# PHYSICS INVESTIGATORY PROJECT

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| Name | - | Aditya Singh |
| Class and Section | - | XII – A |
| Roll No. | - | 4 |
| School | - | Jaipuria Vidyalaya |

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# ***Certificate***

This is to certify that **Aditya Singh**, a student of class **XII-A** has successfully completed the project under the guidance of **Mr. Nitin Khabrani** (Physics Teacher) During the academic year 2016-17 in partial fulfillment of chemistry practical examination conducted by CBSE, New Delhi.

*Signature of external examiner* *Signature of chemistry teacher*

# ***Acknowledgement***

It would my utmost pleasure to express my sincere thanks to my physics teacher **MR. NITIN KHABRANI** in providing a helping hand in this project.

His valuable guidance and support and supervision all through this project are responsible for attaining its present form.

# ***Introduction***

***A.C. Generator*** means Alternating current generator. It is a device which is used **to convert mechanical energy into electrical energy.**

A.C. generator forces electric current to flow through an external circuit. The source of mechanical energy may be a reciprocating or turbine steam engine, water falling through a turbine or waterwheel, an internal combustion engine, a wind turbine, a hand crank, compressed air ,or any other source of mechanical energy.

# ***Principle of A.C. Generator***

It is based on the **principle of electro magnetic induction**, i.e., whenever amount of magnetic flux linked with a coil changes, an e.m.f. is induced in the coil. The direction of current induced is given by Fleming's right hand rule.

# ***Construction of A.C. generator***

The A.C. Generator is consist of four main parts :

**(1) THE COIL (ARMATURE) :**

A rectangular coil ABCD consist of a large number of turns of copper bound over a soft iron core is called armature. The soft iron core is used to increase the magnetic flux.

**(2) MAGNETIC FIELD :**

It is usually a permanent sponge magnet having concave poles. The armature is rotated of a magnet so that axis of the armature is perpendicular to magnetic field lines.

**(3) <u>SLIP RINGS :</u>**

Slip rings are the magnetic rings which are connected in the terminal of the armature. These rings are rotated with the coil and these are use to draw the current from the generator.

