1. Electrostatics

1. What is meant by quantisation of charge ?

The charge q on any object is equal to an integral multiple of fundamental unit of charge e. This is called quantisation of electric charge.

$$q = n e$$

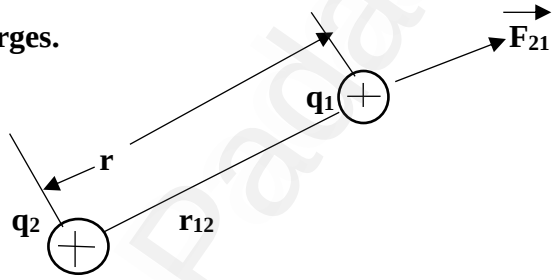
Charge of electron = - 1.6 X 10^{-19} C.

n is any integer (0 , ± 1 , ± 2 , ± 3 …)

2.Write down the Coulomb's law in vector form and mention what each term represents.

Coulomb's law states that,

Electrostatic force is directly proportional to the product of the magnitude of the point charges and inversely proportional to the square of the distance between two point charges.



- **The force on the point charge q_2 exerted by another point charge q_1 is**

$$\vec{F}_{21} = k \frac{q_1 q_2}{r^2} \hat{r}_{12}$$

- q_1 , q_2 ⟶ **Point Charges**
- $\hat{r}_{12}$ ⟶ **Unit Vector**
- **K** ⟶ **Proportionality Constant** $k = \frac{1}{4 \pi \epsilon_0}$

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3. What are the differences between Coulomb force and gravitational force?

S.No	Coulomb Force	Gravitational Force
1.	It may be attractive or repulsive.	It is always attractive in nature
2.	It depends upon medium.	It does not depend upon the medium.
3.	It is always greater in magnitude because of high value of K $K = 9 \times 10^9 \ N m^2 \ C^{-2}$	It is lesser than Coulomb force because value of G $G = 6.67 \times 10^{-11} \ N m^2 \ kg^{-2}$
4.	The force between the charges will not be same during motion or rest.	It is always same whether the two masses are rest or motion.

---

4. Write short note on superposition principle.

When a number of charges are interacting the total force of a given charge is the vector sum of the individual forces exerted on the given charge by all the other charges.

$$\vec{F}_1^{\,tot} = \vec{F}_{12} + \vec{F}_{13} + \vec{F}_{14} + \ldots\ldots\ldots + \vec{F}_{1n}$$

$$\vec{F}_1^{\,tot} = K \left\{ \frac{q_1 q_2}{r_{21}^2} \hat{r}_{21} + \frac{q_1 q_3}{r_{31}^2} \hat{r}_{31} + \ldots\ldots\ldots \frac{q_1 q_2}{r_{n1}^2} \hat{r}_{n1} \right\}$$

---

5. Define electric field .

The electric field at the point P at a distance r from the point charge q is the force experienced by a unit charge and is given by

$$\vec{E} = \frac{\vec{F}}{q_0} = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2} \hat{r}$$

S I unit : $N \ C^{-1}$

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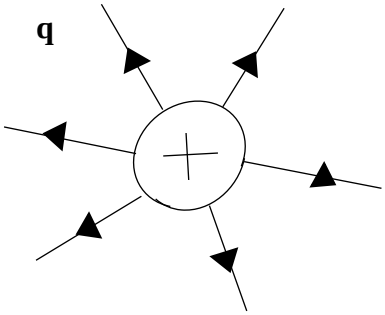
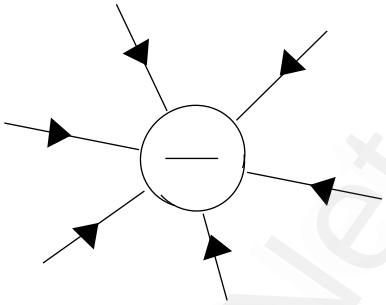
6. What is meant by " electric field lines " ?

