters. The idea is simple. At first, we will take an AC supply and then we will convert it to dc and after that we will convert it to ac with high frequency. This will lower the skin depth of a magnetic material and will increase I^2R losses due to eddy currents. These I^2R losses will be the source of heat.

Flow-chart of the Project:



Explanation:

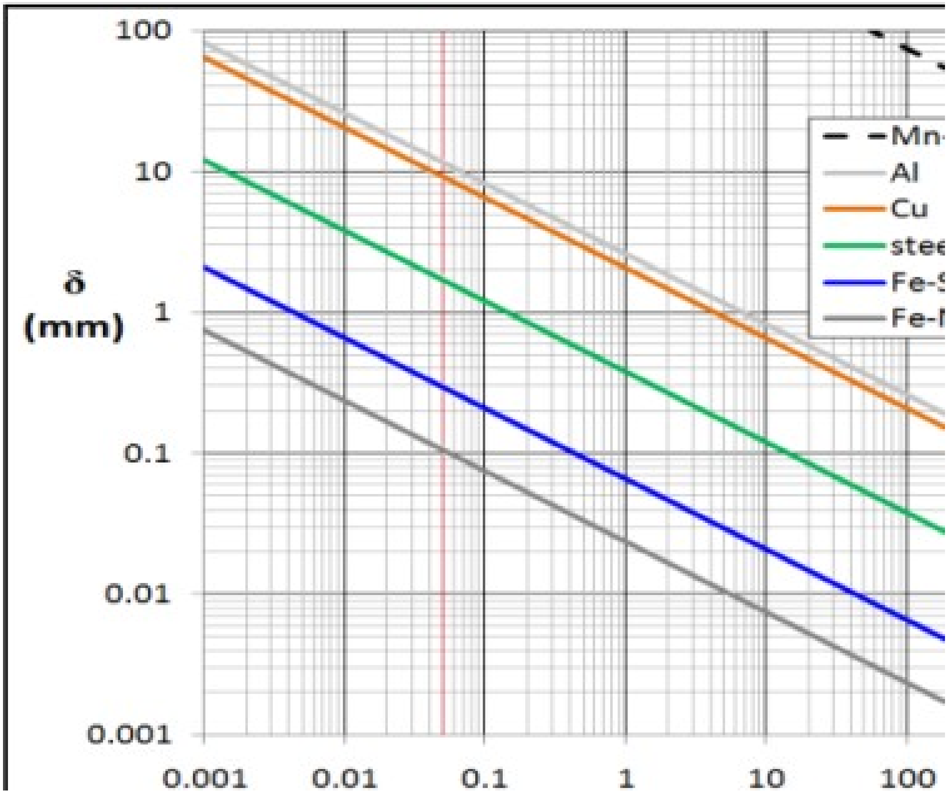
The resonant converter circuit consists of MOSFETs, inductor, capacitor and diodes. MOSFETs are used because they offer higher switching speeds and lower conduction loss at low currents. But they cannot block reverse conduction, so diodes are used here. The resonant converter circuit produces high frequency AC current. This high frequency AC current creates a time varying magnetic field. Whenever a pot (made of magnetic material) is placed on top of the induction coil, eddy currents are generated. These currents undergo ohmic losses due to the resistivity of the pot. The pot / coil combination can be modeled as a transformer as in the upcoming figure. The coil inductance is then the magnetizing inductance, and the eddy current loss can be modeled as a resistor ZL on the secondary. However, the turns ratio and effective resistance are both non-linear functions of the physical pot, its contents, the resonant frequency, and the magnetic field coupling between the coil and the pot.



In our simulation, we used a center tap transformer for modelling the coil-pot combination. There is an additional loss (heating) mechanism in ferromagnetic materials called hysteresis loss. This loss can be thought of as energy needed to flip the magnetic dipoles in the ferromagnetic material and contributes a significant, but not overwhelming, percentage of the heat generated in an induction stove. High frequency is required for increasing heat. We know skin effect refers to the tendency of high frequency currents to flow on the surface of conductors. The current density decreases exponentially with distance from the conductor's surface. The "skin depth" is the distance from the surface at which the current has followed to 1/e of the total current.

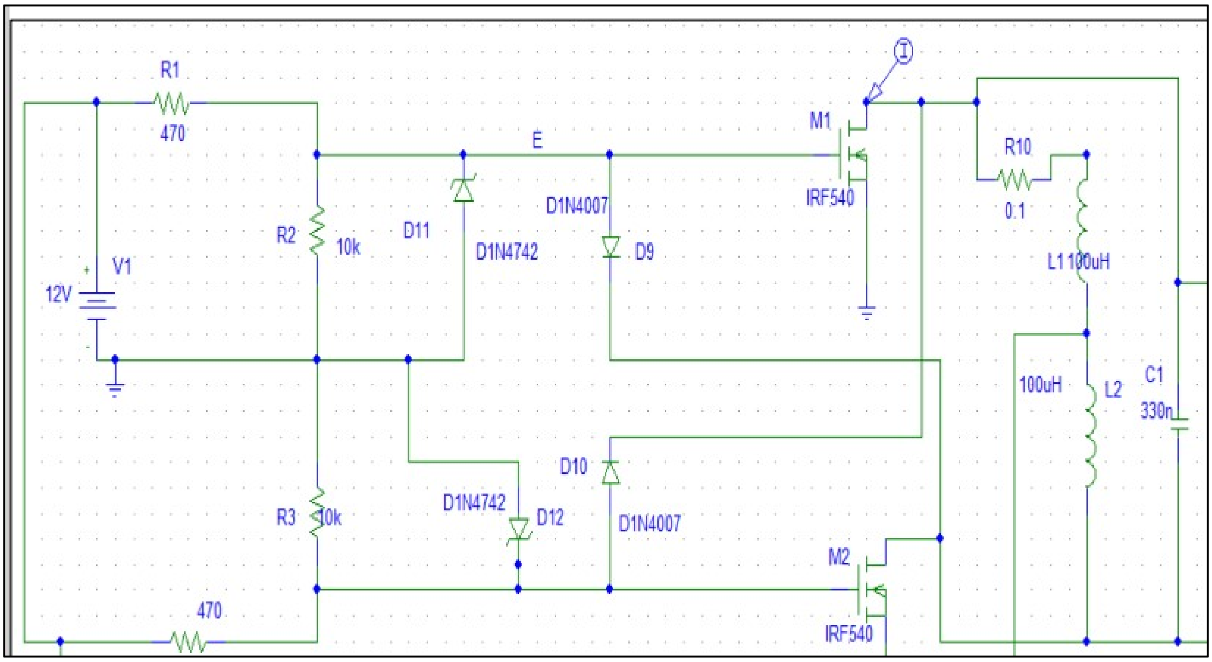
$$\delta = \sqrt{\frac{2\rho}{\omega\mu_r\mu_0}}.$$

