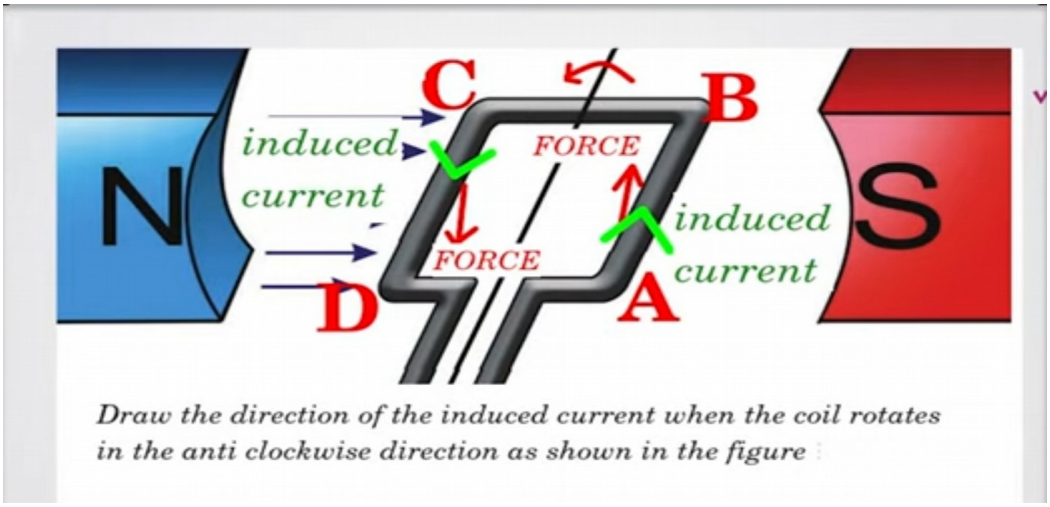
UNIT 3

Electromagnetic Induction

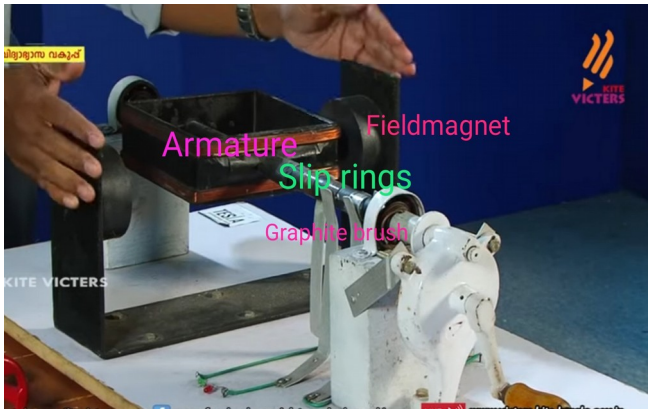
03/09/2020 – Class 19

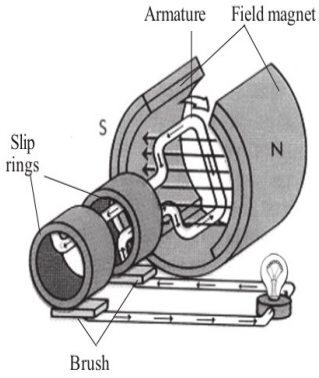
Assignment Answer

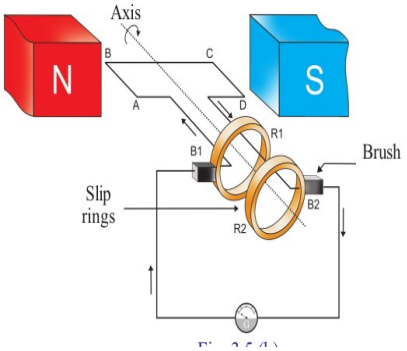


Activity 1

Observe the working model and picture of an AC Generator.







