**ACKNOWLEDGEMENT**

I would like to express my gratitude to my teacher, [Teacher’s Name], for their invaluable guidance and support in completing this assignment. I would also like to thank my family and friends for their encouragement and help throughout the process. Without their assistance, this project would not have been possible.

**INTRODUCTION**

An AC generator, also known as an alternator, is a device that converts mechanical energy into electrical energy using the principle of electromagnetic induction. This assignment focuses on understanding how an AC generator works and how to build a simple one using basic materials.

**THEORY**

**How Electromagnetic Induction Works**

Electromagnetic induction is the process by which a changing magnetic field induces an electric current in a conductor. The phenomenon was discovered by Michael Faraday in 1831. According to Faraday’s Law of Induction, an electromotive force (EMF) is generated when there is a change in magnetic flux through a coil of wire. The greater the rate of change, the higher the induced current.

In an AC generator, a coil of wire is rotated in a magnetic field, causing the magnetic flux through the coil to change continuously. This variation in flux induces a current in the wire, producing alternating current (AC). The direction of the current changes periodically, which is why it’s called "alternating current."

**HISTORY**

**The History of AC Generators**

The concept of generating electricity from motion dates back to the early 19th century. In 1831, Michael Faraday demonstrated the principle of electromagnetic induction, which laid the foundation for AC generators. He showed that electricity could be generated by moving a magnet through a coil of wire.

In the late 19th century, Nikola Tesla developed the first practical AC generator, revolutionizing the way electricity was produced and distributed. Unlike direct current (DC), which was promoted by Thomas Edison, alternating current (AC) could be transmitted over long distances with less power loss, leading to its widespread adoption.

Today, AC generators are used in power plants, wind turbines, and various industrial applications, providing electricity for millions of homes and businesses.

**AIM**

To construct a simple three-phase AC generator at home using basic materials and to understand the basic principles behind its operation, including the concept of electromagnetic induction.

**MATERIALS REQUIRED**

* Thick copper wire (1m)
* Winding wire (21 gauge, 20m)
* PVC pipe (diameter 6 inches, length 12 inches)
* 2 Ball bearings
* Wooden planks / thick cardboard
* Plastic pegs
* 12 Volt UPS battery (high current)
* Crocodile clips
* Carbon brushes
* Slip rings
* Connecting wires
* Potentiometer
* Multimeter
* Bulb and holder

**PROCEDURE**

 **Prepare the Base and Stator**

* Cut a sturdy wooden plank to serve as the base of the generator. This base will hold the PVC pipe (stator) and the wooden shaft (rotor).
* Fix the PVC pipe (6 inches in diameter, 12 inches long) onto the wooden base using pegs or screws. This pipe will act as the stator. Ensure the pipe is securely fastened so that it doesn’t move during rotation.
* Attach 6 plastic pegs on each side of the pipe, with a 60-degree separation between each peg. These pegs will serve as winding points for the coil.

 **Wind the Stator Coils**

* Using the 21-gauge winding wire, wrap the wire between the pegs on the PVC pipe, along its length. Wind three separate coils with equal spacing. Ensure each coil has around 6–8 turns, and all coils are evenly wound and compact for efficient electromagnetic induction.
* After winding each coil, strip off about 1-2 cm of insulation from both ends of each wire for electrical connections. These coils will act as the stator windings.

 **Prepare the Rotor (Main Coil)**

* Cut a piece of thick copper wire (1 meter) and bend it into the shape of a rectangle. This rectangular copper loop will serve as the rotor coil.
* Attach the copper loop to a wooden shaft, which will help support the loop and make it easier to rotate. The shaft should be long enough to allow the loop to rotate inside the stator coils without touching them.

 **Mount the Rotor**

* Build two wooden beams on either side of the stator to support the wooden shaft. The beams should be tall enough to hold the shaft above the PVC pipe stator.
* Insert ball bearings in the middle of the beams to allow smooth rotation of the wooden shaft. Place the wooden shaft through the bearings, ensuring that the rectangular copper loop can rotate freely within the PVC pipe stator.

 **Install Slip Rings and Carbon Brushes**

* Attach slip rings to the ends of the wooden shaft to enable the transmission of the current generated by the rotating coil. The slip rings will rotate with the shaft, while stationary carbon brushes will maintain electrical contact with the slip rings.
* Connect the ends of the copper wire loop (the rotor coil) to the slip rings, ensuring a firm electrical connection.

 **Connect the Rotor Coil to the UPS Battery**

* Connect the ends of the rectangular copper loop (the rotor coil) to the 12V UPS battery using crocodile clips. This connection will supply current to the copper loop, turning it into an electromagnet. The battery will energize the rotor, allowing it to create a magnetic field as it rotates.
* Ensure the connections are secure so that the rotor becomes a strong electromagnet when the battery is connected.
* The slip rings will still be attached to the shaft, but their primary role here will be to allow the rotation of the shaft without disrupting the electrical connection from the battery to the rotor coil.

 **Testing the Generator**

* Once all connections are made, manually rotate the wooden shaft, causing the rectangular copper loop to rotate inside the PVC pipe stator. As the rotor turns, electromagnetic induction will generate alternating current (AC) in the stator coils.
* Use the multimeter to measure the voltage and adjust the potentiometer to control the output. Observe how the bulb lights up as the generator produces electricity.

**OBSERVATIONS**

1. When the UPS battery is connected to the rectangular copper loop (rotor), the loop becomes an electromagnet, creating a magnetic field.
2. As the rotor is manually rotated, the changing magnetic field induces alternating current (AC) in the stator coils wound on the PVC pipe.
3. The multimeter displays a varying voltage output, depending on the speed of rotation of the rotor. A faster rotation generates a higher voltage.
4. When connected to a load (such as a bulb), the bulb lights up as the rotor spins, confirming the generation of electricity.
5. The brightness of the bulb increases with the speed of rotation and the strength of the induced current.

**RESULT**

A simple three-phase AC generator was successfully constructed using the principle of electromagnetic induction. By manually rotating the electromagnet (rectangular copper loop) inside the stator (PVC pipe with wound coils), an alternating current was generated. The multimeter recorded voltage output, and the bulb connected to the stator coils lit up, demonstrating successful power generation.

**PRECAUTIONS**

1. Ensure the rotor is properly connected to the UPS battery to maintain a strong magnetic field.
2. Handle the copper wires carefully when stripping insulation to avoid cutting the wires or damaging the connections.
3. Make sure the ball bearings on the shaft allow smooth and stable rotation to minimize friction and energy loss.
4. Avoid overloading the circuit by keeping the voltage and current within the limits of the connected components (multimeter, bulbs, etc.).
5. Rotate the rotor consistently to maintain a steady voltage output and prevent abrupt changes in current.
6. Ensure all electrical connections are secure to avoid power loss or short circuits.

**CONCLUSION**

This project demonstrated the working principles of a three-phase AC generator using electromagnetic induction. By converting mechanical energy into electrical energy, the generator produced alternating current. The connection of the UPS battery to the rotor coil created an electromagnet, allowing the induced current to light up a bulb and produce measurable voltage.