- **Electric field vectors are visualized by the concept of electric field lines.**
- **They form a set of continuous lines which represent the electric field in some region of space visually.**



For positive charge , electric field lines radially outward



For negative charge , electric field lines radially outward

---

7. The electric field lines never intersect . Justify.

If some charge is placed in the intersection point , then it has to move in two different directions at the same time., which is physically impossible. Hence , electric field lines do not intersect.

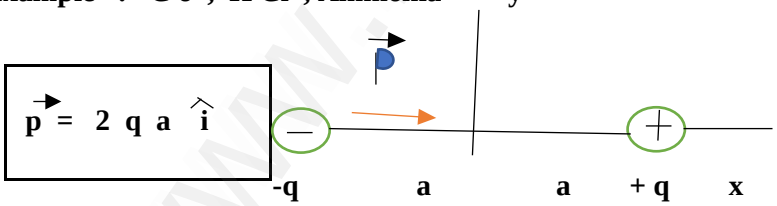
---

8. Define electric dipole . Give the expression for the magnitude of its electric dipole moment and the direction.

Electric Dipole :

Two equal and opposite charges separated by a small distance constitute electric dipole.

Example : C o , H Cl , Ammonia



Magnitude of electric dipole moment :

The product of magnitude of one of the charges and distance between them.

$$|\vec{P}| = 2qa$$

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9. Write the general definition of electric dipole moment for a collection of point charge.

The electric dipole moment for a collection of ' n ' point charges is given by

$$\vec{p} = \sum_{i=1}^{n} q_i \, r_i$$

- r_i ⟶ **Position vector of charge** q_i
- **S I Unit : Coulomb meter (C m)**

---

10. Define ' electrostatic potential ".

Electric potential at a point P is equal to the work done force to bring unit positive charge with constant velocity from infinity to the point P in the region of the external electric field.

$$V_P = -\int_{P}^{\infty} \vec{E} . d\vec{r}$$

$$V = \frac{1}{4\pi\epsilon_0} \frac{q}{r}$$

---

11. What is an equipotential surface ?

An equipotential surface is a surface on which all the points are at the same electric potential.

---

12. What are the properties of an equipotential surface ?

1. The work done to move a charge q between any two points A and B , $W = q (V_A - V_B)$.

2. If the points A and B lie on same equipotential surface , Work done is zero because $V_A = V_B$

3. The electric field is always normal to an equipotential surface.

---

13. Give the relation between electric field and electric potential.

- **Consider a positive charge q kept fixed at the origin .**
- **To move a unit positive charge by a small distance dx towards q in electric field E.**
- **The work done is given by** $dW = - E\,dx$.

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- The minus sign implies that work done against the electric field.
- This work done is equal to electric potential difference.
- The electric field is negative gradient of electric potential.

$$E = -\left(\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial y}\hat{j} + \frac{\partial V}{\partial z}\hat{k}\right)$$

1. $dW = dV$
2. $dV = -E\,dx$
3. $E = -\frac{dV}{dx}$

---

14. Define electrostatic potential energy.

Electric potential energy is defined as the work done in bringing the various charges to their respective positions from infinitely large mutual separation.

---

15. Define electric flux.

- The number of electric field lines crossing given area kept normal to be electric field lines is called " electric flux "
- It is a scalar quantity. S I unit : N m^2 C^{-1}

$$\Phi_E = \vec{E} \cdot \vec{A} = E\,A\,\cos\theta$$

---

16. What is meant by electrostatic energy density ?

The energy stored per unit volume of space is defined as energy density.

$$u_E = \frac{U}{\text{Volume}} = \frac{1}{2}\varepsilon_0 E^2$$

---

17. Write a short note on electrostatic shielding.

1. The phenomenon of protecting a region of space from any external electric field is called as " electrostatic shielding "
2. Consider a cavity inside the conductor whatever the charges at the surfaces and whatever the electrical disturbances outside , the electric field inside cavity is zero.

Ex : Faraday Cage

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18. What is polarization ?

Polarization $\vec{P}$ is defined as the total dipole moment per unit volume of dielectric.

$$\vec{P} = \chi_e \vec{E}_{ext}$$

χ_e ⟶ **Electric Susceptibility**

19.What is dielectric strength ?

