

A  
MINI PROJECT REPORT  
ON  
PORTABLE MINI REFRIGERATOR

*Submitted to the DEPARTMENT OF*  
ELECTRICAL & ELECTRONICS ENGINEERING  
*In partial fulfillment of the requirements for the degree of*  
BACHELOR OF TECHNOLOGY  
*In*  
ELECTRICAL & ELECTRONICS ENGINEERING



PRANVEER SINGH INSTITUTE OF  
TECHNOLOGY  
KANPUR - 208020

Dr. APJ ABDUL KALAM TECHNICAL UNIVERSITY

Minor Project Report

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## **CERTIFICATE**

We hereby certify that the work which is being presented in the B.Tech. Project Report entitled “PORTABLE MINI REFRIGERATOR”, in partial fulfillment of the requirements for the award of the Bachelor of Technology in Electrical & Electronics Engineering and submitted to the Department of Electrical & Electronics Engineering of PSIT-Kanpur UP is an authentic record of my own work carried out during the Academic year 2021-22.

The matter presented in this Report has not been submitted by me for the award of any other degree elsewhere.

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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

Date:-

Project Mentor  
Assistant Professor  
(Mr. Deepak Pandey)

Dr. Raghvendra Singh  
(Head of Department)

## **ACKNOWLEDGEMENT**

We would like to express our sincere token of gratitude to Director, Prof. Sanjeev Kumar Bhalla Sir, Head of Department, Dr. Raghvendra Singh Sir for his constant support and motivation for successful compilation of the Project. Special thanks to our Project Mentor, Mr. Deepak Pandey Sir whose deep insights and useful suggestions helped us in preparing the final version of the report. His invaluable guidance helped us to keep our progress on track. Without guidance it would never take shape so we would like to thank Sir. Above all, we are grateful to the Almighty, the author of knowledge and wisdom for his countless blessings bestowed upon us which led to the successful completion of the project.

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## **2.INTRODUCTION**

The term refrigeration refers to the process of removing heat from an enclosed space or substance for the purpose of lowering the temperature. Refrigeration can be considered an artificial, or human-made, cooling method.

Refrigeration refers to the process by which energy, in the form of heat, is removed from a low-temperature medium and transferred to a high-temperature medium. This work of energy transfer is traditionally driven by mechanical means, but can also be driven by heat, magnetism, electricity, laser, or other means. Refrigeration has many applications, including household refrigerators, industrial freezers, cryogenics, and air conditioning. Heat pumps may use the heat output of the refrigeration process, and also may be designed to be reversible, but are otherwise similar to air conditioning units.

In 1758, Benjamin Franklin and John Hadley, professor of chemistry, collaborated on a project investigating the principle of evaporation as a means to rapidly cool an object at Cambridge University, England. They confirmed that the evaporation of highly volatile liquids, such as alcohol and ether, could be used to drive down the temperature of an object past the freezing point of water. They conducted their experiment with the bulb of a mercury thermometer as their object and with a bellows used to quicken the evaporation; they lowered the temperature of the thermometer bulb down to  $-14\text{ }^{\circ}\text{C}$  ( $7\text{ }^{\circ}\text{F}$ ), while the ambient temperature was  $18\text{ }^{\circ}\text{C}$  ( $65\text{ }^{\circ}\text{F}$ ). They noted that soon after they passed the freezing point of water  $0\text{ }^{\circ}\text{C}$  ( $32\text{ }^{\circ}\text{F}$ ), a thin film of ice formed on the surface of the thermometer's bulb and that the ice mass was about a 6.4 mm (1/4 in) thick when they stopped the experiment upon reaching  $-14\text{ }^{\circ}\text{C}$  ( $7\text{ }^{\circ}\text{F}$ ).

In 1820, the English scientist Michael Faraday liquefied ammonia and other gases by using high pressures and low temperatures, and in 1834, an American expatriate to Great Britain, Jacob Perkins, built the first working vapor-compression refrigeration system in the world. It was a closed-cycle that could operate continuously, as he described in his patent.

