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Module - 7

PHYSICS

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PHYSICS

MODULE – 7

EDITION : 2026

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SYLLABUS

Syllabus
Source of Energy : Conventional and new sources of Energy, source of solar energy, causes of origin of energy in the Sun, solar heating devices, solar cooker, solar cell, wind energy, biogas, fossil fuels, ideal fuel, properties of ideal fuel. Nuclear energy, nuclear Fission, Fusion, chain reaction, nuclear reactor, uses and harms of nuclear energy. General information about M.P. energy development corporation (MPUVN).
Light : Nature of light reflection of light, laws of reflection, reflection from plane and curved surface, image formation by plane convex and concave mirror, relation between focal length and radius of curvature, determination of focal length of concave mirror by single pin method. Relation between u-v-f [numerical examples].
Refraction of light : Laws of refraction, refraction by glass slab, critical angle, total internal reflection, use of total internal reflection in daily life. lens [converging and diverging lens]. Definition focal length optical centre image formation by lens Human eye. its defects and remedies. Comparison between photographic camera and human eye. Simple telescope and astronomical telescope- Construction, working, uses, ray diagram [no formula derivation].
Electricity and its effects : Electric intensity, potential, potential difference, electric curenl Ohm's law. Resistance specific resistance, influencing factors, combination of resistance and related numerical examples thermal effect of current it's use, calculation of power and electrical energy spent, (numerical) precautions observed in electric experiments. Chemical effects of electric current. Primary and secondary cells their properties and drawback. Leclanche cell, dry cell, lead accumulator cell, construction.
Magnetic effect of current : Oersted experiment, electromagnetic induction, electric motor, working principle and use of generator, general studies of alternating current and direct current, electric discharge in gases, discharge tube, cathode rays. X-rays and their properties.
Magnetism : Magnet and it's types artificial magnet, methods of preparing magnets, molecular theory of magnetism, demagnetization, magnetic keepers, magnetic lines of force and their properties. Plotting the lines of force Terrestriel magnetism, magnetic storm, magnetic meridian geographical meridian, relation between VH1 and Ø

Module - 7

CONTENTS

CHAPTER 1 LIGHT

1.1 What is light ?

Light is a form of energy which produces the sensation of vision when it enters our eyes and falls on the retina. light is understood as :

- An ***electromagnetic wave*** that can travel in ***vacuum***.
- A form of energy that can be *absorbed*, *reflected*, *refracted*, or *converted* into other forms.

We Usually Study Light in Two Ways :

1. ***Ray Optics (Geometrical Optics)*** : Treats light as a ray travelling in straight lines. Used to study *reflection*, *refraction*, *mirrors*, *lenses*, and *optical instruments*.
2. ***Wave / Quantum Nature*** : Used to explain phenomena like *interference*, *diffraction*, *photoelectric effect*, etc.

► ***Visible Light and Electromagnetic Spectrum***

Light that can be seen by the human eye is called ***visible light***.

- The ***wavelength range*** of visible light in air is approximately **4000 Å to 8000 Å** or 4×10^{-7}m to 8×10^{-7}m
- This visible region is a small part of the ***electromagnetic spectrum***, which also includes radio waves, microwaves, infrared, ultraviolet, X-rays and gamma rays.

The ***energy*** of visible light photons is of the order of a few ***electron-volts (eV),*** which is suitable for producing visual sensation.

► ***Speed of Light***

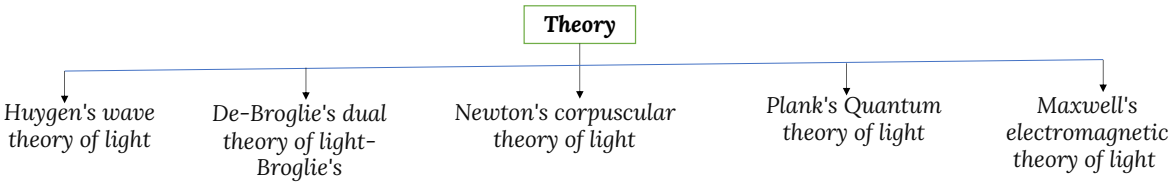
- The speed of light in vacuum is denoted by c.
- Its value is approximately: c= 3×10^{8} m s^{-1}
- Light is an electromagnetic wave, and ***its speed in vacuum is the same for all observers in inertial frames*** (a fundamental postulate of special relativity).
- In any ***medium*** (like glass, water, air):
- The speed of light is ***less than*** c.
- If v is the speed of light in the medium and n is the ***refractive index*** of the medium, then: n/μ = $\frac{c}{v}$ or $v = \frac{c}{n}$

► **PROPERTIES OF VISIBLE LIGHT**

- No material medium is required for the propagation of light energy, i.e., it travels even in **vacuum.**
- Its velocity is constant in all inertial frames i.e. it is an absolute constant. It is independent of the relative velocity between the source and the observer.

- It propagates in straight line.
- It exhibits **the phenomena of reflection, refraction, interference, diffraction, polarisation and double refraction.**
- It can emit electrons from metal surface *i.e.,* it can produce **photoelectric effect.**
- It produces thermal effect and exerts pressure when incident upon a surface. It proves that light has **momentum and energy.**
- Its velocity is different in different media. In rarer medium it is more and in denser medium it is less.
- Light energy propagates via two processes.
  (a) The particles of the medium carry energy from one point of the medium to another.
  (b) The particles transmit energy to **the neighbouring particles** and in this way energy propagates in the form of a disturbance.