The maximum electric field the dielectric can withstand before it breakdown is called " dielectric strength ".

For example : Dielectric strength of air 3 X 10^6 V m^{-1}

---

20. Define capacitance . Give its unit.

The capacitance of a capacitor is defined as the ratio of the magnitude of charge on either of the conductor plates to the potential differences existing between them.

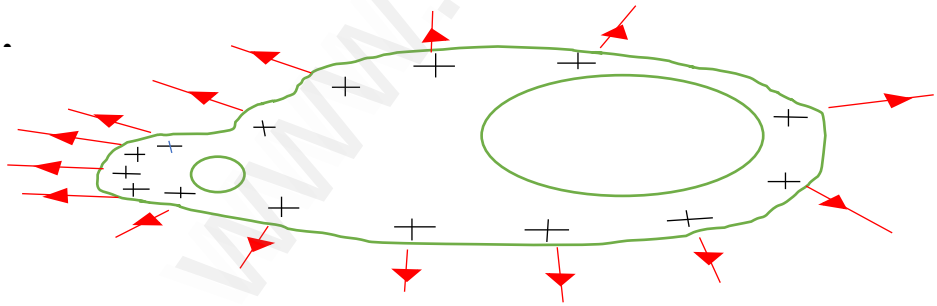
$$C = \frac{Q}{V}$$

- **SI unit : Coulomb per volt or farad (F)**

---

21. What is corona discharge ?

- **The total charge of the charged conductor near the sharp edge reduces.**
- **Leakage of charges from the sharp points to the charged conductor.**
- **Corona discharge also known as " action of points "**



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2. Current Electricity

1.Why current is a scalar ?

- **Current has both magnitude and direction.**
- **But the direction of current does not obey vector law of addition.**
- **In general , current is defined as the scalar product of the current density and area vector in which charges cross.**
- **Current (I) may be positive or negative.**
- **Depends on unit vector normal to surface area A.**

$$I = \vec{J} \cdot \vec{A}$$

2.Define current density.

The current per unit area of cross section of the conductor is called current density.

$$J = \frac{I}{A}$$

SI Unit : A m^{-2}

---

3. Distinguish between drift velocity and mobility.

S.NO	Drift Velocity	Mobility
1.	Average velocity acquired by electron inside the conductor when it is subjected to an electric field.	Magnitude of drift velocity per unit electric field.
2.	It is a vector quantity.	It is a scalar quantity.
3.	S I Unit : m s^{-1}	S I Unit : $m^2 V^{-1} s^{-1}$
4.	$\vec{V_d} = \vec{a}\,\tau = = -\mu \vec{E}$	$\mu = \frac{\lvert \vec{V_d} \rvert}{\lvert \vec{E} \rvert} = \frac{-e\,\tau}{m}$

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4. State microscopic form of Ohm's law.

Microscopic form of Ohm's law :

$$\vec{J} = \sigma \vec{E}$$

J ⟶ Current Density

σ ⟶ Conductivity

E ⟶ Electric field

---

5. State macroscopic form of Ohm's law.

Macroscopic form of Ohm's law :

$$V = I R$$

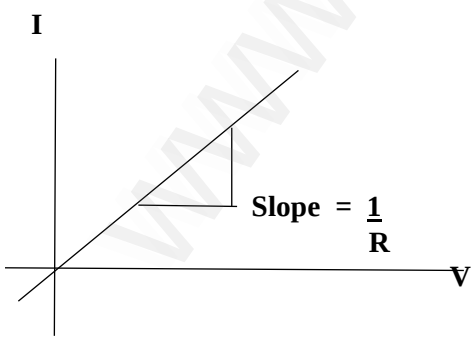
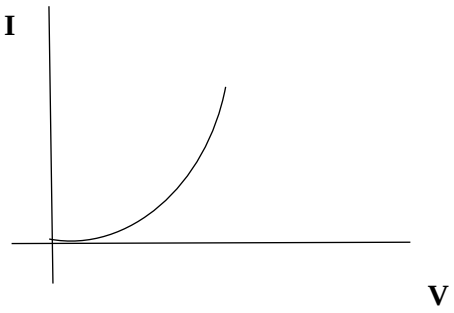
V ⟶ Potential Difference

I ⟶ Current

R ⟶ Resistance

---

6. What are ohmic and non ohmic device ?

S.NO	Ohmic Device	Non Ohmic Device
1.	Material or devices that obey Ohm's law.	Material of devices that do not obey Ohm's law.
2.	A graph of I against V is linear .(straight line)	A graph of I against V is non-linear
3.		

