SNS COLLEGE OF ALLIED HEALTH SCIENCES- COIMBATORE 35

DEPARTMENT : RADIOGRAPHY AND IMAGNG TECHNOLOGY

SUBJECT : GENERAL PHYSICS, RADIATION PHYSICS AND PHYSICS OF DIAGNOSTIC RADIOLOGY

PAPER : PAPER II (UNIT 5 – PHYSICS OF DIAGNOSTIC RADIOLOGY : X-ray TUBE)

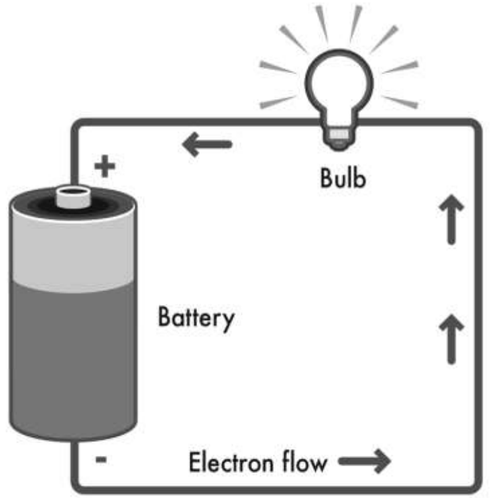
TOPIC : 1. BASIC PHYSICS, UNITS AND APPLICATIONS

BASIC PHYSICS, UNITS AND APPLICATIONS

ELECTRIC CURRENT

- Current is the rate of flow of electric charge in an electric circuit.
- The SI unit of electric charge is the coulomb (C)
- The electric current is defined as the net amount of charge that passes through per unit of time at a specific point.
- **Current = Quantity of Charge / Time**
- **The electrons flow in the opposite direction of the current.**
- The SI unit of the electric current is the ampere.
- One ampere of current represents one coulomb of electrical charge

(6.24×10^{18} charges), moving a specific point in one second.



There are two types of electric current,

- Direct current (DC) and
- Alternating current (AC).
- I (amperes) = Q (coulombs) / t (Seconds)
- One ampere of current represents one coulomb of electrical charge (6.24×10^{18} charges) moving a specific point in one second.

BASIC PHYSICS, UNITS AND APPLICATIONS

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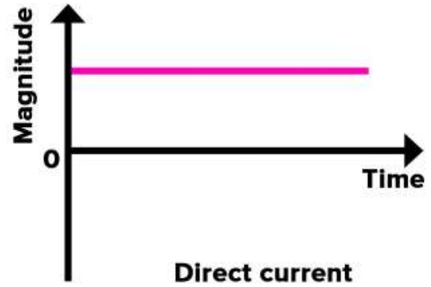


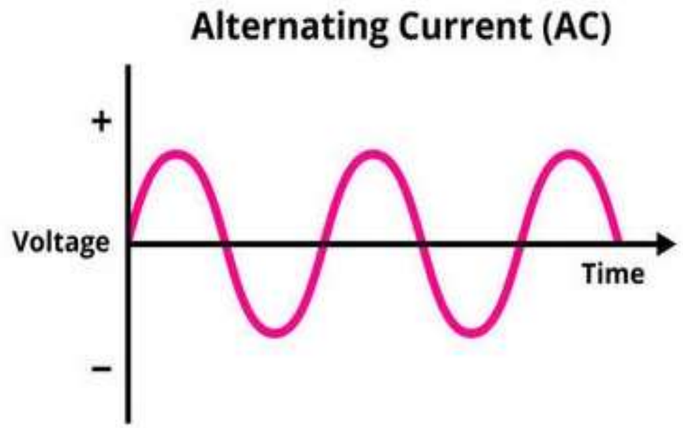
1. DIRECT CURRENT (DC)

- The Direct current is commonly used in power batteries.
- In a battery, the electrons move from the negative toward the positive terminal.
- The potential difference between the terminals of a battery is constant, so it is called direct current. In direct current, the electric charge flows in one direction constantly and does not change the direction.
- The Direct current has a constant magnitude and direction.
- Direct current may be obtained from an alternating current by the rectifier.
- Direct current may be converted into alternating current by inverters.

