Chapter 24

Magnetism

I. Magnetic Fields

- Magnetic fields are produced by electric charges in motion, i.e. by electric currents.
- Magnetic fields exert forces on other moving electric charges (or currents) as long as the moving charges do not travel in the same (or opposite) direction as the magnetic field that is exerting the force.
- Magnetic fields do not speed up or slow down moving charges, instead, the magnetic field deflects the moving charges.
- The unit of magnetic field in the metric system is the Tesla.

2. Magnets

- A simple bar magnet (or horseshoe magnet) has a single “North” pole and a single “South” pole.
- In a magnet, like poles repel each other and opposite poles attract.
• The magnetic field generated by a magnet is actually generated by the motion of the electrons in the magnet. The electrons spin and orbit around their nuclei in such a way that the magnetic fields they generate line up in the same direction.
• The magnetic field outside a magnet is directed from the North pole toward the South pole of the magnet.

3. **Magnetic Domains**

• The magnetic fields generated by individual atoms may be strong enough that interactions among adjacent atoms cause large clusters of them to line up with one another. These large clusters are called *magnetic domains*. Magnetic domains are still microscopic in size.
• Permanent magnets are made by placing iron materials in strong magnetic field.
4. Magnetic Force on Current-Carrying Wires

- A current-carrying wire experiences a force when in the presence of a magnetic field.
• Electric motors work on this principle. A battery is used to pass an electric current through a coil of wire. The coil of wire is placed in a magnetic field generated by a magnet. This magnetic field produces a force on the coil of wire forcing it to rotate.

5. The Earth’s Magnetic Field

• The Earth is a magnet.
• The earth’s South Magnetic Pole is located near the earth’s north geographic pole, and the earth’s North Magnetic Pole is located near the south geographic pole.
Cosmic rays consist of protons and other subatomic particles. Most of these charged particles are deflected away by the earth’s magnetic field and make up the *Van Allen Radiation Belts*. Sometimes the trapped cosmic rays make it to the atmosphere near the poles and interact with the molecules in the atmosphere there, causing them to glow like a fluorescent lamp!

⇒ Aurora Borealis (northern lights) in the north geographic pole, and
⇒ Aurora Australis (southern lights) in the south geographic pole