► **DIFFERENT THEORIES OF LIGHT**



1.2 Ray Optics

Optics is the branch of physics that deals with the behaviour and properties of light and its interaction with matter. ***Ray optics*** or ***geometrical optics*** is the part of optics in which:

- Light is considered to travel in ***straight lines called rays***.
- We use ***simple geometric constructions*** (ray diagrams) to study image formation by mirrors, lenses and optical instruments. This approach is valid when the ***wavelength of light*** is very small compared to the size of obstacles and apertures involved. (This condition is satisfied for most everyday situations with lenses, mirrors, telescopes, etc.)
- ***Ray of light*** **:** A ***ray*** is an idealized line showing the *direction of propagation of light*. It has no thickness.
- ***Beam of light*** **:** A *beam* is a bundle or collection of rays. Beams can be:
  - ***Parallel beam*** : rays are parallel.
  - ***Converging beam*** : rays approach and meet at a point.
  - ***Diverging beam*** : rays spread out from a point.
- ***Pencil of light*** **:** A very ***narrow beam*** of light is often called a ***pencil of light***.

► ***Types of Optical Media***

Depending on how light passes through, materials are classified as:

1. ***Transparent medium***
   - Most of the light incident on the medium can pass through it.
   - Objects can be seen clearly through it.
   - Examples: clear glass, pure water, air.
2. ***Translucent medium***
   - Allows light to pass through but ***not clearly***.

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CHAPTER 2

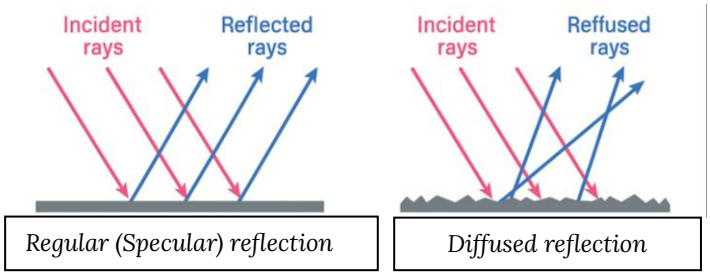
REFLECTION OF LIGHT & MIRROR

2.1 *Reflection of Light*

When a ray of light travelling in one medium strikes the boundary between two media, a part (or all) of it may be sent back into the first medium. This ***sending back of light*** into the same medium is called **reflection *of light***.
Example : Light from a bulb falling on a mirror and coming back into the same room.

There are **two types of reflection** :

1. ***Regular (Specular) reflection*** : it occurs when light falls on a smooth, polished surface such as a plane mirror, calm water, or polished metal, and the reflected rays are parallel to each other, due to which a clear and well-defined image is formed.
2. ***Diffused reflection*** : it occurs when light falls on a rough or uneven surface such as a wall, paper, or rough metal. In this case, parallel incident rays are reflected in many different directions instead of one fixed direction. Because of this, no clear image is formed on the surface, but the object itself is still visible from many directions. This process of diffuse reflection enables us to see most of the objects around us in our daily life.

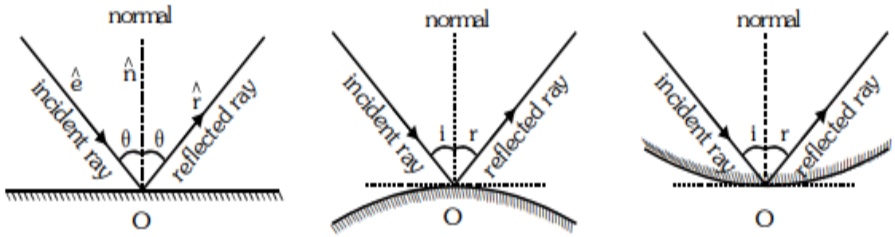


Regular (Specular) reflection | *Diffused reflection*

► ***Laws of Reflection***

When a ray of light is reflected from a surface, it obeys the following laws of reflection :

- The incident ray, the reflected ray, and the normal to the reflecting surface at the point of incidence all lie in the same plane.
- The ***angle of reflection*** is ***equal*** to the ***angle of incidence***. ∠ i = ∠r where i= angle of incidence, r= angle of reflection.



CHAPTER 3 REFRACTION

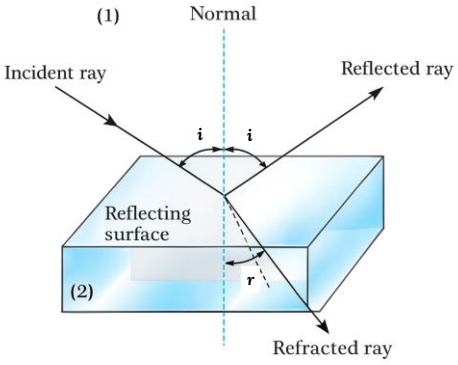
3.1 REFRACTION

When a ray of light passes ***obliquely*** from one ***transparent medium*** to another (for example, from air to water), its ***direction generally changes*** at the surface separating the two media.

This ***change in the direction of propagation of light*** when it passes from one transparent medium to another is called ***refraction of light***.

➢ Examples :

- A stick partially immersed in water appears ***bent*** at the surface.
- The bottom of a swimming pool appears ***shallower*** than it actually is.
- A coin at the bottom of a glass of water appears raised.



► ***Laws of Refraction (Snell's Laws)***

The refraction of light obeys the following **laws of refraction** :

1. ***First Law*** : The *incident ray*, the *refracted ray*, and the *normal* to the interface (surface) at the point of incidence all lie in the *same plane*.
2. ***Second Law (Snell's Law)*** : For a given pair of media at a given wavelength of light, the ratio of the *sine of the angle of incidence* to the *sine of the angle of refraction* is a *constant*.