## **2.1 OBJECTIVE**

Focused on designing and fabricates a mini DC Portable Refrigerator which is powered by battery which can be useful application in outdoor activities such as: -

- Picnics
- Sports
- Vehicles

In this proposed work, the main aim is to develop a refrigeration system with a capacity of 4L of cooling chamber. It is necessary to design a system capable of maintaining the temperature of the materials between 3 °C to 23 °C.

Thermoelectric cooling uses the Peltier effect to create a heat flux between the junction of two different types of material. A Peltier cooler, heater or thermoelectric heat pump is a solid-state active heat pump which transfer heat from one side of the device to the other, with consumption of electrical energy, depending on the direction of the current assembly.

### **Principle**

It works on the principle of Peltier effect.

**PELTIER EFFECT:-** The Peltier effect is the phenomenon that a potential difference applied across the thermocouple causes the temperature difference between the junctions of the different materials in the thermocouple.

The hot junction can be placed outside of an insulated area and the cold junction can be placed inside the region.

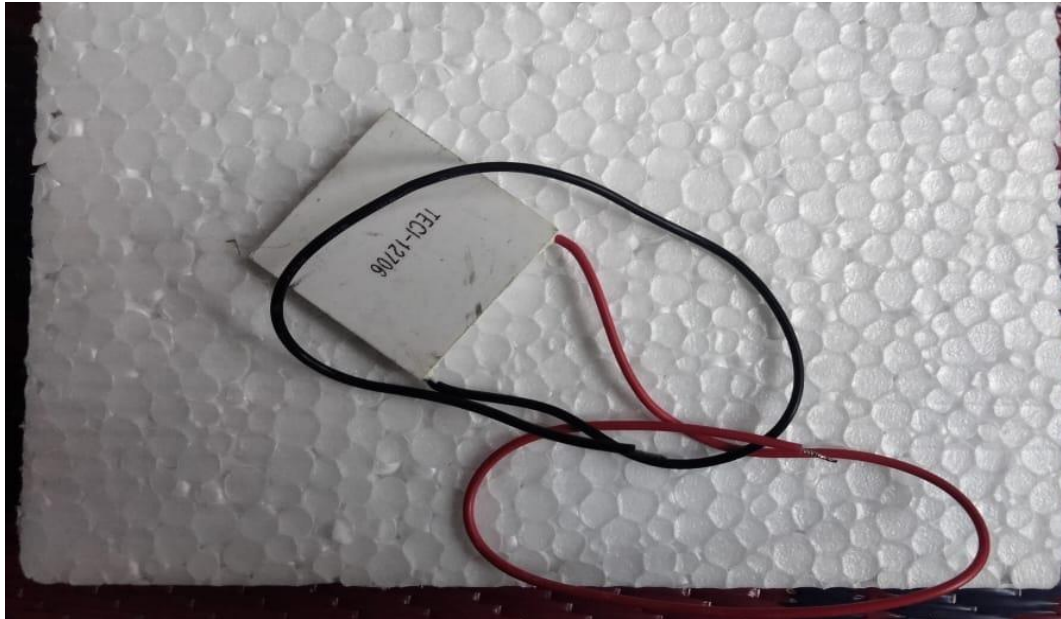
The Peltier effect can be use to cool the region.



### **3.MATERIALS REQUIRED**

#### **3.1PELTIER MODULE**

Peltier modules are solid state heat pumps that operates on the Peltier effect. Heat pump is a thermodynamic system which transfers heat from low temperature body and gives out the same to high temperature body.



A voltage is applied across joined conductors to create an electric current. When the current flows through the junctions of the two conductors, heat is removed at one junction and cooling occurs. Heat is deposited at the other junction. The main application of the Peltier effect is cooling.

The Peltier effect, mini refrigerator operates according to the Peltier effect. The effect creates a temperature difference by transferring heat between two electrical junctions. A voltage is applied across joined conductors to create an electric current.