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7. Define electrical resistivity .

It is defined as resistance offered to current flow by a conductor of unit length having unit area of cross section. S I Unit : Ω m

$$\rho = \frac{R\ A}{l}$$

8.Define temperature coefficient of resistance.

It is defined as the ratio of increase in resistivity per degree rise in temperature to its resistivity.

$$\alpha = \frac{\rho_T - \rho_0}{\rho\,(T - T_0)} = \frac{\Delta\rho}{\rho\,\Delta T}$$

9.Write a short note on super conductor.

The resistance of certain materials become zero below certain temperature T_C . This temperature is known as critical temperature or transition temperature . The materials which exhibit this property are known as super conductor.

Ex : Mercury exhibits super conductor at 4.2 K [R = 0]

10.What is electric power and electric energy?

Electric Power :

The rate at which the electrical potential energy is used. Unit : Watt

$$P = \frac{W}{t} = V\ I$$

Electrical Energy :

Electrical energy is the product of electric power and time.

Unit : Watt hour (1 K W h = 3.6 X 10^6 J)

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11. Derive the expression for power P = V I in electrical circuit.

1. $P = \frac{dU}{dt}$ ($dU = V\,dQ$)

2. $P = \frac{V\,dQ}{dt}$

3. $P = V\,I$

---

12. Write down the various forms of expressions for power in electrical circuits.

Power : $P = V\,I$

Ohm's Law : $V = I\,R$

1. $P = (I\,R)\,I = I^2\,R$

2. $P = V\,(\frac{V}{R})$

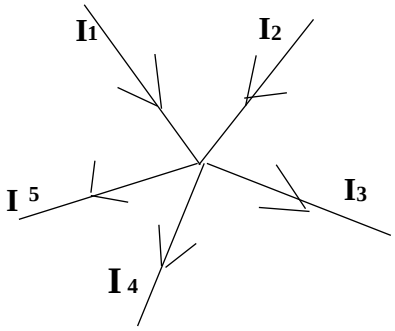
---

13. State Kirchoff's current rule.

Kirchhoff's First Rule:

- **Current rule or junction rule.**
- **It states that the algebraic sum of currents of any junction of a circuit is zero.**
- **Charge enter a junction must leave the junction.**
- **Current entering the junction as positive, current leaving the junction as negative.**
- $I_1 + I_2 - I_3 - I_4 - I_5 = 0$

  $I_1 + I_2 = I_3 + I_4 + I_5$
- **Law of conservation of electric charge.**



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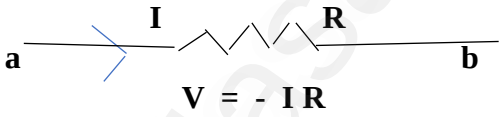
14. State Kirchhoff's voltage rule.

Kirchhoff's Second Rule:

- **Voltage rule or loop rule.**
- **It states that in a closed circuit the algebraic sum of the products of the current and resistance of each part of the circuit is equal to total emf included in the circuit.**
- **Law of conservation of energy.**
- **Product of current and resistance is taken as positive when the direction of current is followed.**

- **Product of current and resistance is taken as negative if the direction of current is opposite.**



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15. State the principle of potentiometer.

- **The emf of the cell is directly proportional to the balancing length.**

$$\varepsilon \propto l$$

$$\varepsilon = I r l$$

When constant current flows through a wire of uniform cross – sectional area , the potential drop across any length of the wire is directly proportional to that length.

---

16. What do you mean by internal resistance of a cell ?

The battery is made of electrodes and electrolyte , there is resistance to the flow of charges with in the battery . This resistance is called " Internal resistance "

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17. State Joule's law of heating.