In induction heating, the skin effect produces a favorable outcome for heating a pot. As frequency increases, the effective resistance of the pot increases with the square root of frequency. It should also be noted that the skin depth is much larger in non-magnetic materials (i.e., materials with lower relative magnetic permeability) and therefore non-magnetic materials are not suitable for induction heating.



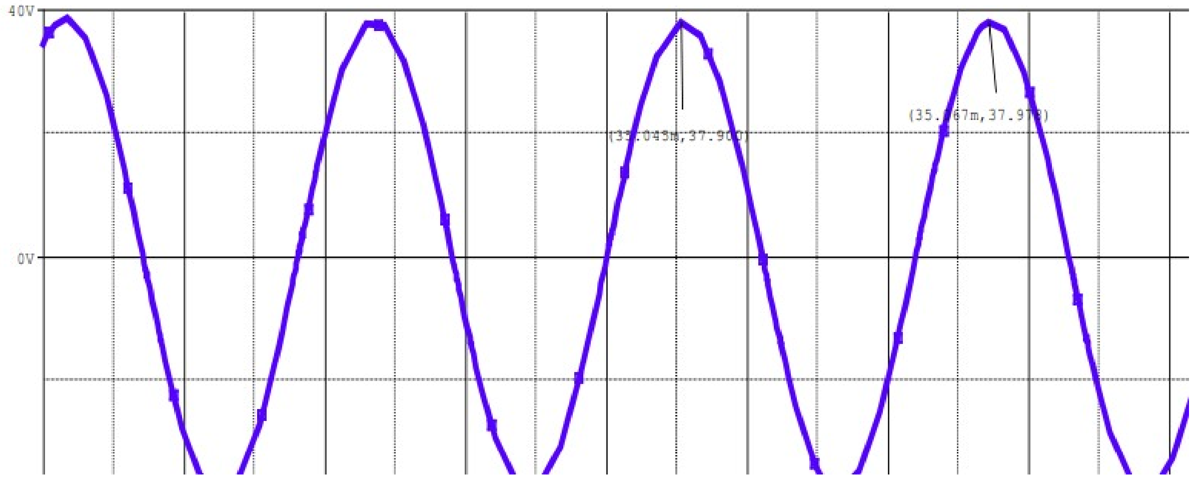
We will use Cu material for the induction coil and steel pot for demonstrating the heating.

3.3 Circuit Diagram



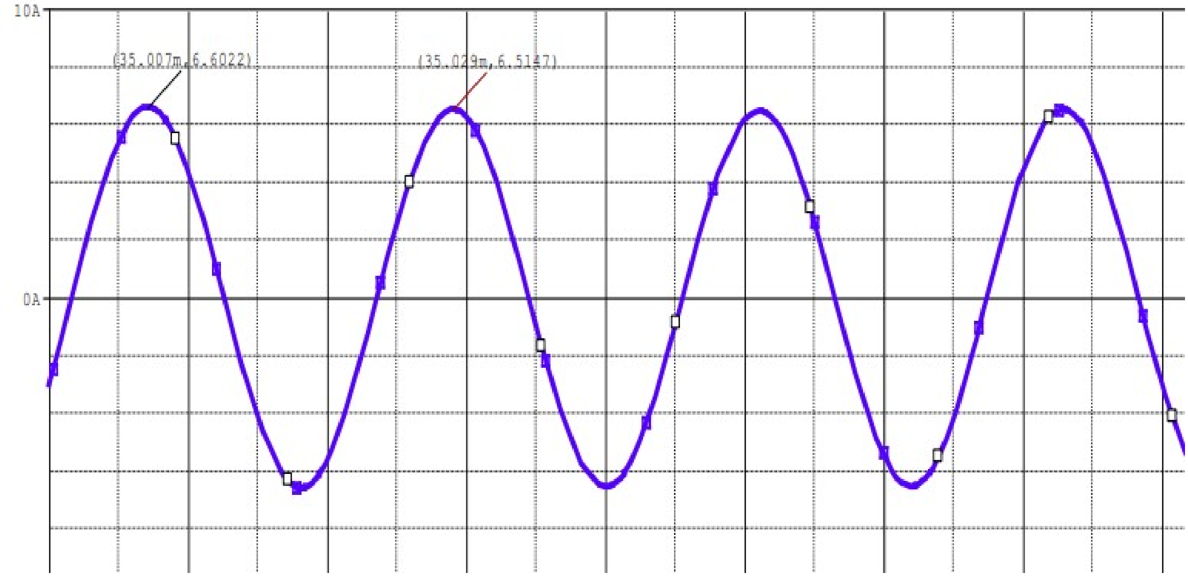
3.4 Simulation Model

Output Voltage:



Here, the peak value is around 37.9 V and rms value is about 26.8 V.

