Electromagnetic Induction

- The generation of a current by a changing magnetic field is electromagnetic induction.

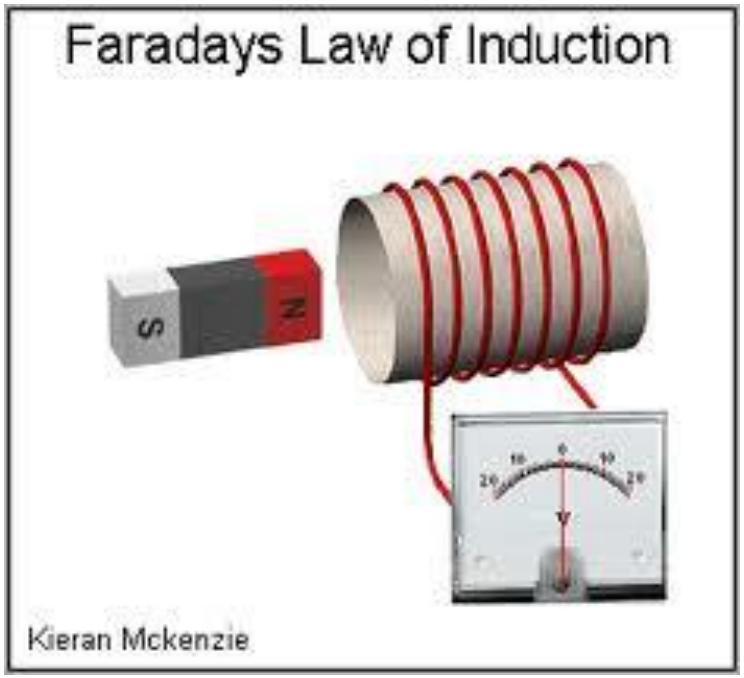
  - wire cuts across magnetic lines of force

  - a magnet is moved in & out of coils of wire.

- Key: Motion within the magnetic field & magnetic lines of force are cut.

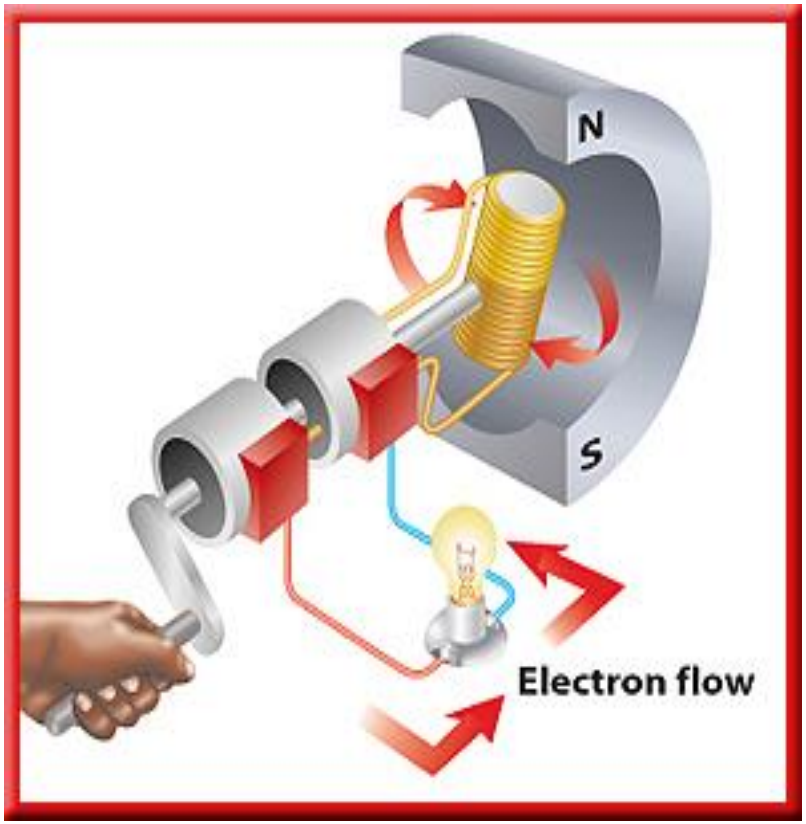
Faraday's Law

The induced voltage in a coil is ~ # loops & rate at which the magnetic field changes within those loops.