It states that , Heat developed in an electrical circuit due to flow of current varies directly as,

1. **Square of the current**
2. **Resistance of the circuit**
3. **Time of flow of current**

$$H = I^2 R t$$

---

18. What is Seeback effect.

- **Seeback discovered that in a closed circuit consisting of two dissimilar metals , when junctions are maintained at different temperatures an emf is developed.**
- **The current that flows due to the emf developed is called " thermoelectric current ".**
- **The two dissimilar metal connected to form two junctions is known as " Thermocouple "**

---

19. What is Thomson effect ?

- **If two points in a conductor are at different temperatures , the density of electrons at these points will be different.**
- **Due to difference in electron density , The potential difference is created between these points.**

---

20. What is Peltier effect ?

When current is passed through a thermocouple , heat is evolved at one junction and absorbed at other junction.

---

21. State the applications of Seeback effect.

1. **Used in thermoelectric generators to convert waste heat into electricity.**
2. **Used in automobiles for increasing fuel efficiency.**
3. **Used in thermocouples to measure the temperature difference.**

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3. Magnetism & Magnetic effects of electric current

1. What is meant by magnetic induction ?

The magnetic induction inside the specimen is equal to the sum of magnetic field produces in vacuum due to magnetising field and the magnetic field due to induced magnetism of the substance.

$$\vec{B} = \vec{B_0} + \vec{B_M} = \mu \vec{H} + \mu \vec{M}$$

---

2. Define magnetic flux.

The number of magnetic field lines crossing per unit area is called magnetic flux Φ_B .

- **Scalar Quantity.**
- **SI unit : weber**
- **CGS unit : maxwell**
- **Dimension : $M\ L^2\ T^{-2}\ A^{-1}$**

$$\Phi_B = \vec{B} . \vec{A} = B\ A\ \cos\ \theta$$

1 weber = 10^8 maxwell

---

3. Define magnetic dipole moment.

- **Product of pole strength and magnetic length.**
- **It is a vector quantity.**

  It is denoted by $\vec{P_m}$. **SI Unit : $A\ m^2$**

$$\vec{p_m} = q_m \vec{d} = 2\ q_m\ l$$

---

4. State Coulomb' s inverse law.

The force of attraction or repulsion between two magnetic poles is directly proportional to product of their pole strength and inversely proportional to square of the distance between them.

$$\vec{F} \ \alpha \ \frac{q_{m\,A}\, q_{m\,B}}{r^2}\ \hat{r}$$

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5. What is magnetic susceptibility ?

It is defined as the ratio of the intensity of magnetisation ($\vec{M}$) induced in the material to the applied magnetising field $\vec{H}$

$$\chi_m = \frac{|\vec{M}|}{|\vec{H}|}$$

It is a dimensionless quantity.

---

6. State Biot – Savart's law .

Magnetic field due to current element is

- **Directly as strength of current I**
- **Directly as length of element dl**
- **Directly as sine of angle θ between dl and r**
- **Inversely as square as distance r**

$$dB \alpha \frac{I\ dl\ \sin\theta}{r^2}$$

$$dB = \frac{\mu_0}{4\pi} \frac{I\ dl\ \sin\theta}{r^2}$$

---

7. What is magnetic permeability ?

- **Measure of ability of the material to allow the passage of magnetic field lines.**
- **Measure of capacitance of the substance to take magnetisation.**
- **Degree of penetration of magnetic field through the substance.**

---

8. State Ampere's circuital law.

The line integral of the magnetic field over a closed loop μ_0 times net current enclosed by loop .

$$\oint_C \boldsymbol{B}.d\boldsymbol{l} = \mu 0\ I_{\text{enclosed}}$$

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9. Compare dia , para and ferro magnetism. (or)

18. Give the properties of dia / para / ferro materials.

Properties	Dia Magnetism	Para Magnetism	Ferro Magnetism
1. Magnetic susceptibility	χ_m is negative	χ_m is positive & small	χ_m is positive & large
2.Susceptibility	Temperature independent	$\chi_m \alpha \frac{1}{T}$	$\chi_m = \frac{C}{T - T_C}$
3. Relative Permeability	μ_r less than unity	μ_r greater than unity	μ_r is large
4. Magnetic field lines	Repelled or expelled when placed in magnetic field .	Attracted when placed in magnetic field.	Strongly attracted when placed in a magnetic field.
5. Examples	Bismuth , Copper , Water	Aluminium , Platinum , Chromium , Oxygen	Iron , Nickel , Cobalt

---

10. What is meant by hysteresis ?

The phenomenon of lagging of magnetic induction behind the magnetising field is called hysteresis.