Discussion

- What is a generator? **Generator is a device that converts mechanical energy into electrical energy by making use of electromagnetic induction.**
- What is the energy change taking place in a generator? **Mechanical energy to electrical energy**
- What are the main components needed for the production of electricity using electromagnetic induction? **A magnet and a coil.**
- What are the main parts of an AC generator? **Field magnet, Armature, Slip rings, brushes.**
- Which part of the generator creates magnetic flux? **Field magnet**
- Which is the rectangular coil in the generator? **Armature**
- How armature is made? **By wound an insulated copper wire on a soft iron core.**
- Electricity produced in the armature of a generator, reaches the external circuit through which parts? **Slip rings and brushes**

Inference

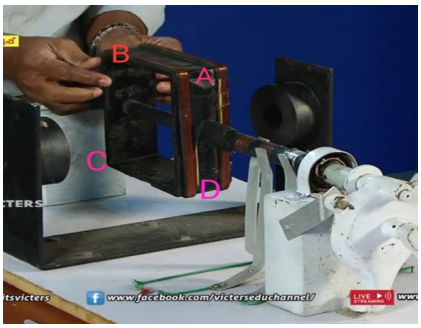
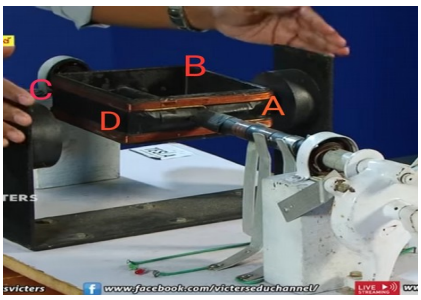
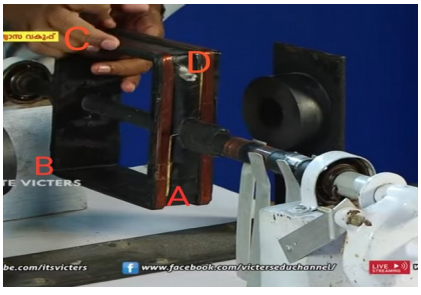
Generator is a device that converts mechanical energy into electrical energy by making use of electromagnetic induction.

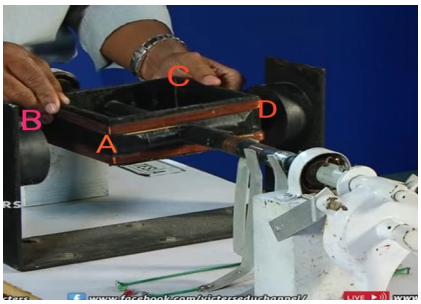
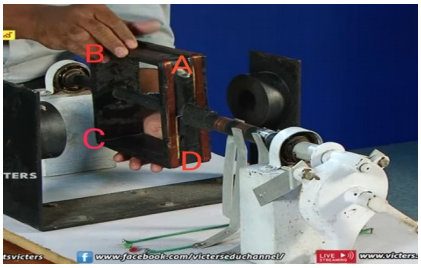
Parts of an AC Generator

- **Field Magnet**- The magnet that creates magnetic flux in the generator
- **Armature**- An arrangement of insulated conducting wire wound on a soft iron core. This can be made to rotate about an axis.
- **Slip Rings**- Metal rings which are welded together with the armature coil. They rotate along with the armature on the same axis of rotation as the armature
- **Brushes** -They are arrangements which always make contact with the slip rings. Current flows through them to the external circuits.

Activity 2

The various stages of rotation of an armature coil while completing one rotation in a magnetic field and the graph of the emf produced by the coil are shown.

Stage	Position of the armature	Induced emf
	Armature is in 0^0. Plane of the armature is perpendicular to the magnetic field line.	Since there is no change in the magnetic flux linked with the armature coil, the induced emf and current is zero.
	When armature turned 90^0. Plane of the armature is parallel to the magnetic field lines.	Induced emf and current in the armature coil is maximum. The rate of change of magnetic flux linked with the coil is maximum.
	When armature turned 180^0. Plane of the armature is perpendicular to the magnetic field lines.	Since there is no change in the magnetic flux linked with the armature coil, the induced emf and current is zero.