   Mathematically,

$$\frac{\sin i}{\sin r} = \mu_{21}$$

   Where

   i= angle of incidence (in medium 1), r= angle of refraction (in medium 2) and μ_{21}= refractive index of **medium 2 with respect to medium 1**.

► ***Refractive Index***

The ***refractive index*** of one medium with respect to another is defined as:

$$\mu_{21} = \frac{\sin i}{\sin r}$$

It is a measure of how much the speed and direction of light change on entering the second medium.

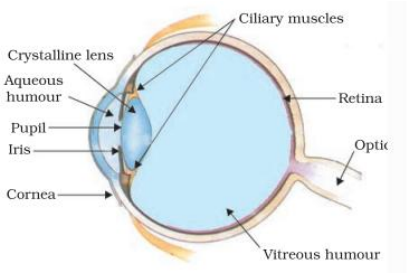
- ***Absolute Refractive Index***

  The ***absolute refractive index*** of a medium is the refractive index of that medium with respect to ***vacuum*** **(or air)**. If

CHAPTER 4 OPTICAL INSTRUMENTS

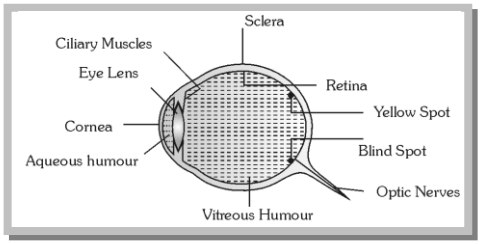
4.1 *Human eye*

The ***human eye*** is a natural optical instrument that enables us to see objects around us. It works on the principle of ***refraction of light by a lens system*** and ***image formation on a light-sensitive screen***. It enables us to see the wonderful world and the colours around us. The human eye is like a camera. Its lens system forms an image on a light-sensitive screen called the retina. Light enters the eye through a thin membrane called the cornea. It forms the transparent bulge on the front surface of the eyeball.



► ***Main parts***

- ***Cornea*** : The transparent, curved front surface of the eye. First refracting surface; does most of the focusing of incoming light.
- ***Aqueous humour*** : A transparent fluid between cornea and eye lens. Helps maintain the shape of the front part of the eye and provides nourishment.
- ***Iris*** : The coloured part of the eye (brown, blue, etc.). Controls the size of the pupil and thus regulates the amount of light entering the eye.
- ***Pupil*** : The small opening in the centre of the iris. Acts like a variable aperture, controlling the amount of light entering the eye.



- ***Eye lens*** : A transparent, flexible, convex lens made of living tissue. Its curvature can be changed by ciliary muscles to adjust focal length.
- ***Ciliary muscles*** : Muscles attached to the eye lens. Change the shape (curvature) of the lens to focus objects at different distances.Responsible for accommodation of the eye.
- ***Vitreous humour*** : A jelly-like transparent fluid between lens and retina. Helps maintain the spherical shape of the eyeball.
- ***Retina*** : The light-sensitive screen at the back of the eye. Contains rods and cones (light-sensitive cells).
  - Rods: sensitive to low light (brightness).
  - Cones: sensitive to colour.
- ***Yellow spot*** : It is the most sensitive part, the image formed at yellow spot is brightest.
- ***Blind spot*** : Optic nerves goes to brain through blind spot. It is not sensitive for light.
- ***Power of accommodation*** : The ability of eye to see near objects as well as far objects is called power of accomodation. When we look distant objects, the eye is relaxed and it's focal length is largest.
- ***Range of vision*** : For healthy eye it is 25 *cm* (near point) to ∞ (far point). A normal eye can see the objects clearly, only if they are at a distance greater than 25 *cm*. This distance is called Least distance of distinct vision and is represented by *D*.

Exercise - 1

1. Write only the wrong statement out of the following is? [MPPSC Forest Service (Main) 2019]
(a) Light travels in a straight line.
(b) Light is a wave motion.
(c) Light travels with a speed greater than the speed of sound.
(d) Light cannot travel through vacuum.

2. The phenomenon of splitting of light into its component colours is known as [MPPSC Forest Service (Main) 2023]
(a) Dispersion
(b) Reflection
(c) Scattering
(d) Refraction

3. The number of images of an object placed between two mirrors inclined at an angle of 45° are: [MPPSC Forest Service (Main) 2018]
(a) 5
(b) 6
(c) 7
(d) 8

4. Mirror used by a dental surgeon is ? [MPPSC Forest Service (Main) 2019]
(a) Plane
(b) Convex
(c) Concave
(d) Both convex and concave

5. What should be the minimum length of a plane mirror to get a full image of a person of height 4 feet ? [MPPSC Forest Service (Main) 2019]
(a) 4 feet
(b) 6 feet
(c) 2 feet
(d) 1 feet

6. The focal length of a plane mirror is [MPPSC Forest Service (Main) 2019]
(a) 0
(b) 10cm
(c) 20 cm
(d) ∞

7. A man approaches a vertical plane mirror at speed of 2m/sec. At what rate does he approach his image ? [MPPSC Forest Service (Main) 2019]
(a) 2 m/sec
(b) 4 m/sec
(c) 6 m/sec
(d) 8 m/sec

8. An object is placed at (i) 10 cm , (ii) 5 cm in front of a concave mirror radius of curvature 15 cm , then the nature of images is [MPPSC Forest Service (Main) 2020]
(a) Magnified, real and inverted in both cases
(b) Magnified, virtual and erect in both cases
(c) Magnified, real and inverted in (i) case and magnified, virtual and erect in (ii) case
(d) Magnified, real and erect in (i) case and magnified, virtual and inverted in (ii) case

9. A convex mirror has a radius of curvature of 22 cm. An object is placed 14 cm away from the mirror. The lateral magnification of the image will be [MPPSC Forest Service (Main) 2021]
(a) +0·44
(b) -0·44
(c) +0·84
(d) -0·24