#### **Advantages of Peltier Module**

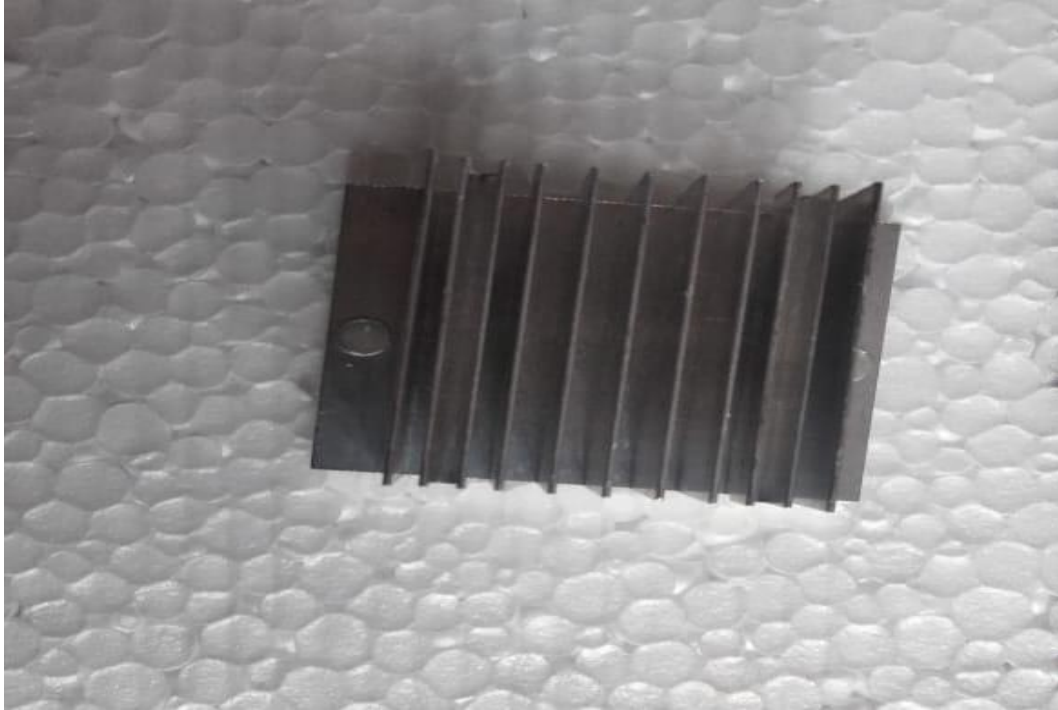
- 1) It does not have any moving parts. So, it is noise-free and environment-friendly.
- 2) Peltier module is small and light in weight. So, you can easily adjust it in any electronic equipment.
- 3) It is exceptionally reliable in quality and performance. Thus it helps to deliver a precise temperature.

- 4) The solid-state of the Peltier module makes it very durable. So it has got a very long life expectancy of more than 5 years in normal condition.

### **Disadvantages of Peltier Module**

- 1) It cannot provide a temperature below 10°C. Besides, it will also not deliver very high temperatures.
- 2) You will not be able to use it in AC voltage. This is because Peltier modules operate at a low voltage (around 12 volts). Similarly, the alternating nature of the voltage causes the Peltier module to operate in opposite direction. The continuous variation in the heating and cooling action will cause the module to rupture quickly.
- 3) The hot and cold sides are very close to each other. Thus, it causes difficulty in transferring heat energy from one side to another. So, due to this, an extra fan is needed for temperature control.

### **3.2 HEAT SINK**



#### **What is a heat sink?**

A heat sink is a piece of metal that sits on top of a computer chip such as a CPU and draws power away from components by letting it rise through a series of fins.

By themselves, heat sinks are passive, meaning they have no moving parts. In most cases, however, the heatsink is combined with a fan that blows the hot air away or a liquid cooling solution that carries the heat halfway through the pipes.

#### **What is the purpose of a heat sink?**

A CPU is prone to overheating because some of its components product heat. Without the heatsink, the heat generated by the components stay in your CPU, which will burn or fry it.

Because most components are made of electronic chips, they absorb heat easily. If they receive too much heat, they become damaged and, therefore, useless, posing a risk to the functionality of high-performance computers.