	When armature turned 270^0. Plane of the armature is parallel to the magnetic field lines.	Induced emf and current in the armature coil is maximum in the opposite direction. The rate of change of magnetic flux linked with the coil is maximum.
	When armature turned 360^0. Plane of the armature is perpendicular to the magnetic field lines.	Since there is no change in the magnetic flux linked with the armature coil, the induced emf and current is zero.

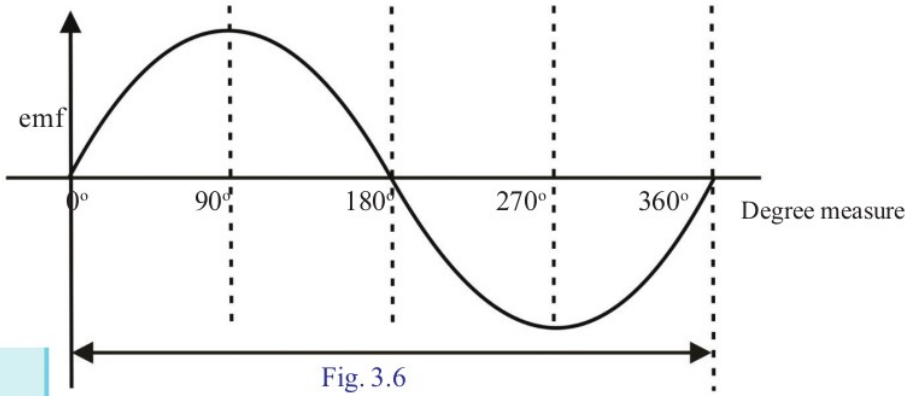


Fig. 3.6

Discussion

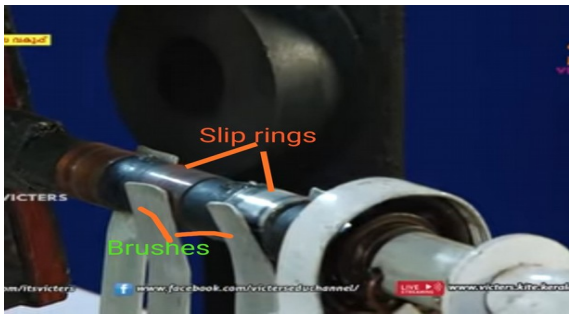
- Which stages of rotation of the armature, the induced emf produced is maximum? **When the plane of the armature is parallel to the magnetic field lines. (when the armature turned 90^0, and 270^0)**
- Which stages of rotation of the armature, the induced emf produced is minimum? **When the plane of the armature is perpendicular to the magnetic field lines. (when the armature turned 0^0, 180^0, and 360^0)**
- Is the magnitude of current produced in the armature is constant? **No, increasing and decreasing.**
- In the first half cycle of the rotation of armature coil the side AB moves in which direction? **Downwards.**
- In the second half cycle of the rotation of armature coil the side AB moves in which direction? **Upwards.**
- What is the difference between the emf produced in the armature coil during the first and second half cycle? **The direction of emf is changes after the first half cycle.**
- Why the direction of induced emf in the armature coil is changed after every half rotation? **The direction of motion of the armature is changing.**
- For producing one cycle of an AC, the armature turned how many degrees? **360^0**
- The direction of current is changing in how many times during one cycle of an AC? **Two**
- The number of cycles formed in one second is called.....? **Frequency of AC.**

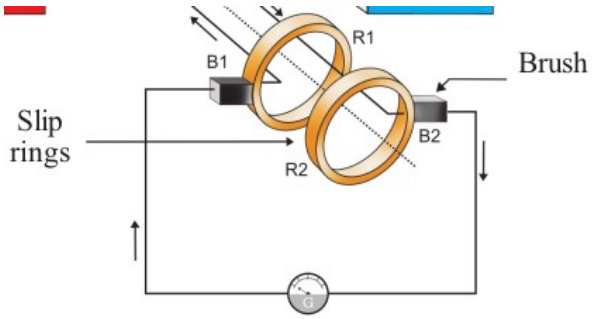
Inference

- The direction of current produced in an AC generator, reverses during every half rotation of the armature and the magnitude of current is increasing and decreasing.
- In an AC generator, the induced emf generated in the first half rotation in one direction and that generated in the second half rotation in the opposite direction together form the cycle of AC
- The number of cycles per second is the frequency of AC.