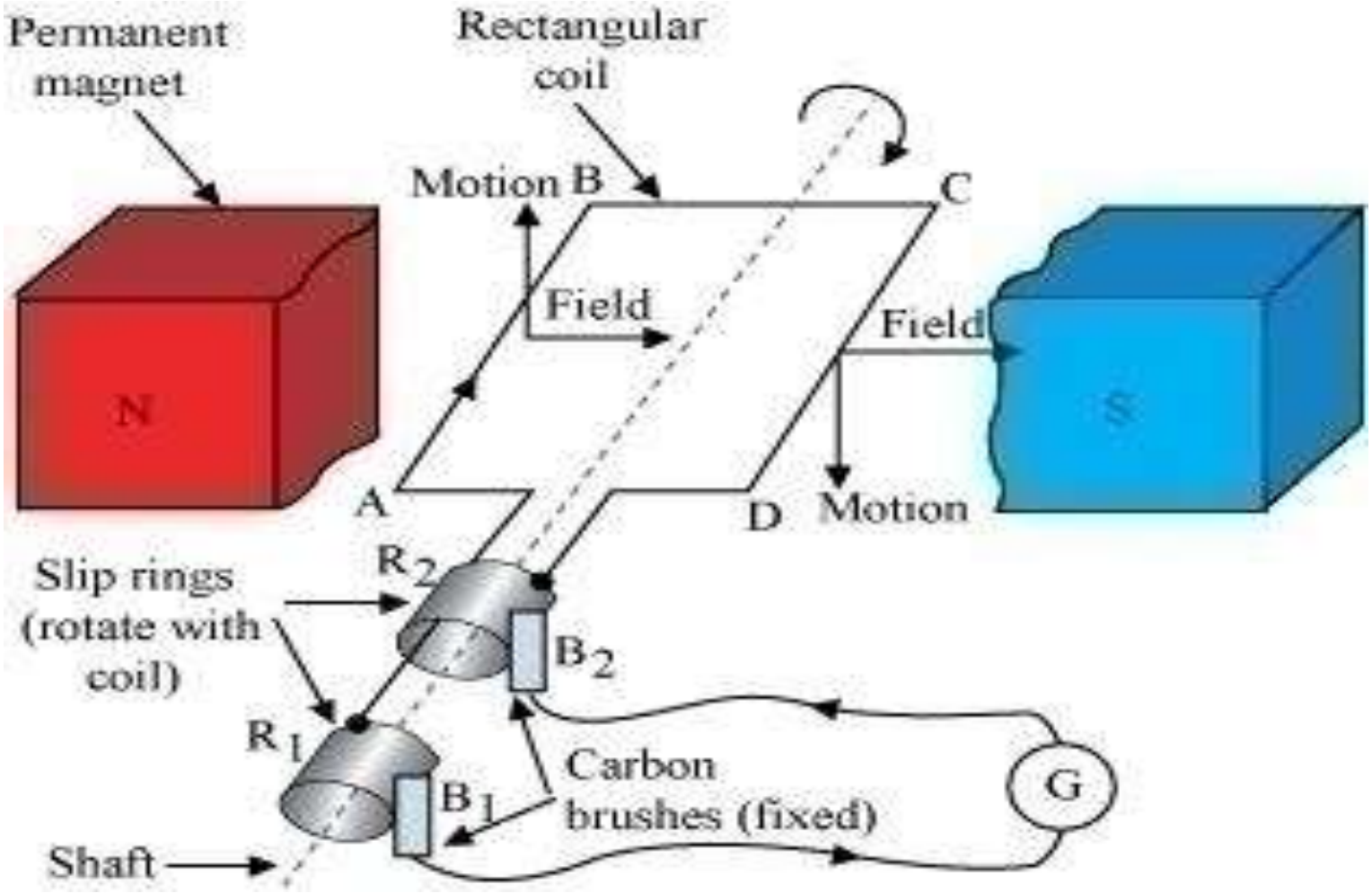
**(4) <u>BRUSHES :</u>**

The brushes $B_1$ & $B_2$ are just touch the slip rings. They are not rotating with the coil and these brushes leads to the output of load resistance.

# ***Theory***

1. The strong magnetic field is produced by a current flow through the field coil of the rotor.
2. The field coil in the rotor receives excitation through the use of slip rings and brushes.
3. Two brushes are spring-held in contact with the slip rings to provide the continuous connection between the field coil and external circuit.
4. The armature is contained within the windings of the stator and is connected to the output.
5. Each time the rotor makes one complete revolution, one complete cycle of AC is developed.
6. A generator has many turns of wire wound into the slots of the rotor.
7. The magnitude of AC voltage generated by an AC generator is dependent on the field strength and speed of the rotor.
8. Most generators are operated at a constant speed; therefore, the generated voltage depends on field excitation, or strength.

# Circuit Diagram



# ***Working of an A.C. Generator***

The coil is rotated in anti-clock wise direction. In the first half rotation the arm AB is moving outward and CD is moving inward. So the e.m.f. is induced in the arm AB from A to B. And in the arm CD from C to D. After half rotation (in the second half). The arm CD is moving outward and AB is moving inward. In this time current is induced in arm CD from D to C. And in arm AB from B to A. In the second half rotation the current direction is changing so in this generator AC is produced.

# ***Expression for Instaneous e.m.f. produced***

Let position of the coil at any time t. It's make angle $\theta$ with vertical. If w is uniform angular speed
of the coil.

Then $\theta = \omega t$

B be the strength of magnetic field n be the number of turns in the coil and A area of the coil then magnetic flux with the coil in this position is given by :

$$\Phi = nBA\cos\theta = nBA\cos\omega t.$$

differentiate w.r.t. time :-

$$\frac{d\emptyset}{dt}=\mathrm{nBA}\frac{d\cos(\omega t)}{dx}$$

$$\frac{d\emptyset}{dt}=\mathrm{nBA}-\sin(\omega t)\omega$$

$$\frac{d\emptyset}{dt}=-\mathrm{nBA}\,\omega\,\sin(\omega t)\omega$$

$$\varepsilon=-\frac{d\emptyset}{dt}=-(-\mathrm{nBA}\,\omega\,\sin(\omega t)\omega)$$

Maximum value of e.m.f. say so $\boldsymbol{\varepsilon}^{\circ}$

$$\varepsilon=\varepsilon^{\circ}\sin(\omega t)$$

# Result :-

Hence, maximum value of instantaneous e.m.f. in a AC Generator is given by

$$\varepsilon = \varepsilon^{\circ} \sin(\omega t)$$

# ***Applications of A.C. Generator***

1. Aircraft auxiliary power generation, wind generators, high speed gas turbine generators.
2. Hybrid electric vehicle (HEV) drive systems, automotive starter generators.
3. An ac generator, or 'alternator', is used to produce ac voltages for transmission via the grid system or, locally, as portable generators.
4. All of our household appliances runs on ac current.
   Ex: Refrigerator, washing machines, oven, lights, fan etc.
5. The main advantage of AC is ease of power distribution. It is more efficient to use high voltage to distribute power, but it is not safe to have high voltage at home. It is easy to step up (and step down) AC voltage using a transformer.

# ***Bibliography***

- ***CBSE Lab manual***
- ***Help of Physics Teacher***
- ***NCERT Textbook***
- ***Websites:-***

***www.google.com***
***www.wikipedia.com***