How does a heat sink work?

A heat sink moves heat away from a component in four basic steps:

The source generates heat: This source is any system that creates heat and requires it to be removed to function.

Heat transfers away from the source: Heat moves into the heat sink and away from the source via natural conduction, which is directly impacted by the heat sink material's thermal conductivity. This is made possible due to high-thermal conductivity materials such as copper and aluminum in the heat sink.

Heat distributes throughout the heat sinks: Heat naturally travels throughout the heat sink via natural conduction, moving across the thermal gradient from a high-temperature to a low-temperature environment. This means that heat sinks will usually be hotter towards the source and cooler towards the sink's extremities.

Heat moves away from the heat sink: This process relies on the heat sink's temperature gradient and its working fluid--most commonly air or a non-electrically-conductive liquid.

The working fluid passes across the surface of the warm heat sink, using thermal diffusion and convection to move heat away from the surface and into the surrounding environment.

This relies on a temperature gradient, so no convection and subsequent heat removal will occur if the surrounding temperature is not cooler than the heat sink.

The total surface area of the heat sink becomes beneficial, as a large surface area provides an increased area for thermal diffusion and convection to occur.

### 3.3 HEAT SINK FAN



Sometimes the heat sink itself becomes hot during the heat transfer, so to overcome this problem a device called Heat Sink Fan is used.

The fan inside your walk-in freezer blows warmer air onto the evaporator coils, allowing heat to be absorbed by the refrigerant running through them. The refrigerant is then returned to the compressor to complete the cycle.

So these fans are attached over the fins of the heat sink and it cools down the heat produced in the heat sink.

Many older refrigerators and most small refrigerators (like small bar and dorm refrigerators) do not have fans, but most modern **frost-free** refrigerators have two. One is under the refrigerator to cool the compressor and force air through the exterior coils. The second is

inside and moves air around the coils inside the refrigerator. This second fan helps provide more even cooling, and also aids in the defrost process.

### **3.4 TEMPERATURE INDICATOR**

The temperature indicator is a device that is used to know about the temperature inside the chamber of refrigerator.

It has a probe which is inserted inside the chamber of refrigerators and the probe senses the temperature inside and gives the temperature data to the output display



Temperature sensors work by providing readings via electrical signals. Sensors are composed of two metals that generate an electrical voltage or resistance when a temperature change occurs by measuring the voltage across the diode terminals. When the voltage increases, the temperature also increases

### 3.5 THERMOCOL



Thermal casing is made up of thermocol and is used for keeping cool inside and to store the storage beverages and food stuffing's in the mini refrigerator. Thermocol is an insulator. So, it will helps to cool inside the mini refrigerator.

### **3.6 12V POWER SUPPLY**

A power supply is an electrical device that supplies electrical energy to electrical load. The primary function of a power supply is to convert one form of energy into another form.

Here we are using 12V power supply because it reduces the 220V AC input in to 12V AC output. Because we are using all components which are working with 12V if current.