Output Current:

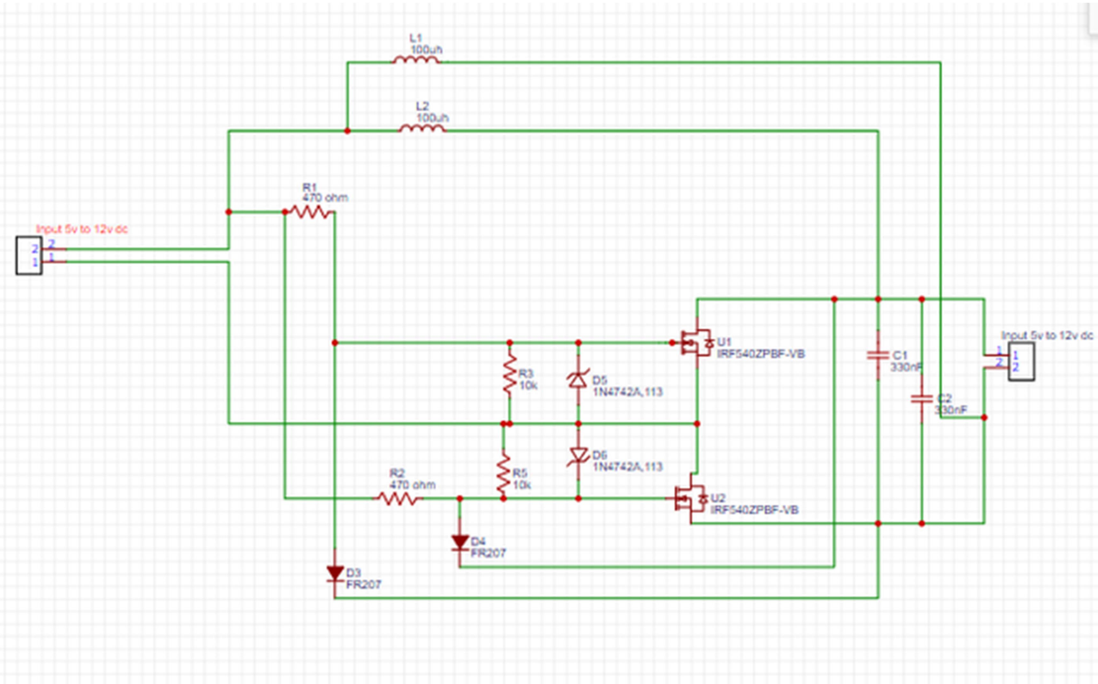


Here, the peak value is around 6.51 A and rms value is about 4.6 A.

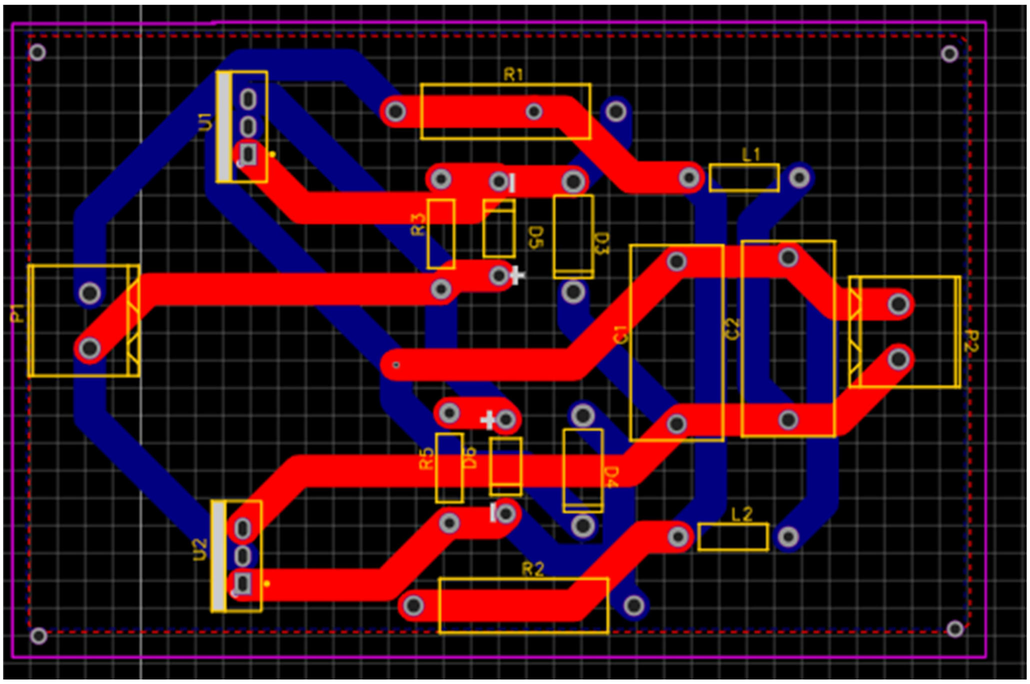
3.5 PCB Design

Although, we implemented the circuit on Veroboard, it can also be built using the following PCB schematic. The designs are given below:

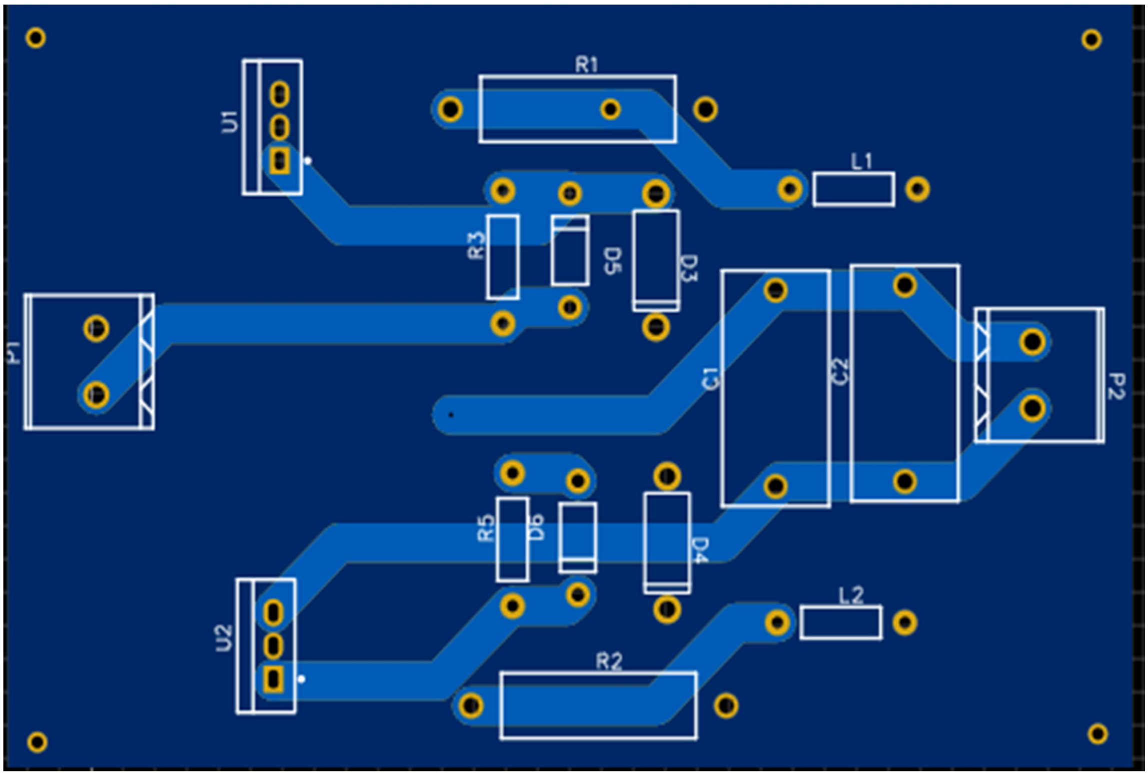
Schematic:



Top and Bottom Layer:



3D View:

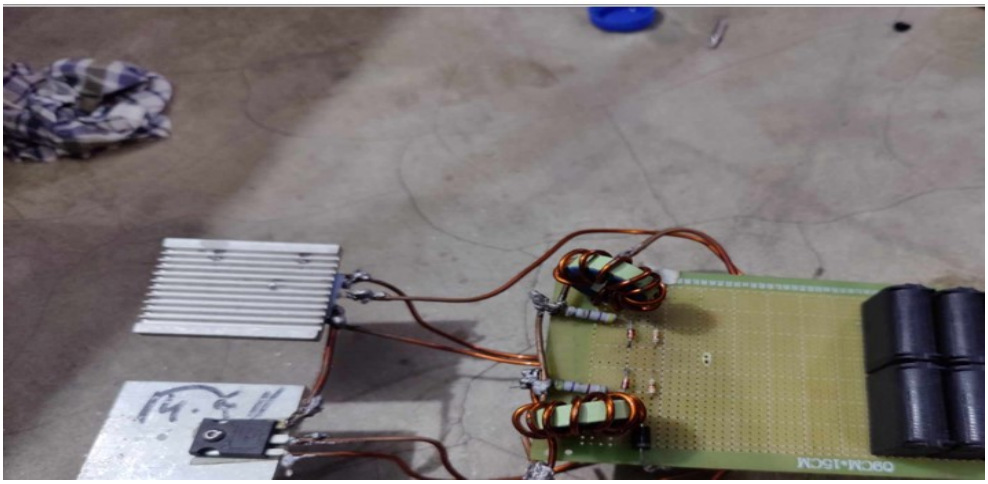


4 Implementation

When we designed our model at first in Veroboard, it didn't work because the two inductors should be higher in value than the coil's inductance. Using a traditional yellow core (powdered iron core) which has a permeability of 75 and turns of 45-50 using SWG 20 wire we can get an inductance of 100uH. Due to the mismatch of inductance value our first two designs failed. But in our third design we have achieved the desired result,

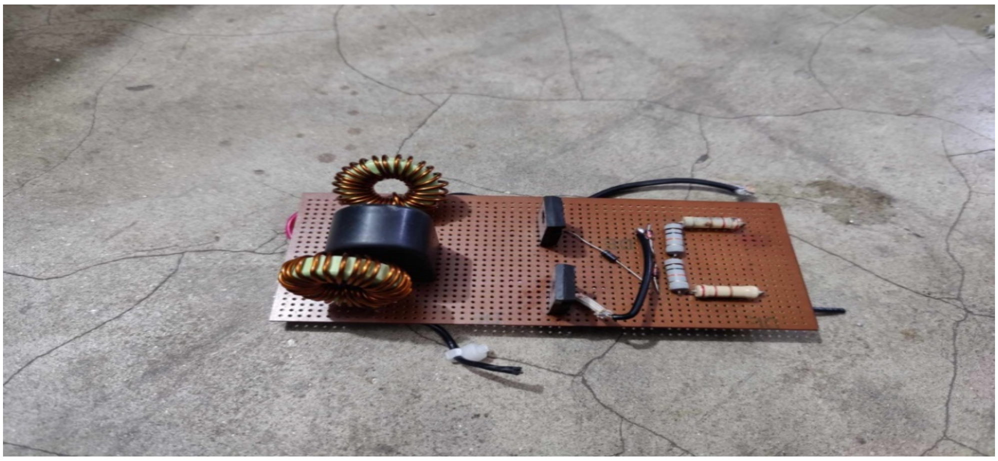
4.1 Description

First Model:



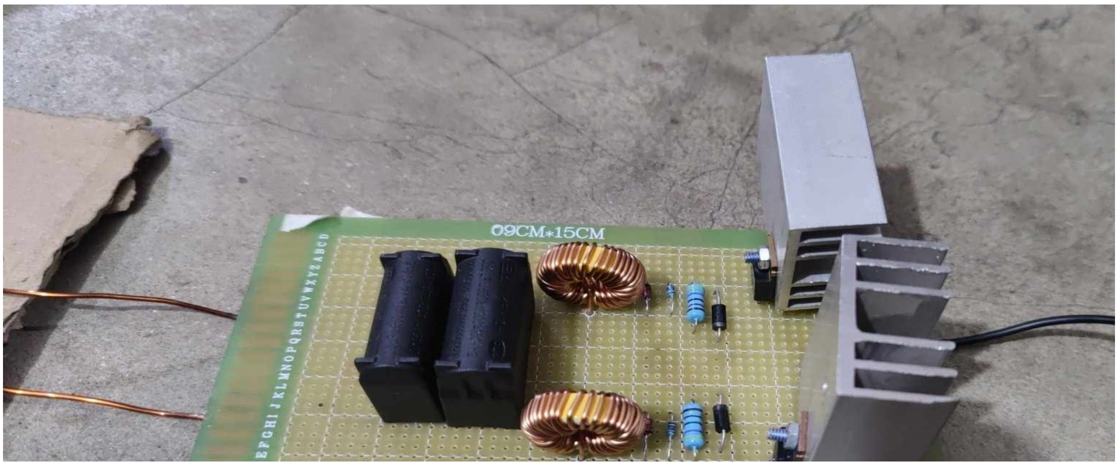
This model didn’t work because the inductance values are too low here. Connecting the circuit with the power source caused a huge spark and it damaged the battery.

Second Model:



Here, we reduced the power of the circuit almost one third times of the previous circuit. This time the power source was okay, but the circuit got damaged due to the higher amount of current. Although we used adequate turns in the inductor core for making it 100uH, it didn’t limit the current because the permeability of the core is very low (u=4). Basically, the inductance wasn’t closer to 100uH.

Third Model:

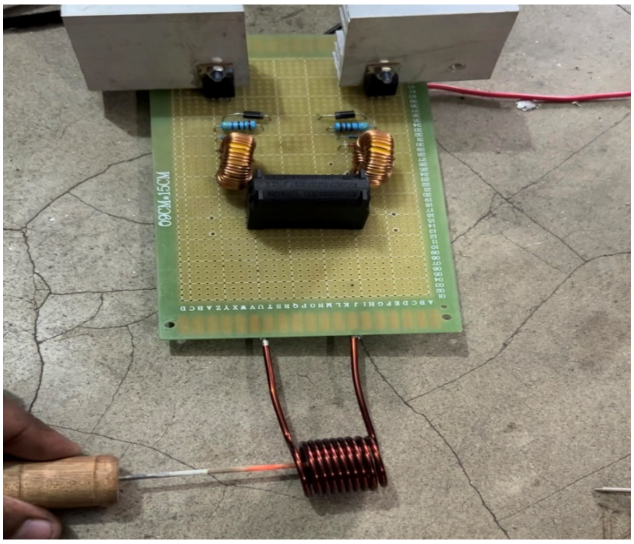


This model worked fine as the inductance values were perfectly matched.

4.2 Experiment and Data Collection

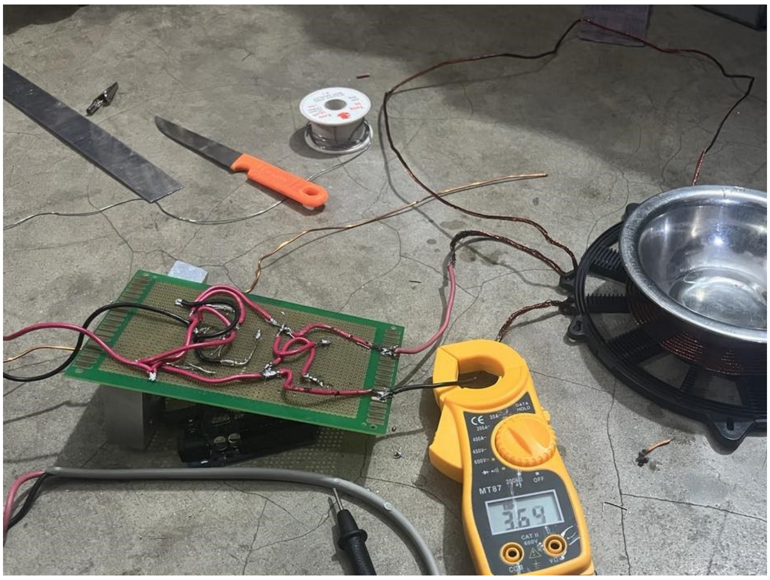
Testing With Different Coils:

- **Cylindrical Coil:**



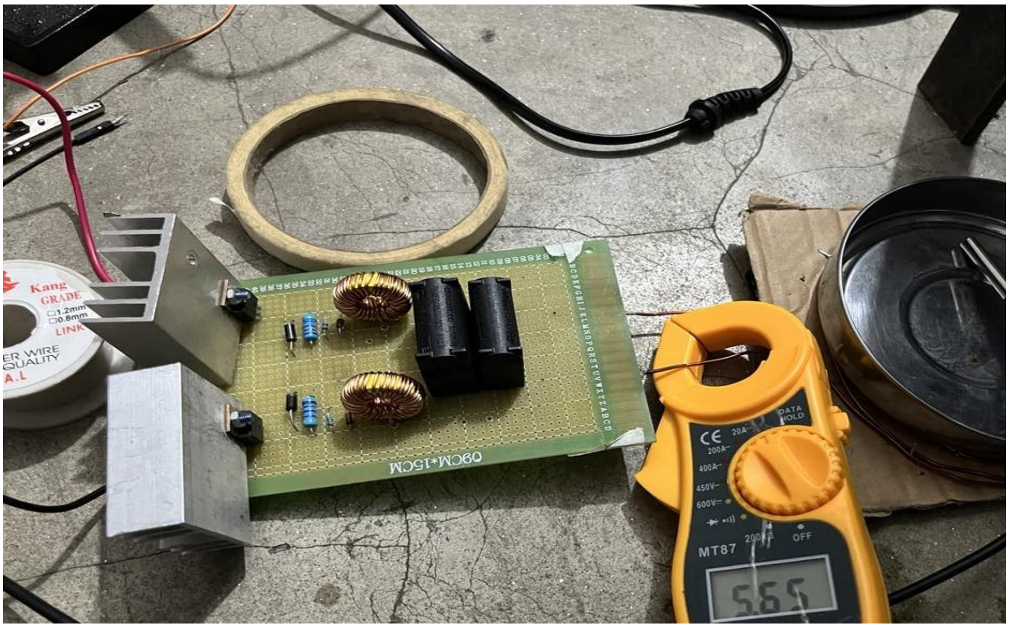
This cylindrical coil made a screw-driver red-hot within 5 seconds.

- **Pancake Coil (High Inductance):**



This coil worked well but the rms current becomes lower if the pancake coil's inductance is too high. Less rms current means less heat and it will take more time for heating up.

- **Pancake Coil (Low Inductance):**



This time we can see that for low inductance pancake coil, rms current is increasing.

Temperature Sensor Data:

This is a sample reading of the temperature where we can see that the temperature is about **83 degree Celsius.**

4.3 Data Analysis

From the experiments, these conclusions are made:

- ❖ Rms output current is inversely related with Pancake / Cylindrical **coil's** inductance.
- ❖ Sensor data showed that temperature goes above 100 degree Celsius without water a**nd with water it ranges between** 70-80 degree Celsius.
- ❖ Connecting more capacitors in parallel increases the frequency. This will create more eddy current losses and more output current.

4.4 Result

This shows the result of our simple induction heating/cooking circuit.

4.5 YouTube Link

https://www.youtube.com/watch?v=W8jnx347hTo

5 Design Analysis and Evaluation

5.1 Novelty

1. Zero-Voltage Switching (ZVS) Control

The central novelty of the project lies in the application of ZVS control technology to induction cookers. Traditional induction cookers suffer from switching losses during the operation of power transistors. In contrast, our ZVS induction cooker minimizes these losses by allowing power switching devices to turn on and off at or near zero voltage. This innovation results in several key advantages:

- ❖ Enhanced Efficiency
- ❖ Reduced Heat Generation

2. Enhanced Reliability and Durability

Our ZVS induction cooker design incorporates robust components and reduced stress on power components due to ZVS operation. This approach leads to:

- ❖ Extended Lifespan
- ❖ Increased Reliability

5.2 Design Considerations (PO(c))

5.2.1 Considerations to public health and safety

When constructing a basic ZVS (Zero-Voltage Switching) induction cooker, it is critical to consider public health and safety. The following are some major concerns that are frequently addressed during the design process:

Electromagnetic Field (EMF):

❖ **Minimizing EMF emissions**: Design the cooker to emit electromagnetic fields (EMFs) within safe limits as defined by electromagnetic compatibility (EMC) standards.

❖ **Shielding and containment:** Incorporate effective shielding within the cooker to contain EMFs and prevent unintended exposure to users and nearby electronic devices

Electrical Security:

❖ **Power supply safety**: To prevent electrical accidents and fires, include robust electrical safety features such as surge protection, short-circuit protection, and ground fault protection.

❖ **Insulation and grounding:** Ensure that the device is appropriately insulated to avoid electric shock dangers, and that suitable grounding is provided to reduce the risk.

❖ **Power supply security:** To prevent electrical accidents and fires, install powerful electrical safety measures such as surge protection, short-circuit protection, and ground fault prevention.

5.2.2 Considerations to environment

These are the environmental consideration we have made throughout our project

❖ **Efficacy in Using Energy:**

Design the cooker to convert electrical energy into heat as effectively as possible to maximize energy efficiency. In addition to saving energy, this lowers the carbon footprint involved with producing power.

❖ **Selection of Materials:**

Materials that are environmentally benign, recyclable, and have little to no negative effects on the environment during manufacture, extraction, and disposal should be used.

5.3 Investigations (PO(d))

5.3.1 Literature Review

Zero Voltage Switching (ZVS) induction heaters have emerged as a compelling topic in recent literature, garnering significant attention due to their potential to revolutionize induction heating technology. The core principle of ZVS induction heating revolves around achieving optimal energy transfer by synchronizing switching events with zero voltage points in the AC waveform. Research in this area has delved into various circuit topologies, control strategies, and applications, aiming to enhance efficiency, reduce power losses, and enable precise temperature control. ZVS induction heaters have been explored in contexts ranging from metal hardening and soldering to materials science and sustainable manufacturing. The current literature previews the ongoing advancements, challenges, and the promise of ZVS induction heaters as a transformative technology with broad-reaching implications for industrial heating processes and energy conservation.