Generators

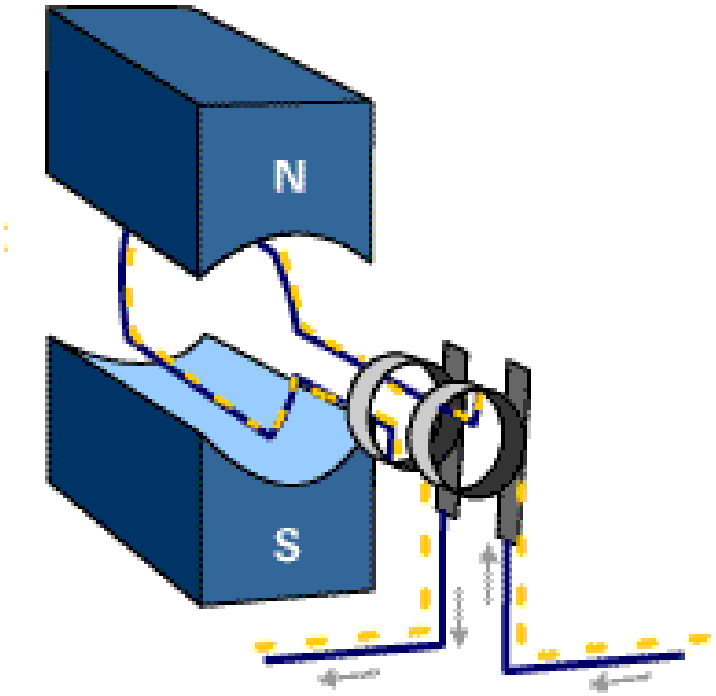
- A generator uses electromagnetic induction to transform mechanical energy into electrical energy.



Generators

- Parts: loop of wire, U-shaped magnet and power source.

- Mechanics:
  - Power source rotates loop of wire
  - Wire cuts magnetic lines of force
  - Current is produced (AC)

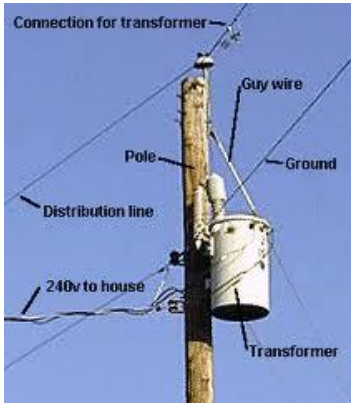


Uses of Generators

- Power plants - The rotating magnets are connected to a **turbine** - a large wheel that rotates when pushed by water, wind, or steam.
- Alternator
- Gas generator

Transformers

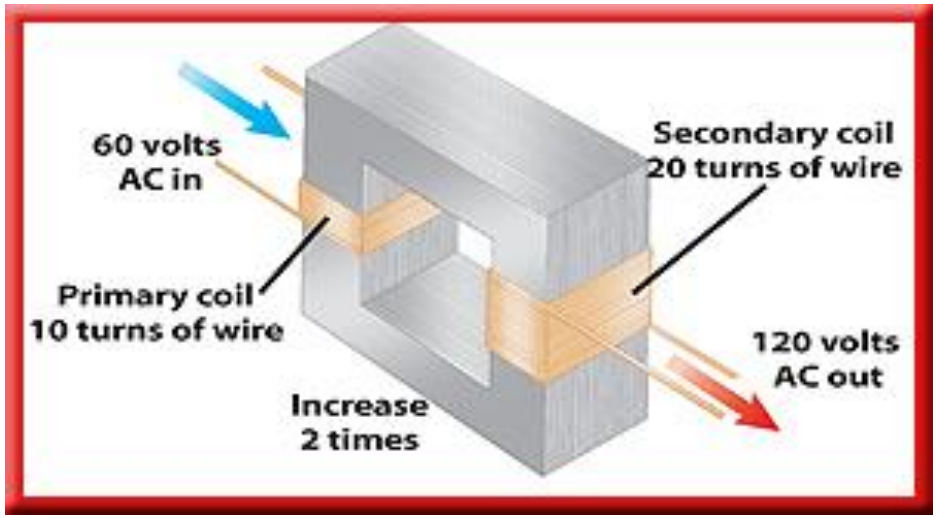
- A transformer is a device that increases or decreases the voltage of an alternating current.
- Combines electromagnetism & electromagnetic induction.



- Operates on the principle that a current in one coil (primary) induces a current in another coil (secondary).