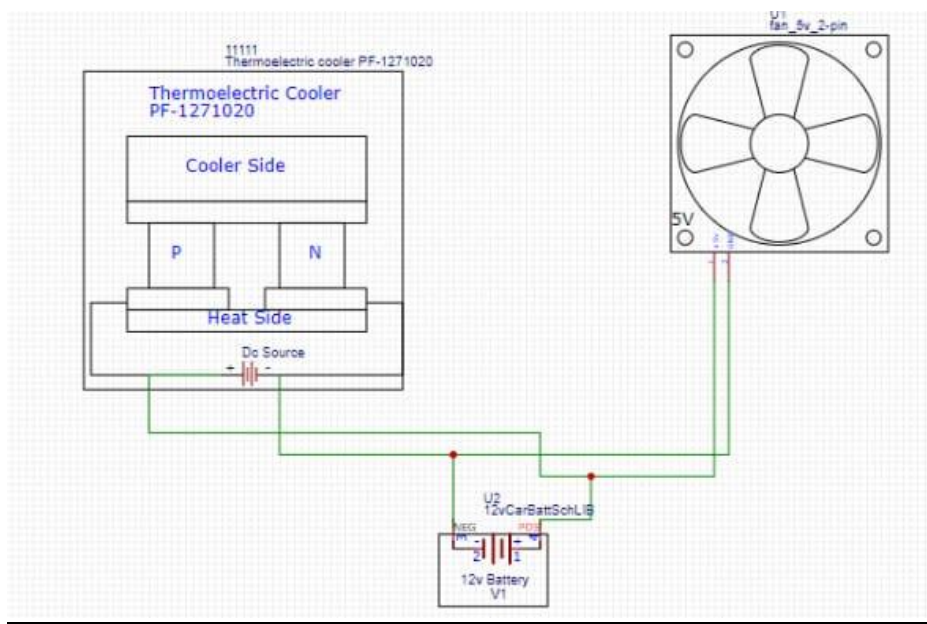


## **4.WORKING & CONSTRUCTION**

### **4.1 WORKING**

Here the mini refrigerator works on the principle of Peltier effect. We are using the thermocol casing on all sides.

### **DIAGRAM**



Because thermocol is a good conductor of heat, so it absorbs some heat coming from outside. We are placing heat sink and heat sink fan on the top of the mini refrigerator. When the heat comes inside the heat sink transfers the heat by any device into the coolant fluid in motion. Sometimes the heat sink itself becomes hot during the heat transfer, then the heat sink fan is

used for the removal of the induced heat in the heat sink. So these fans are attached over the fins of the heat sink and it cools down the heat. Then the area inside the refrigerator must becomes cool.

## **4.2 CONSTRUCTION**

Firstly, a box of thermocol is made of dimensions and then inside the box we will arrange the small fan which is coming inside the box and then the Peltier module will be arranged on the top of the small fan with hot side must be the upper side. On the top of the Peltier Module we can arrange heat sink fan which absorbs heat from the heat sink. Now all the connections must be done carefully then we input of 220V to power supply by using strong wires. After that only two wires will come outside from the box. These are the wires which we want to connect with the power supply in the output places which gives of 12V AC output.

## **FINAL PROJECT**



## **5. ADVANTAGES**

- 1) Refrigeration slows bacterial growth. Bacteria exist everywhere in nature. They are in the soil, air, water, and the foods we eat. When they have nutrients (food), moisture, and favorable temperatures, they grow rapidly, increasing in numbers to the point where some types of bacteria can cause illness.
- 2) These are eco-friendly refrigerators. No Chloro Fluoro Carbons.
- 3) These are light in weight.
- 4) Give fast temperature response.
- 5) It is portable, small in size.
- 6) Have no vibrations
- 7) Creates no noise.

## **6. FUTURE SCOPE**

- 1) High capacity Mini Refrigerator at Commercial Areas such as medical and hospitality sector to store drugs, drinks, and food items.
- 2) Demand in Medical sector, hospitality sector and modern offices.
- 3) Retro and colorful designs.
- 4) Increase Tourism and Hospitality Sector.
- 5) Demand for Cold Storage in Commercial Vehicles.
- 6) Due to its design, it is more popular for the camping trips and outdoor recreational activities.

## **7. COST & ESTIMATION**

<b>Components used</b>	<b>Cost</b>
Peltier Module	467
Heat Sink	199
Heat Sink Fan	99
Temperature Indicator	186
Themocol	60
12V Power Supply	699
Chart + Glaze Paper	30

<b>TOTAL</b>	1,740
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## **8. CONCLUSION**

This is completely eco-friendly project multipurpose and portable. As the cooling unit are of small size, silent contains no liquids or gases, have no moving parts and have a long life. The coefficient of performance of this refrigerator is much smaller than that of a conventional compressor -type refrigerator when the required cooling capacity is high. We have been successful in designing a system that fulfils the proposed goals. However we do realize the limitations of this system. The present design can be used only for light heat load to lower its temperature to a particular temperature. The system is unable to handle fluctuations in load.

Extensive modifications need to be incorporated before it can be released for efficient field use.

## **9. REFERENCE**

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