10. The image of an object is formed by a convex lens on a screen. If lower half of the lens is painted black, the intensity of image becomes: [MPPSC Forest Service (Main) 2018]
(a) Half
(b) One fourth
(c) Same
(d) Twice

11. Maximum lateral displacement of the ray of light incident on a slab of thickness t is: [MPPSC Forest Service (Main) 2018]
(a) t/4
(b) t/3
(c) t/2
(d) t

12. Total internal reflection takes place if light goes from: [MPPSC Forest Service (Main) 2018]
(a) Water to glass
(b) Glass to water
(c) Air to glass
(d) Air to water

13. The power of convex lens of focal length 25cm is [MPPSC Forest Service (Main) 2019]
(a) 1 D
(b) 2 D
(c) 3 D
(d) 4 D

14. When a thin convex lens is put in contact with a thin concave lens of same focal length. The resultant combination has focal length equal to [MPPSC Forest Service (Main) 2019]
(a) f/2
(b) 2f
(c) 0
(d) ∞

15. Red light of wavelength 632 nm in free space is incident at an angle of θ = 39° with respect to the normal on a glass slide of thickness d = 0.78 mm and index of refraction n = 1.52. The wavelength of light in glass will

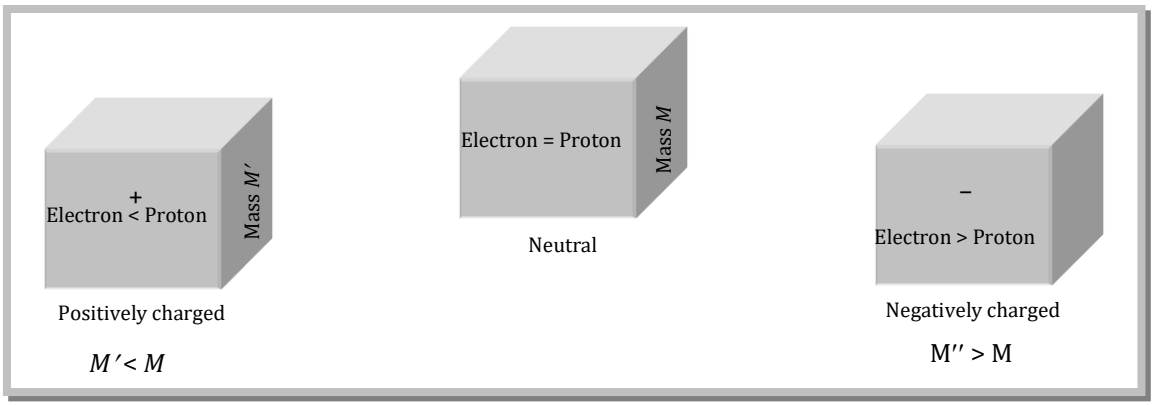
CHAPTER 5 ELECTROSTATIC

5.1 Electric Charge

Definition : Charge is the property associated with matter due to which it ***produces*** and ***experiences electrical*** and ***magnetic effects***.

Origin of electric charge : It is known that every atom is electrically neutral, containing as many electrons as the **number of protons in the nucleus**.

Charged particles can be created by disturbing neutrality of an atom. Loss of electrons gives positive charge (as then $n_p > n_e$) and gain of electrons gives negative charge (as then $n_e > n_p$) to a particle. When an object is negatively charged it gains electrons and therefore its mass increases negligibly. Similarly, on charging a body with positive electricity its mass decreases. Change in mass of object is equal to $n \times m_e$. Where, n is the number of electrons transferred and m_e is the mass of electron $= 9.1 \times 10^{-31}\ Kg$.

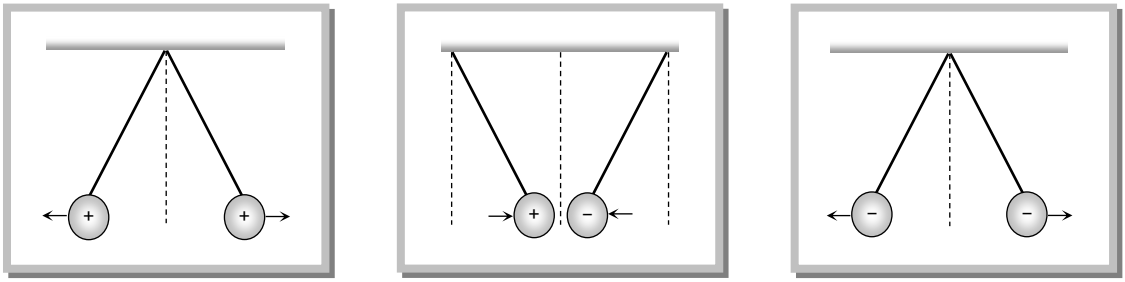


Type : There exists two types of charges in nature

- Positive charge
- Negative charge

Charges with the same electrical sign repel each other, and charges with opposite electrical sign attract each other.