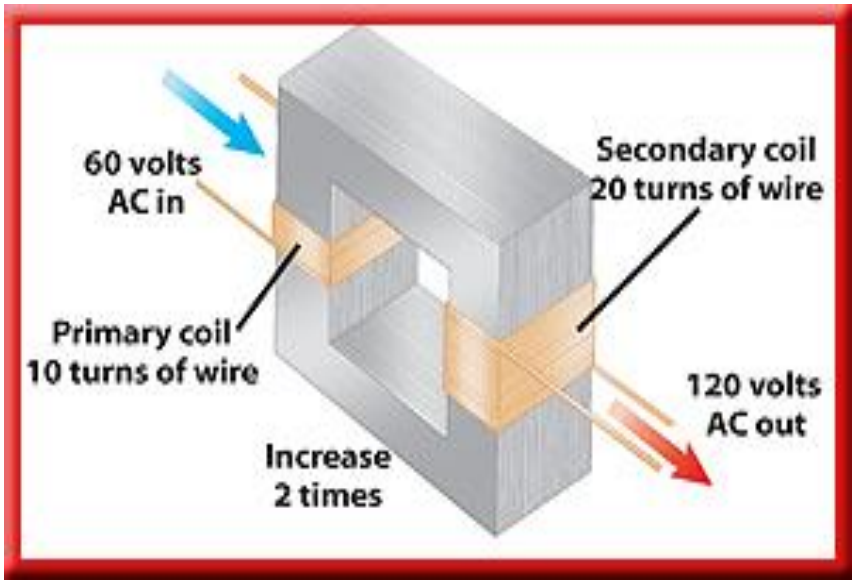
Transformers

- Parts: 2 coils wrapped around same iron core.
- Mechanics:
  - Primary coil creates magnetic field (input V).
  - Secondary coil – current induced due to electromagnetic induction (output V).



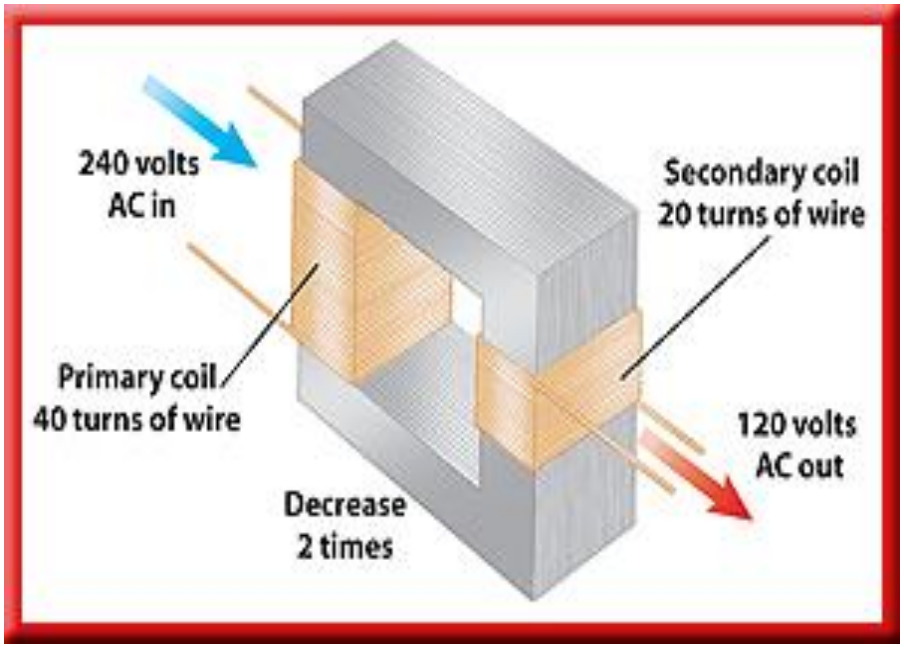
Step-Up Transformers

- A transformer that increases the voltage so that the output voltage is greater than the input voltage.
- The number of wire turns on the secondary coil is greater than the number of turns on the primary coil.



Step-Down Transformer

- A transformer that <u>decreases</u> the <u>voltage</u> so that the output voltage is less than the input voltage.
- the number of wire turns on the secondary coil is less than the number of turns on the primary coil.



Transformer Math

- The relationship between primary & secondary voltages with respect to the # of turns is

$$\frac{\text{Primary voltage}}{\text{\# of primary turns}} = \frac{\text{Secondary voltages}}{\text{\# of secondary turns}}$$

Power Transmission

- This figure shows how step-up and step-down transformers are used in transmitting electrical energy from power plants to your home.