BASIC PHYSICS, UNITS AND APPLICATIONS

2. ALTERNATING CURRENT (AC)

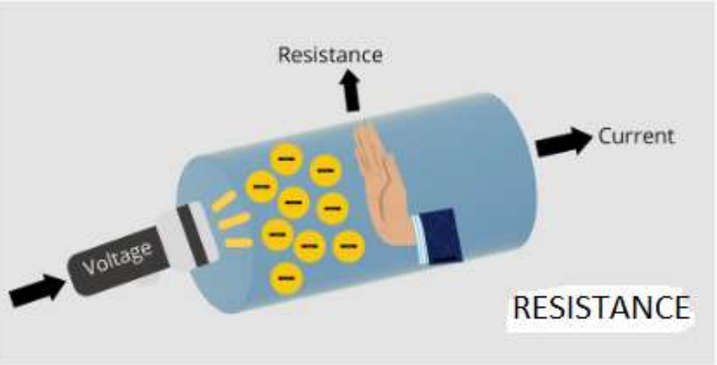
- In alternating current, the electric charge changes the direction after equal intervals of time.
- It has a frequency of 50 Hz at 230V.
- It means that the current changes direction from positive to negative 50 times per second.
- The voltage in AC circuits also periodically reverses because of the current changes direction.
- Therefore the Alternating current continuously changes in magnitude and periodically reverses its direction.
- An alternating current can be identified in a waveform called a sine wave. It is commonly used as electric power for household and heavy machinery.

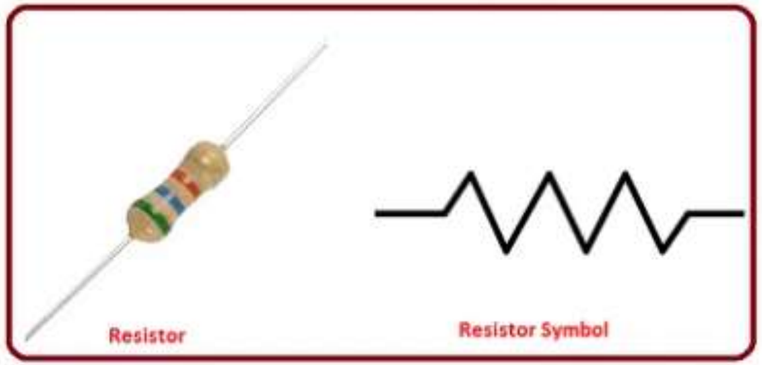


BASIC PHYSICS, UNITS AND APPLICATIONS

RESISTANCE

- The property of a material that restricts the flow of electrons is called resistance.
- It is the property of a conductor to resist the flow of electrons.
- Resistance opposes the flow of electrons through a conductor.
- In the metal, the free electrons move and infrequently collide with atoms of metal.
- By the collisions of free electrons, they lose their energy and produce heat.
- If the resistance is more, less electricity will flow through the circuit.
- The SI unit of resistance is called Ohm. It is represented by the symbol (Ohm).
- One Ohm is the resistance when a voltage of 1 volt is applied with a current of 1 amp Electrical resistance is directly proportional to length (L) and inversely proportional to the cross-sectional area (A) of the conductor.
- **R α p L / A** , p - resistivity
- Materials that have low resistivity conduct electricity proficiently.