5.3.2 Experiment Design:

Initially, we commenced our project by meticulously assembling the circuit on a prototyping board, carefully incorporating key components such as high-frequency capacitors, MOSFETs, Zener diodes, fast diodes, and resistors. Subsequently, we proceeded to fabricate two distinct types of coils: solenoidal and toroidal. These coils were specifically tailored to suit the unique testing requirements of our induction cooker prototype. To energize our setup, we seamlessly linked our Switched-Mode Power Supply (SMPS) to an alternating current (AC) power source, ensuring it was adequately configured to supply the requisite voltage and current. With the foundational components in place, we seamlessly integrated the induction heating module into our circuit configuration. As the project entered the testing phase, we vigilantly commenced the process of data collection. This entailed the continuous monitoring and recording of crucial parameters including current levels, voltage readings, temperature fluctuations, and power consumption patterns. Through this comprehensive and systematic approach, we were able to evaluate, with precision, the overall performance and energy efficiency of our innovative induction cooker prototype.

5.3.3 Data Analysis and Interpretation:

Based on the experimental findings, several key conclusions have been drawn:

RMS Output Current and Coil Inductance: It has been observed that the root mean square (RMS) output current exhibits an inverse relationship with the inductance of the pancake or cylindrical coil. In simpler terms, as the coil's inductance increases, the RMS output current tends to decrease.

Temperature Variation: Sensor data analysis revealed significant temperature variations during the experiments. Without water, the temperature surpassed 100 degrees Celsius, indicating a risk of overheating. However, when water was present, the temperature ranged between 70-80 degrees Celsius, suggesting that water effectively moderates and controls the temperature within a safer range.

Parallel Capacitors and Frequency: Connecting multiple capacitors in parallel was found to have a direct impact on the frequency of the system. Specifically, as more capacitors were added in parallel, the frequency of the system increased. This increase in frequency resulted in higher eddy current losses and subsequently led to an augmentation in the output current.

In summary, these findings underscore the importance of coil inductance, the role of water in temperature control, and the impact of parallel capacitors on system frequency in the context of the experimental setup. These insights can guide further exploration and refinement of the system for optimized performance and safety.

5.4 Limitations of Tools (PO(e))

Mini ZVS (Zero Voltage Switching) induction cookers, while efficient and compact, have limitations. Their power output is often lower than larger models, which can result in slower cooking times and limited pot size. Compatibility with ferrous cookware is essential, excluding non-magnetic materials. Temperature control can be imprecise, leading to challenges in fine-tuning cooking. The cooking area is constrained by the coil's size, restricting pan options. Additionally, ZVS circuits can produce high-frequency noise and vibrations. Building or repairing these cookers demands technical expertise, and without proper safety features, there's a risk of electrical hazards. Lastly, mini ZVS cookers may lack commercial-grade features and may be less durable.

5.5 Impact Assessment (PO(f))

5.5.1 Assessment of Societal and Cultural Issues

Recognizing the potential for both good and negative outcomes is crucial when evaluating the socioeconomic and cultural concerns connected to the deployment of a ZVS induction cooker project. Positively, the use of ecologically friendly and energy-efficient cooking technologies, such as ZVS induction cookers, may help to minimize energy use and carbon emissions, which is in line with the aims of global sustainability. However, cultural preferences and culinary customs must be taken into account for the effective adoption of such technologies. When designing and promoting ZVS induction cookers, cultural considerations about culinary habits, cooking equipment, and the social value of traditional cooking methods should be taken into account. Concerns around pricing and accessibility must also be addressed in order to guarantee that this invention serves a variety of populations.

5.5.2 Assessment of Health and Safety Issues

The ZVS induction cooker project places a significant emphasis on health and safety considerations. Mitigating risks associated with electromagnetic fields, burn hazards, and electrical safety is paramount. We incorporate robust shielding, automatic shut-off features, and temperature controls to prevent accidents. Adherence to international safety standards, rigorous inspections, and user education are key components of our strategy to ensure user well-being. Our commitment to safety aligns with the project's goal of delivering a reliable and secure cooking technology for users while minimizing potential health and safety issues.

5.5.3 Assessment of Legal Issues

The ZVS induction cooker project necessitates a thorough legal assessment. Compliance with safety standards, patents, consumer protection laws, and environmental regulations is vital. Engaging legal experts ensures adherence to these requirements, mitigating potential legal challenges and ensuring the project's legal soundness while promoting innovation and responsible manufacturing.

5.6 Sustainability and Environmental Impact Evaluation (PO(g))

In the development of our ZVS induction cooker project, a critical aspect is the evaluation of sustainability and environmental impact. We prioritize eco-friendly design elements, such as energy efficiency, recyclable materials, and reduced emissions. Life cycle assessments are conducted to quantify the product's environmental footprint, ensuring its sustainability credentials. Furthermore, our commitment extends to responsible manufacturing and packaging, as we aim to minimize waste and promote a greener cooking solution for a more sustainable future.

5.7 Ethical Issued (PO(h))

In our team of five students collaborating on the ZVS induction cooker project, ethical concerns are paramount. We are committed to safety, striving to design a cooker free from potential hazards. Ethical sourcing of materials, adherence to environmental regulations, and responsible waste management are integral to our project. We prioritize transparent communication with users and respect intellectual property rights. Additionally, our focus includes considering the cultural and accessibility aspects to make our innovation inclusive and beneficial to diverse communities. Ethical responsibility guides our journey in developing the ZVS induction cooker.