Activity 3

How the electricity produced in the armature coil reaches the outer circuit?
Observe the slip rings and brushes in the AC generator.





Discussion

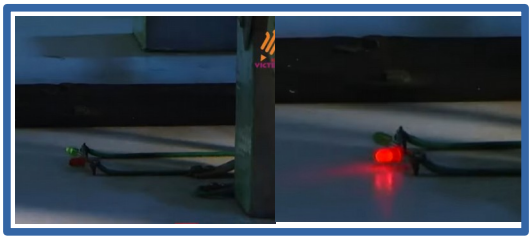
- The ends of the armature coil is welded together with..... part of the generator? **Slip rings.**
- When the armature rotates, what happened to the slip rings? **It also rotates along with the armature on the same axis of rotation.**
- How brushes are arranged in an AC generator? **They are in contact with the slip rings**.
- Does the brushes rotates along with the slip rings? **No**
- Electricity produced in the armature coil reaches the external circuit through which parts of an AC generator? **Through the slip rings and brushes.**

Inference

Current produced in the armature of an AC generator, reaches the outer circuit through the slip rings and brushes,

Activity 4

Workes the model of an AC generator. Two LED bulbs (which allows electricity to pass through only in one direction) are connected parallel to each other in the out put of the generator.



Observation

Two LED bulbs are glowing alternately.

Discussion

- Why the bulbs are glowing alternately? **The direction of current in the outer circuit is changing continuously.**

Inference

The out put of an AC generator is Alternating Current (AC)

Activity 5

Discussion

- What is the frequency of AC reaches in our home? **50 Hz**
- When 50 Hz AC is used, how many times will the direction of current change in the circuit? **100**
- For producing an AC of 50 Hz, the armature of a generator rotates how many times in one second? **50 times**
- Practically, is it possible to rotates the armature 50 times in one second? **No**
- How this problem is solved in the generator? **By increasing the number of armature coils and number of pole pieces of field magnet.**

Inference

In order to overcome practical difficulties, the number of rotations is reduced by increasing the number of armature coils and the number of pole pieces of the field magnet in a generator.

Activity 6

Discussion

- The slip rings of an AC generator is in contact with which part? **Brushes**
- When armature rotates, due to the rubbing of slip rings and brushes what happens? **Produces spark.**
- The armature or field magnet is heavier in a generator? **Armature**.
- Which is easy to rotate, armature or field magnet? **Field magnet**
- How these practical difficulties are solved in an AC generator? **Rotates the field magnet and make armature stationary.**
- The rotating part of a generator is called? **Rotor (Field magnet)**
- The stationary part of a generator is called? **Stator (Armature)**