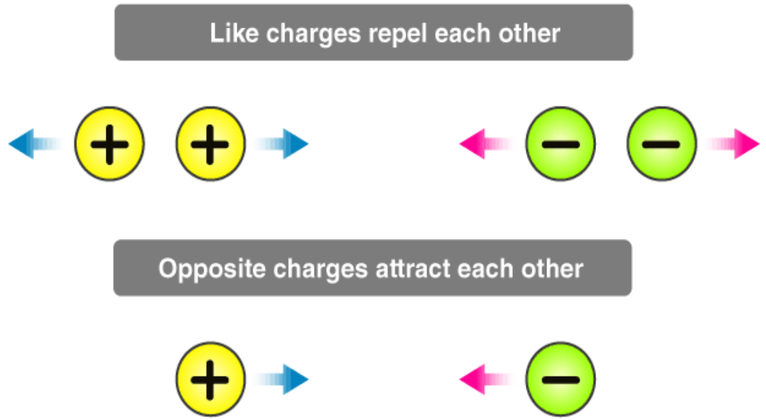


Resistor

BASIC PHYSICS, UNITS AND APPLICATIONS

ELECTRIC CHARGE

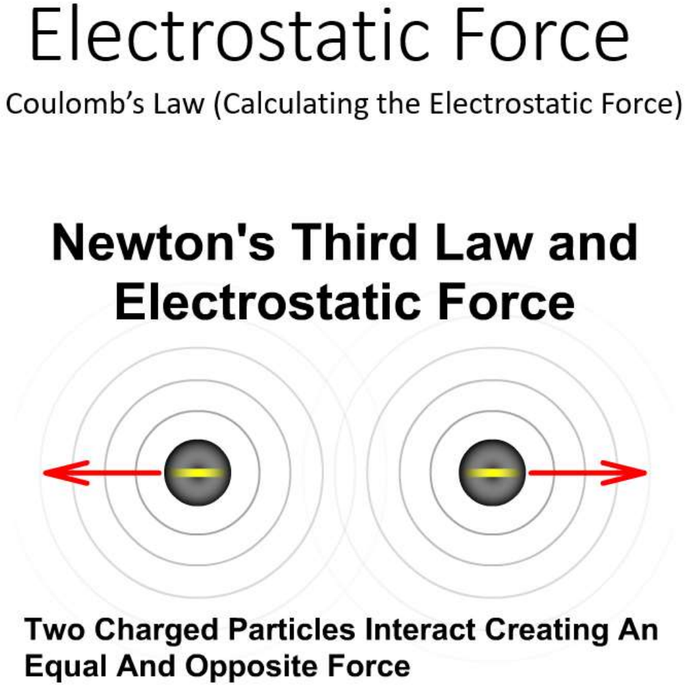
- Elements are made of atoms, every atom contains electrons, protons, and neutrons.
- Generally, an atom contains equal numbers of electrons and protons. When an atom has an imbalance in the number of electrons and protons, it is known as electrically charged.
- Protons are firm inside the nucleus; they are not as free as electrons.
- If an atom has more electrons than protons is said to negative charge.
- The symbol for electric charge is q. and the SI unit is Coulomb (C).
- One coulomb is the amount of charge that flows through a cross-section of a conductor by one ampere of current in one second of time.
- There are ($1.602176634 \times 10^{-19}$ C) electrons in a one-coulomb charge.



BASIC PHYSICS, UNITS AND APPLICATIONS

ELECTROSTATICS

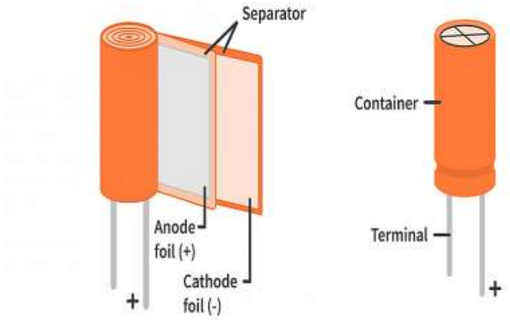
- Electrostatics is the study of forces between charges.
- When the electric charges are at rest, these electrically charged particles attract or repel each other.
- The force of attraction or repulsion between two charged particles is known as the electrostatic force.
- In electrostatics, like charges repel, and opposite charges attract.
- The laws of electrostatics were discovered by the French physicist, coulomb is known as coulomb's law of electrostatics.



BASIC PHYSICS, UNITS AND APPLICATIONS

CAPACITOR

- It is an electronic component that stores electric charge.
- The capacitor is made of two-conductor plates that are separated by an insulator or dielectric material.
- The dielectric material can be made of mica, ceramic, or glass.
- The plates accumulate electric charge when connected to the power source.
- One plate accumulates a positive charge, and the other plate accumulates a negative charge.
- Whenever power is required, it can instantly release the power. Capacitors can be connected in series or in parallel in a circuit.