Unit and dimensional formula : Rate of flow of electric charge is called electric current *i.e.,*



CHAPTER 6

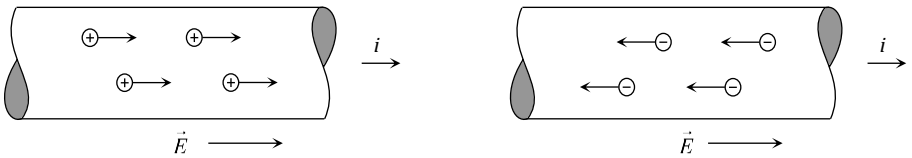
ELECTRIC CURRENT

Syllabus : Electric current Ohm's law. Resistance specific resistance, influencing factors, combination of resistance and related numerical examples thermal effect of current it's use, calculation of power and electrical energy spent,(numerical) precautions observed in electric experiments. Chemical effects of electric current. Primary and secondary cells their properties and drawback. Leclanche cell, dry cell, lead accumulator cell, construction. Magnetic effect of current - Oersted experiment, electromagnetic induction, electric motor, working principle and use of generator, general studies of alternating current and direct current,

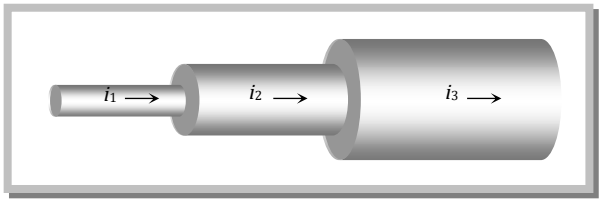
6.1 Electric Current

Definition **:** Electric current is the ***rate of flow of electric charge*** through any cross-section of a conductor. If a charge **ΔQ** passes through a cross-section in time **Δt**, then the current is: $i_{av} = \frac{\Delta Q}{\Delta t}$ and instantaneous current $i = \underset{\Delta t \to 0}{Lim} \frac{\Delta Q}{\Delta t} = \frac{dQ}{dt}$. If flow is uniform then $i = \frac{Q}{t}$. Current is a scalar quantity. It's S.I. unit is *ampere* (*A*) and C.G.S. unit is *emu* and is called *biot* (*Bi*), or *ab ampere*. 1*A* = (1/10) *Bi* (*ab amp*.)

- ***The direction of current*** : The conventional direction of current is taken to be the direction of flow of positive charge, *i.e*. field and is opposite to the direction of flow of negative charge as shown below.



  Though conventionally a direction is associated with current (Opposite to the motion of electron), it is not a vector. It is because the current can be added algebraically. Only scalar quantities can be added algebraically not the vector quantities.
- ***Charge on a current carrying conductor*** : In conductor the current is caused by electron (free electron). The no. of electron (negative charge) and proton (positive charge) in a conductor is same. Hence the net charge in a current carrying conductor is zero.
- ***Current through a conductor of non-uniform cross-section*** : For a given conductor current does not change with change in cross-sectional area. In the following figure $i_1 = i_2 = i_3$



- **Types of current** : In our houses ac is supplied at 220*V*, 50*Hz*. Electric current is of two type :

Exercise - 2

1. The role of $ZnCl_2$ in a dry cell is to [MPPSC Forest Service (Main) 2021]
(a) Avoid Corrosion Of Zinc Container
(b) Provide Mechanical Strength To Cell
(c) Control Cell Temperature
(d) Prevent crack of seal of cell

2. A wire of resistance R is stretched to reduce its diameter to half of its original value, The new resistance is: [MPPSC Forest Service (Main) 2018]
(a) 2R
(b) 4R
(c) 8R
(d) 16R

3. The resistivity of the material depends on : [MPPSC Forest Service (Main) 2018]
(a) Length of the wire
(b) Diameter of the wire
(c) Temperature of the wire
(d) Material of the wire

4. Five equal resistances each of resistance 3Ω are connected as shown in the fallowing figure. The equivalent resistance between the points A and E : [MPPSC Forest Service (Main) 2018]
(a) 5Ω
(b) 8 Ω
(c) 10 Ω
(d) 15 Ω

5. A battery of emf E and internal resistance r is connected across the load R. When the current flows through the resistance R, power is dissipated in the form of heat energy. The output power will be maximum when: [MPPSC Forest Service (Main) 2018]
(a) R = r
(b) R = 2r
(c) R = 3r
(d) R = 4r

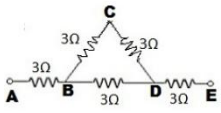
6. At the time of short circuit, the amount of current in the circuit [MPPSC Forest Service (Main) 2019]
(a) Reduces substantially
(b) Increases heavily
(c) Does not change
(d) Varies continuously

7. Which of the following instrument can detect the presence of electric current in a circuit? [MPPSC Forest Service (Main) 2019]
(a) Motor
(b) Galvanometer
(c) Generator
(d) None of the above

8. If an electric current is passed through a nerve, the human? [MPPSC Forest Service (Main) 2019]
(a) Begins to laugh
(b) Begins to weep
(c) Is excited
(d) Becomes insensitive to pain

9. The specific resistance of a wire ? [MPPSC Forest Service (Main) 2019]
(a) Varies with its length
(b) Varies with its cross-section
(c) Varies with its mass
(d) Does not depend upon its length, mass and cross-section

10. In electroplating, the article to be electroplated is known as ? [MPPSC Forest Service (Main) 2019]



(a) Electrolyte
(b) Anode
(c) Cathode
(d) Conductor

11. In a dry cell, which of the following energy is converted into electrical energy? [MPPSC Forest Service (Main) 2019]
(a) Mechanical
(b) Chemical
(c) Kinetic
(d) Potential

12. The amount of heat produced in 5 minutes by an electric heater rated at 1000 W is [MPPSC Forest Service (Main) 2019]
(a) 2×10^5J
(b) 3×10^5J
(c) 4×10^5J
(d) 300 J

13. A piece of wire of resistance R is cut into five equal parts. These parts are then connected in parallel. If equivalent resistance is R then the ratio of R \ R is [MPPSC Forest Service (Main) 2019]
(a) $\frac{1}{25}$
(b) $\frac{1}{5}$
(c) 5
(d) 25