---

11. Define magnetic declination and inclination.

Magnetic Declination :

Angle between magnetic meridian at a point and geographical meridian.

Magnetic Inclination :

Angle subtended by Earth's total magnetic field $\vec{B}$ with horizontal direction in the magnetic meridian.

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12. What is resonance condition in cyclotron ?

When the frequency ' f ' at which the positive ion circulates in the magnetic field becomes equal to the constant frequency of the electrical oscillator f_{osc}. This is called as " resonance condition".

$$f_{osc} = \frac{q\ B}{2\ \pi\ m}$$

---

13. Define one ampere.

One ampere is defined as that constant current which when passed through each of the two infinitely long parallel straight conductor kept side by side parallelly at a distance of one metre apart in air or vacuum causes each conductor to experience a force of 2×10^{-7} newton per metre length of conductor.

14.State Fleming's left hand rule.

Stretch out fore finger , the middle finger and the thumb of the left hand such that they are in three mutually perpendicular directions.

- **Fore finger points in the direction of magnetic field.**
- **Middle finger points in the direction of the electric current.**
- **Thumb points in the force experienced by the conductor.**

---

15. Is an ammeter connected in series or parallel in a circuit . why ?

The ammeter is connected in series in a circuit because it si a low resistance instrument. Such that it will not change the current passing through it.

---

16. Explain the concept of velocity selector.

By proper choice of electric field $\vec{E}$ and magnetic field $\vec{B}$ inside an arrangement

- **such as Bainbridge mass spectrometer.**
- **The particle with particular speed can be selected .**
- **This speed is independent of mass and charge.**
- **Such an arrangement of fields is called velocity selector**

$$V = \frac{E}{B}$$

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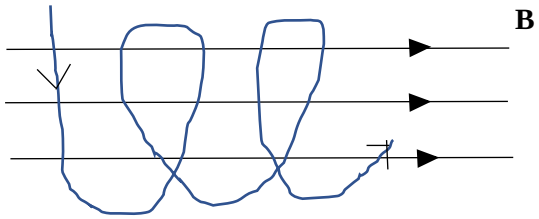
17. Why is the path of a charged particle not a circle when its velocity is not perpendicular to the magnetic field ?

- **If a charged particle moves in uniform magnetic field , then velocity of a particle is split up into two components :**

1. **One component parallel to the field which remains unchanged.**
2. **Other component perpendicular to the field keeps changing due to Lorentz force.**
3. **Hence , the path of particle is not a circle. It is a helical around field lines.**



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19. What happens to the domains in a ferromagnetic material in the presence of external magnetic field ?

1. The domains having magnetic moments parallel to the field grow bigger in size.

2. The other domains are rotated so that they are aligned with the field.

---

20. How is a galvanometer converted into i) an ammeter ii) a voltmeter.

1. **A galvanometer can be converted into an ammeter of given range by connecting a suitable low resistance S called shunt in parallel to the galvanometer.**
2. **A galvanometer can be converted into a voltmeter by connecting a suitable High resistance R called shunt in parallel to the galvanometer.**

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4.Electromagnetic induction & Alternating current

1. What is meant by electromagnetic induction ?

Whenever the magnetic flux linked with a closed coil changes , an emf is induced and hence an electric current flows in the circuit .This phenomenon is known as " electromagnetic induction "

2.State Faraday's laws of electromagnetic induction.

Faraday's first law :

Whenever magnetic flux linked with a closed circuit changes , an emf is induced in the circuit which lasts in the circuit as long as the magnetic flux is changing.