BASIC PHYSICS, UNITS AND APPLICATIONS

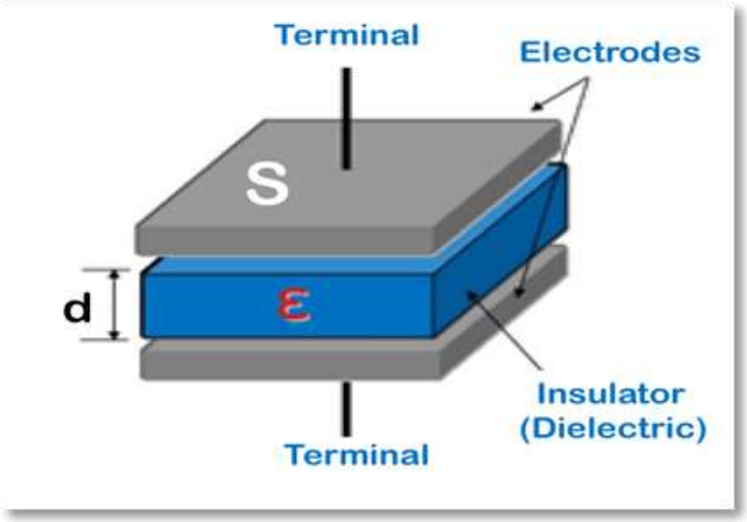
CAPACITOR USES

- Capacitors are commonly used in electronic devices to maintain power supply
- Capacitors are used in electric motors to boost rotational motion on the rotor.
- The capacitor is used for smoothing and filtering the power supply.
- The capacitor is used in mobile X-ray units as an internal power source.

BASIC PHYSICS, UNITS AND APPLICATIONS

CAPACITANCE

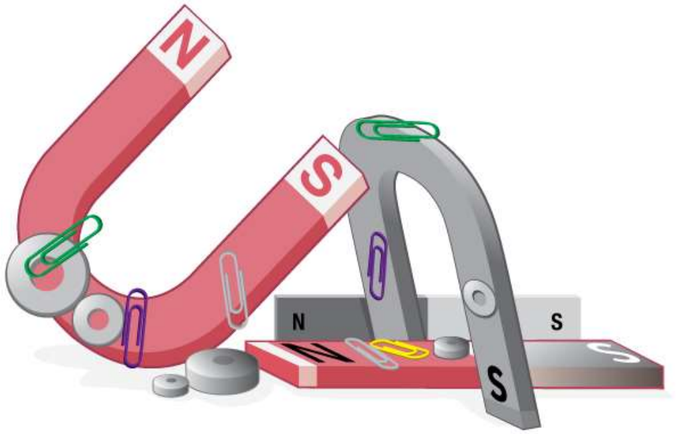
- It is the storage ability of a conductor.
- The capacitance is the amount of electric charge that is stored in the capacitor.
- The capacitance (C) of the capacitor is equal to the electric charge (Q) divided by the voltage (V) VQ is the electric charge in coulombs (C), which is stored on the capacitor.
- **C = Q / V**
- The SI unit of capacitance is Farad.



BASIC PHYSICS, UNITS AND APPLICATIONS

MAGNET

- Magnets are made of ferromagnetic metals such as nickel and iron.
- There are three types of magnets which include



1. PERMANENT MAGNET

- Permanent magnets do not lose their magnetic property once they are magnetized.

2. TEMPORARY MAGNET

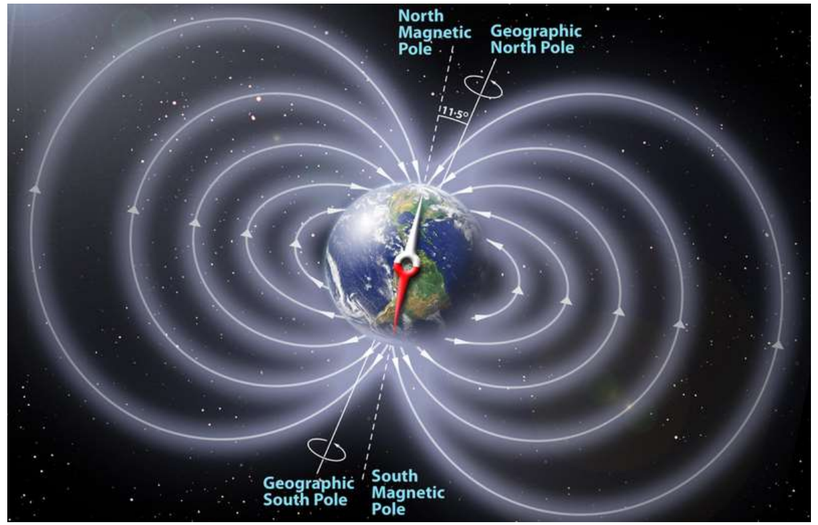
- Temporary magnets do not have magnetic property, but in the presence of a magnetic field, it becomes magnetized. When the magnetic field is removed, it loses its magnetic property.