14. The frequency of direct current is [MPPSC Forest Service (Main) 2019]
(a) Zero
(b) 50 Hz
(c) 60 Hz
(d) 100 Hz

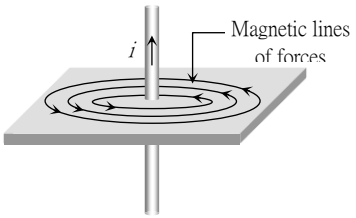
15. An electric toaster uses nichrome for its heating element when a negligibly small current passes through it, its resistance at room temperature 25°C is found to be 75Ω. When the toaster is connected to a 230 V supply, a steady state current of $2.3 A flows. The steady state temperature of the nichrome element will be (Take temperature co-efficient of resistance of nichrome $1.7 \times 10^{-4\,o}C^{-1}$ [MPPSC Forest Service (Main) 2020]

CHAPTER 7

MAGNETIC EFFECT OF CURRENT AND MAGNATE

Syllabus : Magnetism - Magnet and it's types artificial magnet, methods of preparing magnets, molecular theory of magnetism, demagnetization, magnetic keepers, magnetic lines of force and their properties. Plotting the lines of force Terrestrial magnetism, magnetic storm, magnetic meridian geographical meridian, relation between VH1 and ϕ

7.1 *Magnetic Effect of Current*

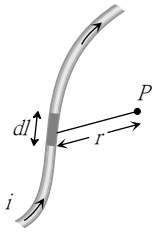


Oersted discovered that when electric current flows through a conductor, it produces a ***magnetic field around the conductor***. The magnetic field ***exists only as long as current flows*** in the wire. When the current stops, the magnetic field disappears.

If the ***direction of current is reversed***, the ***direction of the magnetic field also reverses***. A ***moving electric charge*** produces **both *electric*** **and *magnetic fields***, while a ***stationary charge*** produces ***only an electric field***.

► *Biot Savart's Law*

Biot–Savart's law is used to calculate the ***magnetic field at any point*** produced by a ***current-carrying conductor***. Although the law is originally defined for an ***infinitesimally small element of a conductor***, it can also be applied to ***long straight conductors*** or conductors of other shapes by integrating the contribution of each small element. To understand Biot–Savart's law, we must first understand the term ***current element***.



In the figure shown below, there is a segment of current carrying wire and *P* is a point where magnetic field is to be calculated. $i\vec{dl}$ is a current element and *r* is the distance of the point '*P*' with respect to the current element $i\vec{dl}$. According to Biot-Savart Law, magnetic field at point '*P*' due to the current element $i\vec{dl}$ is given by the expression

$$dB = k\frac{i\,dl\sin\theta}{r^2}$$

$$\text{also } B = \int dB = \frac{\mu_0 i}{4\pi}\cdot\int\frac{dl\sin\theta}{r^2}$$

In C.G.S. : $k = 1 \Rightarrow dB = \frac{idl\sin\theta}{r^2}$ *Gauss*

In S.I. : $k = \frac{\mu_0}{4\pi} \Rightarrow dB = \frac{\mu_0}{4\pi}\cdot\frac{idl\sin\theta}{r^2}$ *Tesla*

where μ_0 = Absolute permeability of air or vacuum $= 4\pi\times10^{-7}\ \frac{Wb}{Amp - metre}$. It's other units

$$\frac{Henry}{metre} \text{ or } \frac{N}{Amp^2} \text{ or } \frac{Tesla - metre}{Ampere}$$

Exercise - 3

1. An ac generator consist of a coil of 50 turns and area 2.5m^2 rotating at an angular speed of 60 rad s^{-1} in a uniform magnetic field B = 0.3 T between two fixed pole pieces the resistance of the circuit including that of the coil is 500 Ω. What is the maximum current drawn from the generator: [MPPSC Forest Service (Main) 2018]

(a) 2.3 A
(b) 4.5 A
(c) 5.2 A
(d) 6.5 A

2. A steel wire has a magnetic movement M. If the wire is bend into semicircular arc, The new magnetic movement becomes: [MPPSC Forest Service (Main) 2018]

(a) M
(b) 2M
(c) 2πM
(d) $\frac{2}{\pi}M$

3. Lenz's law is a consequence of the law of conservation of? [MPPSC Forest Service (Main) 2019]

(a) Charge
(b) Mass
(c) Momentum
(d) Energy

4. According to Faraday's law, the total charge induced in a conductor that is moved in a magnetic field depends upon ? [MPPSC Forest Service (Main) 2019]

(a) Change in magnetic flux
(b) Initial magnetic flux
(c) Final magnetic flux
(d) Rate of change of magnetic flux

5. Magnetic lines of force ? [MPPSC Forest Service (Main) 2019]

(a) Always intersect
(b) Are closed curves
(c) Tend to crowd far away from magnetic poles
(d) Do not pass through vacuum

6. A live wire is hidden in a wall. Its position can be located with the help of [MPPSC Forest Service (Main) 2019]

(a) Watt-meter
(b) Moving coil galvanometer
(c) Magnetic needle
(d) The position of wire cannot be located without breaking the wall

7. A magnetic needle is allowed to oscillate in an uniform magnetic field. Its magnetic moment is 6.7× 10^{-2} AM^2 and moment of inertia is 7.5×10^{-6} Kgm^2 . It performs 10 complete oscillations in 6.0sec. The magnitude of magnetic field is [MPPSC Forest Service (Main) 2020]

(a) 1.51T
(b) 1.02T
(c) 0.12T
(d) 0.012T

8. The susceptibility of diamagnetic and paramagnetic materials is respectively [MPPSC Forest Service (Main) 2020]

(a) Positive, positive
(b) Negative, positive
(c) Positive, negative
(d) Negative, negative

