RAMA UNIVERSITY

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FACULTY OF ENGINEERING & TECHNOLOGY

Electrical Machine-1

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Faradays Law of Electro-magnetic Induction

Faraday's first Law

- Any change in the magnetic field of a coil of wire will cause an emf to be induced in the coil. This emf induced is called induced emf and if the conductor circuit is closed, the current will also circulate through the circuit and this current is called induced current.

Faraday's Second Law

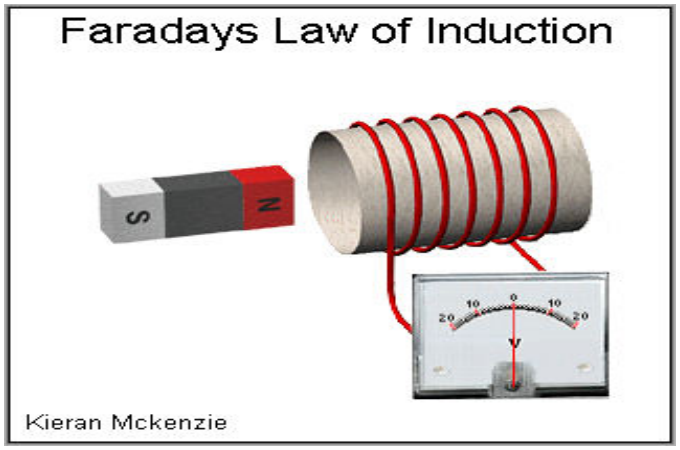
- It states that the magnitude of emf induced in the coil is equal to the rate of change of flux that linkages with the coil. The flux linkage of the coil is the product of the number of turns in the coil and flux associated with the coil.
- According to Faraday's law of electromagnetic induction, the rate of change of flux linkage is equal to induced emf.

$$E = N\frac{d\phi}{dt}$$

LENZ'S LAW

- The direction of induced emf is given by Lenz's law.
- According to this law, the induced emf will be acting in such a way so as to oppose the very cause of production of it .

e = -N (dØ/dt) volts

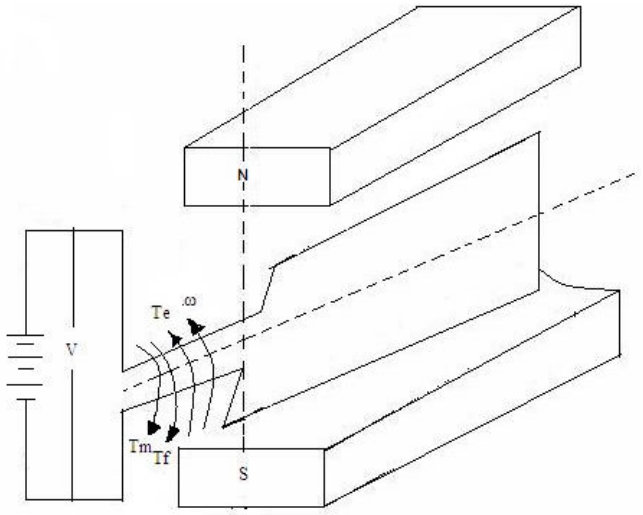


Motor Action

Fig. shows a coil placed in a constant stationary magnetic field. the resistance R is removed and in place of this a battery is connected across the coil.

Now the current 'i' will start flowing through the coil. the current carrying conductor produces a magnetic field Fr

- The field Fr tries to come in line with the main field Fm.
- Thus an electromagnetic torque Te is developed in the coil is anticlockwise direction. therefore coil start rotating in anticlockwise direction say at an angular speed 'ω' rad/sec
- Now again the second action start, when the coil moves in the magnetic field, flux is cut by the conductors and hence an emf is induced in them.
- The direction of this induced emf will be opposing the cause due to which the emf is induced.
- Thus the induced emf will be opposing the supply voltage v and the current in the coil will flow due to the difference between v and e. if r is the resistance of the coil.
- Then applied voltage V = e + ir
- Multiplying both side by 'i' in equation we get
- $Vi = e.i + i^2r$
- Here Vi = electrical power input to the machine
- e.i. = electrical power available for conversion into mechanical power
- I2r = power lost due to resistance of the coil.



Principle operation of Generator

Whenever a conductor is moved within a magnetic field in such a way that the conductor cuts across magnetic lines of flux, voltage is generated in the conductor.

The amount of voltage generated depends on:

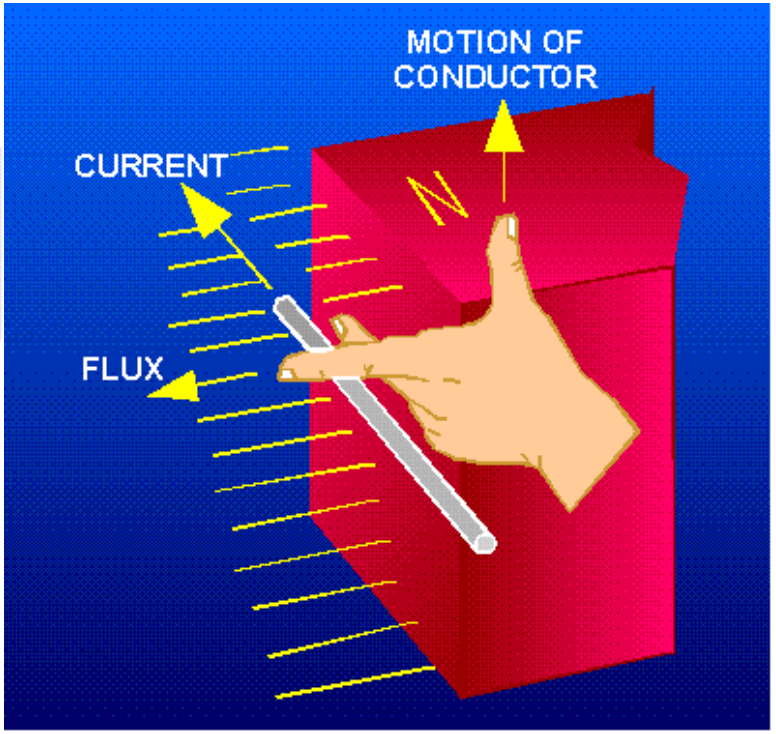
i. the strength of the magnetic field,

ii. the angle at which the conductor cuts the magnetic field,

iii. the speed at which the conductor is moved, and

iv. the length of the conductor within the magnetic field

- The polarity of the voltage depends on the direction of the magnetic lines of flux and the direction of movement of the conductor.
- To determine the direction of current in a given situation, the Left-hand Rule for Generators Is used.
  - thumb in the direction the conductor is being moved
  - forefinger in the direction of magnetic flux (from north to south)
  - middle finger will then point in the direction of current flow in an external circuit to which the voltage is applied



Left Hand Rules