3. ELECTROMAGNET

- An electromagnet is a type of temporary magnet in which the magnetic field is produced by an electric current. Electromagnets typically consist of wire wounds into a coil.
- When the electric current passes through the wire, it produces a magnetic field. The strength of an electromagnet can be changed by changing the amount of electric current, and the poles of an electromagnet can even be reversed by reversing the flow of electricity.

BASIC PHYSICS, UNITS AND APPLICATIONS

MAGNETISM



- Magnetism is an unseen force in specific materials.
- This force repels or attracts metal objects towards a magnet.
- Magnetism is caused by the motion of electric charges.
- Each atom has electrons that carry electric charges.
- The spin movement of electrons generates a microscopic magnet.
- In most materials, equal numbers of electrons spin in opposite directions and cancel out their magnetism.
- In magnets, the electrons spin in the same direction.
- This creates two poles, a North and the South Pole. All Magnets have two poles, called north and south poles.
- Unlike poles of magnets attract each other and like poles of magnets repel each other.
- The magnets produce magnetic forces and magnetic lines.
- The magnetic field creates forces on other magnets. The number of field lines indicates the strength of the magnetic field.

BASIC PHYSICS, UNITS AND APPLICATIONS

VARIOUS APPLICATIONS AND USES OF MAGNETS

- We might be using computers in our day-to-day lives but never wondered about the presence of a magnet inside it. Magnetic elements on a hard disk help to represent computer data, which is later 'read' by the computer to extract information.
- Magnets are used inside TVs, sound speakers and radios. The small coil of wire and a magnet inside a speaker transforms the electronic signal to sound vibrations.
- Magnets are used inside a generator to transform mechanical energy into electrical energy.
- In contrast, other kinds of motors use magnets to change electrical energy to mechanical energy.
- Electrically charged magnets can help cranes to move large metal pieces.
- Magnets are used in filtering machines that separate metallic ores from crushed rocks.
- It is also used in food processing industries for separating small metallic pieces from grains etc.
- Magnets are used in MRI machines which are used to create an image of the bone structure, organs, and tissues. Even magnets are used to cure cancer.

BASIC PHYSICS, UNITS AND APPLICATIONS

VARIOUS APPLICATIONS AND USES OF MAGNETS

- At home, you use magnets when you stick a paper on the refrigerator in order to remember something. Attaching a magnetic bottle opener to the fridge can come in handy.
- We often use pocket a compass to find out directions when we are on a trek. The pocket compass uses a magnetic needle to point north.
- The dark strip on the back of debit and credit cards is magnetic and is used to store data like computers' hard drives. We often use pocket a compass to find out directions when we are on a trek. The pocket compass uses a magnetic needle to point north.
- The dark strip on the back of debit and credit cards is magnetic and is used to store data like computers' hard drives. Magnets can help collect all the nails which are scattered on the ground after a repair job.

BASIC PHYSICS, UNITS AND APPLICATIONS

REACTANCE

- Reactance, in electricity, measure of the opposition that a circuit or a part of a circuit presents to electric current in so far as the current is varying or alternating.

REACTANCE AND IMPEDANCE

- Reactance is a measurement of capacitance and inductance's resistance to current. The impedance of a circuit is a measurement of its overall resistance to current

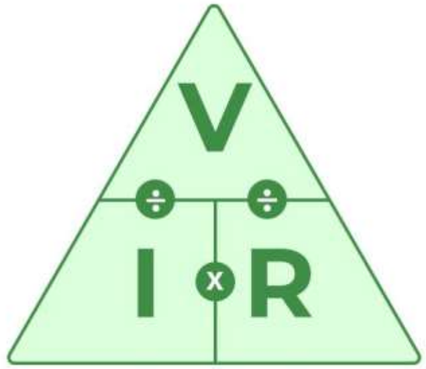
RESONANCE

- A phenomenon in which an external force or a vibrating system forces another system around it to vibrate with greater amplitude at a specified frequency of operation

BASIC PHYSICS, UNITS AND APPLICATIONS

Ohms Law

- Ohms law describes the relationship between voltage, current and resistance.
- Ohm's law states that the potential difference (voltage) between two points is directly proportional to the current and the resistance of the circuit at a constant temperature.
- If the voltage increases and the resistance remains the same, the current will increase.
- **Ohm's Law, V = I x R**



INTERROGATIONS

1. Explain Ohm’s Law
2. What is capacitors ?
3. Any 3 applications of Magnetic field

REFERENCES

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THANK YOU