6 Reflection on Individual and Team work (PO(i))

Fig : participation of all our group member in the project

6.1 Individual Contribution of Each Member

ID	Contribution
1906001	Worked on 2nd circuit by contributing to Veroboard set up, soldering, coil making, and exploring theoretical aspects of the elements.
1906010	Worked on PCB design part and Simulation with LtSpice and explored the theoretical aspect of resonant converter
1906026	Worked on 3rd circuit set up by contributing to soldering, making toroidal coil, modification of PSpice design and designing PCB, etc
1906031	Worked on 1st circuit set up by contributing circuit set up on Veroboard, debugging simulation in PSpice, collecting data with sensor and multi-meter

6.2 Mode of Team Work

Our team adopts a collaborative and agile approach. We emphasize open communication, regular check-ins, and individual responsibilities. We encourage diverse perspectives and decision-making through consensus. Each member's expertise is valued, and we remain adaptable to changes while focusing on our shared project goals.

6.3 Diversity Statement of Team

As a team of four students, we embrace our unique backgrounds, perspectives, and skills. Our diversity is our strength, driving innovation and creativity in our project. We commit to fostering an inclusive environment, where every voice is valued and heard. Together, we celebrate our differences and leverage them to achieve our project's success.

6.4 Log Book of Project Implementation

Date /week	Milestone achieved	Individual Role	Team Role
6th week	Components are bought		
7th week	First demo circuit was built		
9th week	Fix some error related to the first circuit		
10th week	Second circuit was made		
11th week	Find error in second circuit inductance value		
12th week	3rd circuit was built and we got expected output		

7 Communication (PO(j))

In our team of four students, communication is paramount. We maintain an open, transparent, and proactive channel for sharing ideas and progress. Weekly meetings ensure alignment, while a dedicated messaging platform keeps us connected for quick updates. We value active listening and encourage constructive feedback to ensure our project's success.

7.1 Executive Summary

The ZVS (Zero Voltage Switching) Induction Cooker project represents a breakthrough in energy-efficient cooking technology. This innovation employs advanced electronics to minimize power wastage, offering consumers a highly efficient and eco-friendly cooking solution. Through precise control of induction heating, the ZVS Induction Cooker not only reduces energy consumption but also enhances safety and cooking performance. With its potential to revolutionize the kitchen appliance market, this project is poised to make a significant impact on sustainability and convenience in households worldwide.

Press Release:

Cooking at home just got a whole lot simpler and affordable for everyone with the launch of the Simple DC Induction Cooker. In a world where natural gas shortages and high prices are a concern, this portable kitchen innovation uses electricity to cook efficiently.

This cooker is designed to save you money on energy bills while prioritizing safety. Its straightforward controls make it user-friendly, catering to all skill levels. Built to withstand everyday use and compatible with your existing pots and pans, it's an eco-friendly, cost-effective solution for modern kitchens. Say goodbye to gas troubles and embrace a better way of cooking with the Simple DC Induction Cooker.

7.2 User Manual

Title: User Manual for Custom Induction Cooker

Introduction: Welcome to your customized induction cooker! This user manual will guide you through the safe and efficient operation of your induction cooking setup.

Getting Started:

- **Customize Your Coil:** Ensure your induction coil is designed and built to meet your cooking needs, taking into account factors like size and inductance.

- **Prepare the Cooking Vessel:** Select a compatible cooking vessel made of ferrous materials.

- **Connect the Power Source:** Use a battery or SMPS to power your induction coil, ensuring it provides the necessary voltage and current.

Starting Cooking:

- **Turn on the System:** Activate the power source to start the induction cooking process.

- **Control and Monitor:** If available, use control features to adjust power and temperature settings while monitoring the cooking process.

- **Begin Cooking:** Place your ingredients in the cooking vessel and proceed with your recipe.
- Safety and Shutdown:

- **Safety Measures:** Ensure you have safety features in place to prevent overheating and electrical hazards.

- **Shutdown:** After cooking, turn off the power source and allow the system to cool down before handling or storing it.

Congratulations! You're now ready to enjoy efficient and precise cooking with your customized induction cooker.

8 Project Management and Cost Analysis (PO(k))

8.1 Bill of Materials

Component	Price (Tk)
Capacitor module (330nF) × **2**	120
Toroidal inductor (100 μ***H***) × **2**	140
Resistance (10k)× **2**	70
Resistance (470)× **2**	80
Zener diode (1N4742) × **2**	6
Power diode (FR207) × **2**	6
MOSFET (IRF 540) × **2**	110
Heatsink	40
Veroboard	150
Coil	300
Total	**1022**

8.2 Calculation of Per Unit Cost of Prototype

From the table we can see per unit cost is around 722 tk.

8.3 Calculation of Per Unit Cost of Mass-Produced Unit

Component	Price (tk)
Capacitor module (330nF) × **2**	80
Toroidal inductor (100 μ***H***) × **2**	70
Resistance (10k)× **2**	40
Resistance (470)× **2**	20
Zener diode (1N4742) × **2**	4
Power diode (FR207) × **2**	3
MOSFET (IRF 540) × **2**	60
Heatsink	20
Veroboard	90
Coil	100
Total	**487**

8.4 Timeline of Project Implementation

Week	Milestone Achieved	Duration (days
6	Components are bought	0
7	First demo circuit built	7
9	Fix errors in 1st circuit	14
10	Second circuit built	7
11	Find error in 2nd circuit	7

9 Future Work (PO(l))

The future of ZVS (Zero Voltage Switching) induction cookers lies in increased energy efficiency, smart integration for remote control and automation, advanced control algorithms for precise cooking, and enhanced safety mechanisms with improved hazard detection. These developments promise a more eco-friendly, convenient, and versatile cooking experience

10 References

https://dspace.mit.edu/bitstream/handle/1721.1/100618/932637869-MIT.pdf?sequence=1