**L 29 Electricity and Magnetism [6]**

- Review - magnetism
- Faraday’s Law of Electromagnetic Induction
  - induced currents
  - electric generator
  - eddy currents

**Laws of Magnetism**

- If you pass current through a loop of wire, you get a magnet ➔ Oersted’s discovery
- Basic laws of magnetism
  - Electric currents produce magnetic fields (Ampere)
  - Magnetic field lines are always closed loops
- Permanent magnets: the currents are atomic currents – due to electrons spinning in atoms – these currents are always there
- Electromagnets: the currents flow through wires and require a power source, e.g. a battery

**Bar Magnet**

- Magnetic field lines

**Electromagnet**

- Straight wire with current

**Speakers use magnets to make sound**

- The force between the permanent magnet and the voice coil moves the speaker cone

**The electric motor**

- When a current is present in a coil, it experiences a torque and rotates.

**Faraday’s Law of Electromagnetic induction**

- Faraday thought that if currents could produce magnetic fields, magnetic fields should be able to produce currents
- He was correct with one important requirement ➔ the magnetic field must be changing in some way to induce a current
- The phenomenon that a changing magnetic field can induce a current is called electromagnetic induction
Michael Faraday (1791-1867)

- discovered **electromagnetic induction**
- led to the discovery of the generation of electricity
- son of a blacksmith
- had very little formal education – trained to be a bookbinder
- considered one of the greatest scientists of all time
- declined to accept knighthood.
- gave Christmas lectures for kids

The laws of electricity and magnetism

- **law of electricity.**— electric charges produce **electric “fields”**
- **laws of magnetism.**—
  - currents produce magnetic fields
  - magnetic field lines are closed loops
- **Faraday’s law of electromagnetic induction.**— a changing magnetic field can produce a current (**induced currents**)
The transformer

The voltage on the secondary depends on the number of turns on the primary and secondary.

**Step-up** → the secondary has more turns than the primary

**Step-down** → the secondary has less turns than the primary

Eddy currents

- When time varying magnetic fields are around, currents can appear in nearby conductors — these are eddy currents
- An induction stove uses eddy currents to cook food

Only the metal pot gets hot, not the glass pot or the stove.

Floating magnet – induced currents

As the magnet falls, it induces currents in the copper pipe known as eddy currents. These currents produce a magnetic field that opposes that of the falling magnet, so the magnet does not accelerate but descends slowly.