Faraday's second law :

The magnitude of induced emf in a closed circuit is equal to the time rate of change of magnetic flux linked with the circuit.

$$\varepsilon = \frac{d\,\Phi_B}{dt} = \frac{d}{dt}(N\,\Phi_B)$$

---

3. State Lenz's law.

- **Len's law states that direction of the induced current is such that it always opposes the cause responsible for its production.**

$$\varepsilon = -\frac{d}{dt}(N\,\Phi_B)$$

- **Negative sign signifies that the direction of induced emf is such that it opposes the change in magnetic flux.**

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4. How is Eddy current produced ? How do they flow in a conductor ?

- **Even for a conductor in the form of sheet or plate , an emf is induced when magnetic flux linked with it changes.**
- **There is no definite loop or path for induced current to flow away.**
- **The induced current flow in concentric circular path.**
- **The electric current resemble eddies of water.**
- **This is known as " Eddy current " or "Foucault current ".**

---

6. Mention the ways of producing induced emf.

1. **By changing the magnetic field (B)**
2. **By changing the area of the coil (A)**
3. **By changing the relative orientation of the coil with magnetic field (θ)**

$$\varepsilon = \frac{d\,\Phi_B}{dt} = \frac{d}{dt}(BA\cos\theta)$$

7.What for an inductor is used ? Give some examples.

Inductor is a device used to store energy in a magnetic field when an electric current flows through it.

EX : Coils , Solenoid , Toroid's

---

8. What do you mean by self – induction ?

If magnetic flux is changed by changing the current , an emf is induced in that same coil. This phenomenon is known as " self – induction ".

$$N\,\Phi_B \propto i$$
$$N\,\Phi_B = L\,i$$

---

9. What is meant by mutual induction ?

When an electric current passing through a coil changes with time , an emf is induced in the neighboring coil. This phenomenon is knowns mutual induction.

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10. Give the principle of AC generator.

- **Based on the principle of electromagnetic induction.**
- **Relative motion between conductor and magnetic field changes.**
- **Magnetic flux linked with the conductor induces an emf.**
- **Magnitude of emf given by Faraday law of electromagnetic induction.**
- **Direction by Fleming's right hand rule.**

11.List out the advantages of stationary armature rotating field system of AC generator.

1. **The current is drawn directly from fixed terminals on the stator without the use of brush contacts.**
2. **The insulation of stationary armature winding is easier.**
3. **The number of sliding contact is reduced. The sliding contacts are used for low – voltage DC source.**
4. **Armature windings can be constructed more rigidly to prevent deformation due to any mechanical stress.**

12.What are step- up and step- down transformer ?

Step – up transformer

If the transformer converts an alternating current with low voltage into an alternating current with high voltage , it is called as step – up transformer.

Step – down transformer

If the transformer converts an alternating current with high voltage into an alternating current with low voltage , it is called as step – down transformer.

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13. Define average value of an alternating current.

The average (mean) value of alternating current is defined as the average of all values of current over a positive half – cycle or a negative half – cycle.

$$I_{av} = \frac{\text{Area of + ve (- ve) half cycle}}{\text{Base length of half cycle}}$$

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14. How will you define RMS value of an alternating current ?

The root mean square value of an alternating current is defined as square root of the square of all current over one cycle.

$$I_{RMS} = \sqrt{\frac{\text{Area of one cycle of squared wave}}{\text{Base length of one cycle}}}$$

15.What is phasors ?

A sinusoidal alternating voltage or current represented by a vector which rotates about the origin in anti – clockwise direction at constant angular velocity ω . Such a rotating vector is called phasor.

16.Define electric resonance .

When the frequency of the applied alternating source (ω_r) is equal to the natural frequency $1 / \sqrt{LC}$ of the RLC circuit , the current in the circuit reaches it maximum value. Then the circuit is said to be electrical resonance.

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17. What do you mean by resonant frequency ?