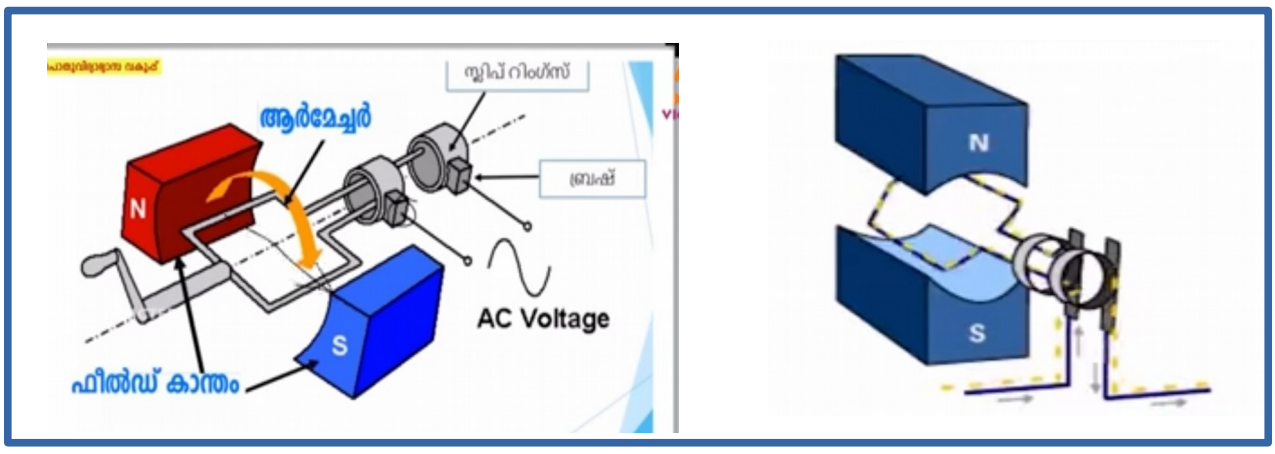
Inference

Why, the field magnet is used as rotor and armature is used as stator in a generator?

- To eliminate the use of slip rings and brushes and there by avoid sparking.
- Field magnet is lighter than armature. So it is easy to rotate.

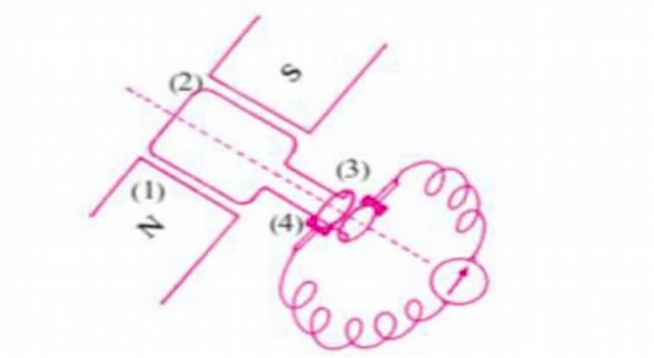
Activity 7

Watch the animation of the working of an AC generator.



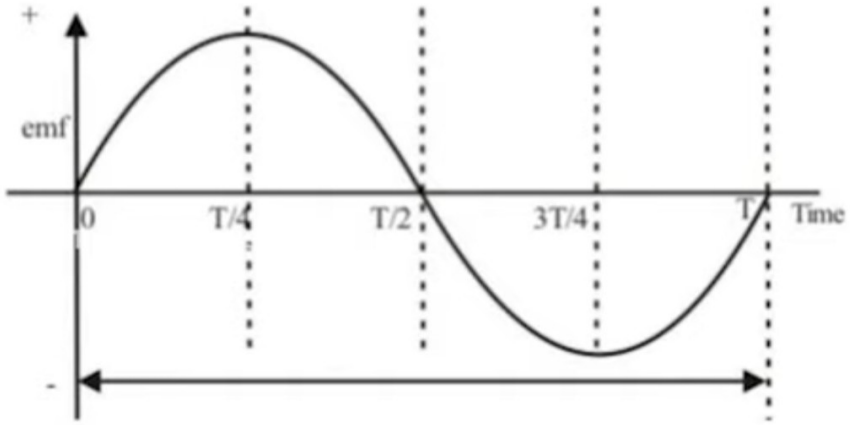
Assignment

1)



a) Write down the names of parts numbered?
b) State the working principle of this device?

2) Analyse the graph and find out the instances at which the emf is maximum and minimum?



3) Complete the given table, based on the above graph?

	Time				
	0	**T/4**	**T/2**	**¾ T**	**T**
Angle of rotation of the armature.	0^0	90^0	180^0	270^0	360^0
Rate of change of flux.	0	maximum	0	.....	.....
Induced emf in volts V.	0	maximum	0	.....	.....