9. A wheel with 10 metallic spokes each 0.5m long is rotated with speed 120 revolutions/minute in a plane normal to horizontal component of Earth's magnetic field H_E at a place. If H_E =4×10^{-5} T at the place, what will happen to emf induced between axle and rim of wheel if same wheel has double metallic spokes ? [MPPSC Forest Service (Main) 2020]

(a) Remains same
(b) Becomes double
(c) Becomes four times
(d) Reduces to half

10. Electrons in an X-ray tube are accelerated by a potential difference of 5.0 kV. If an electron produces one photon on impact with the target, what is the minimum wavelength of the resulting X-rays? (condsider h = 6.626 x 10^{-34} Js and e = 1.6 10^{-19} C) [MPPSC Forest Service (Main) 2021]

(a) 0.062
(b) 0.124
(c) 0.248
(d) 0.424 nm

11. The essential requirements for selection of material for transformer core are [MPPSC Forest Service (Main) 2021]

(a) Low Initial Permeability, Low Hysteresis Loss and Low Specific Resistance
(b) High Initial Permeability, Low Hysteresis Loss and High Specific Resistance
(c) High Initial Permeability, High Hysteresis Loss and High Specific Resistance
(d) Low initial permeability, low hysteresis loss and high specific resistance

12. The percentage of the incoming radiation from the Sun reflected back to space by the Earth is [MPPSC Forest Service (Main) 2022]

(a) 10%
(b) 20%
(c) 30%
(d) 40%

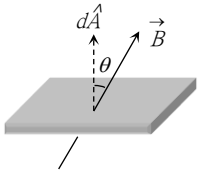
CHAPTER 8

MAGNETIC FLUX

Syllabus : Magnetism - Magnet and it's types artificial magnet, methods of preparing magnets, molecular theory of magnetism, demagnetization, magnetic keepers, magnetic lines of force and their properties. Plotting the lines of force Terrestrial magnetism, magnetic storm, magnetic meridian geographical meridian, relation between VH1 and ϕ

8.1 Magnetic Flux

The total number of magnetic lines of force passing normally through an area placed in a magnetic field is equal to the magnetic flux linked with that area.



For elementary area *dA* of a surface flux linked $d\phi = B\,dA\cos\theta$ or $d\phi = \vec{B}\cdot d\vec{A}$

So, Net flux through the surface $\boldsymbol{\phi = \oint \vec{B}\cdot d\vec{A} = BA\cos\theta}$

For *N*-turns coil $\phi = NBA\cos\theta$

- ***Unit and Dimension***

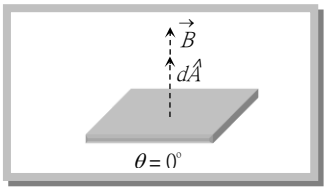
  Magnetic flux is a scalar quantity it's S.I. unit is *weber* (*wb*), CGS unit is *Maxwell* or *Gauss* × cm^2; $1\,wb = 10^8\ Maxwell$.

  Other units :

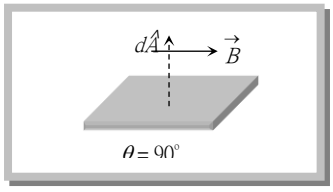
  Tesla × $m^2 = \dfrac{N\times m}{Amp} = \dfrac{Joule}{Amp} = \dfrac{Volt\times Coulomb}{Amp} = Volt\times sec$ = *Ohm* × *Coulomb* = *Henry* × *Amp*.

- ***Maximum and Zero flux***

  If θ = 0°, *i.e.* plane is held perpendicular to the direction of magnetic field then flux from the surface is maximum and if $\theta = 90^o$ *i.e.* plane is held parallel to the direction of magnetic field then flux linked with the surface is zero.



$\phi_{max} = BA$



$\phi = 0$

In case of a body present in a field, either uniform or non-uniform, outward flux is taken to be positive while inward negative and Net flux linked with a closed surface is zero *i.e.*, $\phi = \oint \vec{B}\cdot d\vec{s} = 0$

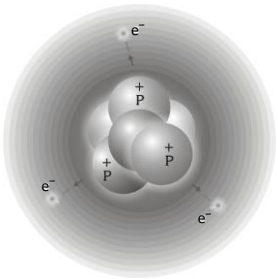
CHAPTER 9

NUCLEUS AND NUCLEAR ENERGY

9.1 Discovery of the Nucleus

► ***Rutherford's α-scattering experiment*** : It established that the mass of atom is concentrated with small positively charged region at the centre which is called '***nucleus***'.

Nuclei are made up of ***proton*** and ***neutron***. The number of protons in a nucleus (Called the atomic number or proton number) is represented by the symbol *Z*. The number of neutrons (Neutron number) is represented by *N*. The total number of neutrons and protons in a nucleus is called it's mass number *A* so $A = Z + N$. Neutrons and proton, when described collectively are called ***nucleons***. Nuclides are represented as ${}_{Z}X^{A}$; where *X* denotes the chemical symbol of the element.



- ***Neutron***

  Neutron is a fundamental particle which is essential constituent of all nuclei except that of hydrogen atom. It was discovered by ***Chadwick***.

  - The charge of neutron: ***neutral***
  - The mass of neutron: 1.6750×10^{-27} *kg.*
  - It's spin angular momentum : $\frac{1}{2} \times \left(\frac{h}{2\pi}\right) J\text{-}s$
  - It's magnetic moment : 9.57×10^{-27} *J/Tesla*.
  - It's half life : 12 minutes.
  - Penetration power : High
  - Types: Neutrons are of two types slow neutron and fast neutron, both are fully capable of penetrating a nucleus and causing artificial disintegration.