When the frequency of the applied alternating source (ω_r) is equal to the natural frequency $1 / \sqrt{LC}$ of the RLC circuit , the current in the circuit reaches it maximum value. Then the circuit is said to be electrical resonance.

$$f_r = \frac{1}{2\pi\sqrt{LC}}.$$

The frequency at which resonance takes place is called resonant frequency.

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18. How will you define Q – factor ?

It is defined as the ratio of voltage across L or C to the applied voltage.

$$Q - \text{factor} = \frac{\text{Voltage across L or C}}{\text{Applied voltage}} = \frac{1}{R}\sqrt{\frac{L}{C}}$$

19.What is meant by wattless current ?

The current in an AC circuit is said to be wattless current if the power consumed by it is zero.

This wattless current occurs in purely inductive or capacitive circuit.

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20. Give any one definition of power factor.

The power factor of a circuit is defined in one of the following ways :

1. **Power Factor = cos Φ**
2. **Power Factor = cosine angle of lead or lag**
3. **Power Factor = $\frac{R}{Z} = \frac{\text{Resistance}}{\text{Impedance}}$**
4. **Power Factor = $\frac{P_{av}}{V_{RMS}\, I_{RMS}} = \frac{\text{True Power}}{\text{Apparent Power}}$**

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21. What are Lc oscillations ?

1. **Whenever energy is given to a circuit containing pure inductor of inductance L and capacitor of capacitance C.**
2. **The energy oscillates back and forth between the magnetic field of inductor and electric field of capacitor.**
3. **The electrical oscillations of definite frequency are generated. These oscillations are called LC oscillations.**

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5.Electromagnetic waves

1. What is displacement current ?

The displacement current can be defined as the current which comes into play in the region in which electric field and electric flux is changing with time.

$$i_d = \varepsilon_0 \frac{d\,\Phi_E}{dt}$$

---

2. What are electromagnetic waves ?

- **Electromagnetic waves is a transverse wave.**
- **Electromagnetic waves are non mechanical waves they do not require any medium for propagation.**
- **Electromagnetic waves is radiated by an accelerated charge which propagates through space as coupled electric and magnetic fields , oscillating perpendicular to each other and to the direction of propagation of the wave.**

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3. Write down the integral form of modified Ampere's circuital law.

Integral form of modified Ampere's circuital law,

$$\oint_l \vec{B} \cdot \vec{dl} = \mu_0 i_c + \mu_0 \epsilon_0 \frac{d}{dt} \int_S \vec{E} \cdot \vec{dA}$$

---

4. Write down the Gauss's law in magnetism.

* **The surface integral of magnetic field over a closed surface is zero.**

$$\oint \vec{B} \cdot \vec{dA} = 0$$

Where B is the magnetic field

1. **Magnetic lines of force form continuous closed path.**
2. **No isolated magnetic monopole exists.**

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5.Give two uses each of i) I R radiation ii) Micro waves iii) U V radiation

i) I R Radiation :

1. **Produce dehydrated fruits.**
2. **Keep plants warm in green house.**
3. **Heat therapy for muscular pain or sprain.**
4. **T V remote as a signal carrier.**
5.

ii) Micro waves :

1. **Used in radar system for air craft and navigation .**
2. **Used in microwave oven for cooking.**
3. **Used in speed of the vehicle.**

iii) U V radiation :

1. **Used to study atomic structure.**
2. **Used to detect invisible finger prints.**
3. **Used in burglar alarm.**
4. **Used to destroy bacteria in sterilize surgical instrument.**

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6. What are Fraunhofer lines ? How are they useful in the identification of elements present in the sun ?

- **Dark lines seen in the solar spectrum are known as Fraunhofer lines.**
- **It is used to identify the elements present in the sun.**

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7. Write notes on Ampere – Maxwell law.

- **This law relates the magnetic field around any closed path to the conduction current and displacement current through the path.**

$$\int_{l} \vec{B} \cdot \vec{dl} = \mu_0 i_c + \mu_0 \epsilon_0 \frac{d}{dt} \int_{S} \vec{E} \cdot \vec{dA}$$

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8. Why are em waves are non – mechanical ?

- **Electromagnetic waves do not require any medium for propagation.**
- **So em waves are non – mechanical wave.**

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