A free neutron outside the nucleus is unstable and decays into proton and electron

$${}_{0}n^{1} \rightarrow \underset{\text{Proton}}{{}_{1}H^{1}} + \underset{\text{Electron}}{{}_{-1}\beta^{0}} + \underset{\text{Antinutrino}}{\bar{\nu}}$$

- ***Thermal neutrons***

  Fast neutrons can be converted into ***slow neutrons*** by certain materials called moderator's (Paraffin wax, heavy water, graphite) when fast moving neutrons pass through a moderator, they collide with the molecules of the moderator, as a result of this, the energy of moving neutron decreases while that of the molecules of the moderator increases. After sometime they both attains same energy. The neutrons are then in thermal equilibrium with the molecules of the moderator and are called thermal neutrons. Energy of thermal neutron is about 0.025 *eV* and speed is about 2.2 *km/s*.

► ***Different types of nuclei***

The nuclei have been classified on the basis of the number of protons (atomic number) or the total number of nucleons (mass number) as follows

CHAPTER 10 ENERGY

10.1 ENERGY

The term **energy** is derived from the Greek word *en-ergon*, meaning ***"in work"*** or ***"the capacity to perform work"*** In physics, energy is defined as the ***ability to do work***, and the amount of work performed is directly dependent on the amount of usable energy available.

In early human civilization, production was limited because primitive societies depended entirely on **human and animal physical labor**. With technological progress, humans learned to control and utilize various forms of energy, leading to exponential growth in productivity and development.

Today, energy is universally recognized as one of the **most crucial inputs for economic growth, technological advancement, and human well-being**. Access to modern energy services is essential for meeting social needs, improving living standards, supporting industries, and boosting economic development.

Energy availability significantly influences:

- **Productivity** (industrial and agricultural output)
- **Health** (medical services, clean cooking fuels, safe water)
- **Education** (lighting, digital learning tools)
- **Water quality** (pumping, purification systems)
- **Communication and digital connectivity**
- **Transportation and mobility**

Modern energy services-including **electricity, natural gas, clean cooking fuels, and mechanical power** enable improvements in healthcare, education, information access, and overall economic productivity.
Thus, a **secure, reliable, affordable, clean, and equitable energy supply** is fundamental not only to national economic growth but also to human development and social progress.

Major Energy End-Use Sectors

Energy consumption is broadly categorized into the following four sectors:

1. **Commercial sector**
2. **Industrial sector**
3. **Transportation sector**
4. **Residential and agricultural services (often combined under miscellaneous services)**

These sectors collectively determine a nation's total energy demand and shape its energy policy.

10.2 *Classification of energy sources*

Energy resources can be classified on the basis of the following criteria.

Exercise - 5

1. Which has highest calorific value: [MPPSC Forest Service (Main) 2018]
(a) Charcoal
(b) Cow dung
(c) Wood
(d) Biogas

2. Which is not the property of an ideal fuel : [MPPSC Forest Service (Main) 2018]
(a) It is a pollution free fuel.
(b) It is a clean fuel.
(c) Its calorific value is lower.
(d) Its accidental hazards are lower.

3. Which of the fallowing variety of coal contains highest percentage of carbon: [MPPSC Forest Service (Main) 2018]
(a) Bituminous
(b) Anthracite
(c) Peat
(d) Lignite

4. Which one is non renewable source of energy: [MPPSC Forest Service (Main) 2018]
(a) Hydrogen
(b) Natural gas
(c) Biogas
(d) Ocean

5. The primary energy resources are always ? [MPPSC Forest Service (Main) 2019]
(a) Conventional only
(b) Non-conventional only
(c) Conventional as well as non-conventional
(d) None of the above

6. Wind energy is a source of energy, which is [MPPSC Forest Service (Main) 2019]
(a) Renewable
(b) Non-renewable
(c) Thermal
(d) Nuclear

7. The advantage of solar cooker is? [MPPSC Forest Service (Main) 2019]
(a) Nutrition value is maintained
(b) Cost is high
(c) Nutrition value gets destroyed
(d) No advantage

8. The solar cells are made by ? [MPPSC Forest Service (Main) 2019]
(a) Metals
(b) Insulators
(c) Semi-conductors
(d) Glass

9. Wind energy is a source of energy which is [MPPSC Forest Service (Main) 2019]
(a) Renewable
(b) Non-renewable
(c) Thermal
(d) None of the above

10. M. P. Urja Vikas Nigam was incorporated as a Company under [MPPSC Forest Service (Main) 2020]
(a) Company Act of 1956 on 15th August 1982
(b) Company Act of 1956 on 25th August 1982
(c) Company Act of 1956 on 15th August 1992
(d) Company Act of 1956 on 25th August 1992

11. Box-type solar cookers are suitable for [MPPSC Forest Service (Main) 2021]
(a) Boiling Only
(b) Boiling And Baking
(c) Frying Only
(d) None of the above

12. The maximum air temperature inside a box type solar cooker is around [MPPSC Forest Service (Main) 2022]
(a) 140 °C - 160 °C
(b) 50 °C - 100 °C
(c) 180 °C - 260 °C
(d) 200 °C - 300 °C

13. The material used for making solar cell is [MPPSC Forest Service (Main) 2023]
(a) Silicon
(b) Iron
(c) Copper
(d) Wood

14. In which year the Madhya Pradesh Urja Vikas Nigam (MPUVN) was established? [MPPSC Forest Service (Main) 2024]
(a) 1981
(b) 1979
(c) 1980
(d) 1982

15. A solar-cell is based upon [MPPSC Forest Service (Main) 2020]
(a) Photovoltaic effect
(b) Thermoelectric effect
(c) Piezoelectric effect
(d) Electromagnetic effect

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