

# PHYSICS

## KEY TERMS

**Electromagnetic Induction &  
Alternating Current**

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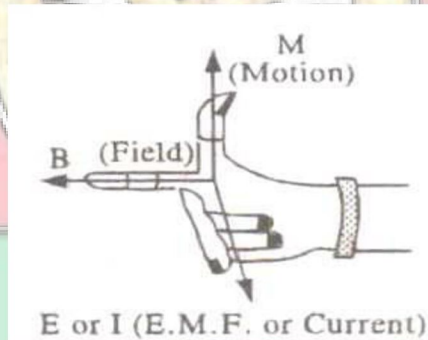
### 1. Faraday's laws of Electromagnetic Induction

**First Law:** Whenever magnetic flux linking with a coil changes, an e.m.f. is induced in the coil. This induced e.m.f. lasts so long as the change in magnetic flux continues.

**Second Law:** The magnitude of the induced e.m.f.  $|\mathcal{E}|$  produced in a coil is directly proportional to the rate of change of magnetic flux  $d\phi/dt$  linked with it.

i.e. 
$$|\mathcal{E}| = \frac{d\phi}{dt}$$

- Lenz's law.** The induced e.m.f. opposes the cause which produces it.
- Fleming's Right Hand Rule.** If the right hand is stretched such that the first finger, the central finger and the thumb are mutually perpendicular to each other and the first finger points along the direction of **magnetic field** and the *thumb* points along the direction of the motion of the conductor, then the direction of **induced e.m.f.** (and hence *current*) will be along the direction of the middle finger (see figure). Thus, The first finger gives direction of magnetic Field. The thumb gives direction of Motion  $v$  or force  $F$ . The middle finger gives direction of induced e.m.f.  $\mathcal{E}$  or current  $i$ .



- Motional E.M.F.** Induced e.m.f. produced **changing the area** of a closed circuit by the movement of the circuit or part of it through a uniform magnetic field is known as **motional e. m. f.**
- Eddy Currents (Foucault Currents).** The induced circulating currents produced in a metal itself due to change in magnetic flux linked with the metal are called **eddy currents**.

Notes : These currents were discovered by Foucault, so they are also known as **Foucault Currents**.

6. **Self Induction.** It is the property of a coil by virtue of which it opposes the growth or decay of the current flowing through it.
7. **Self inductance or coefficient of self induction.** It is defined as the induced e.m.f. produced in the coil through which the rate of decrease of current is unity.

**OR**

It is defined as the magnetic flux linked with a coil when unit current flows through it.

8. **Mutual Induction.** It is the phenomenon of inducing e.m.f. in a coil due to the rate of change of current in a nearby coil.
9. **Mutual inductance or coefficient of mutual induction** of the two coils or circuits can be defined as the magnetic flux linked with the secondary coil due to the flow of unit current in the primary coil.

**OR**

Mutual inductance of two coils can be defined as the induced e.m.f. produced in the secondary coil due to unit rate of decrease of current in the primary coil.

10. **henry (H)** is the S.I. unit for self or mutual induction. Self or mutual inductance is said to be one henry when 1 weber of magnetic flux links with a coil on the passage of 1 ampere of current through it.
11. **Alternating Current (A.C.).** An electric current, magnitude of which changes with time and polarity reverses periodically is called **alternating current (A.C.)**
12. **Mean or Average value ( $I_{av}$ ) of alternating current** is that value of steady current which sends the same amount of charge through a circuit in a certain time interval as is sent by an alternating current through the same circuit in half cycle.
13. **Root Mean Square (R.M.S.) value of Alternating Current** is defined as that steady current which produces the same amount of heat in a conductor in a certain time interval as is produced by the a.c. in the same conductor during the time period  $T$  (i.e. full cycle).  
Root mean square value of a.c. is also known as effective value ( $I_{eff}$ ) or virtual value ( $I_{av}$ ).
14. **Impedance (Z).** The total effective opposition offered by inductance, capacitance and resistance (LCR) circuit to alternating current is called impedance. S.I unit of impedance is  $\Omega$ .

15. **Admittance.** Reciprocal of impedance of a circuit is known as admittance.

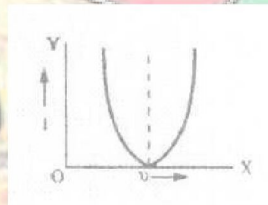
Popular units of admittance are mho ( $\square$ ) or ohm<sup>-1</sup> ( $\square^{-1}$ ) and siemen (S).

16. **LC-oscillations.** Electrical oscillations produced by the exchange of energy between a capacitor which stores electrical energy and an inductor which stores magnetic energy are called L.C oscillations.

17. **Damped Oscillation.** The oscillations in which amplitude with time such that finally the oscillation die off are called damped oscillations.

18. **Electrical Resonance –Series LCR Circuit** is said to take place in a series LCR circuit when the circuit allows maximum current for a given frequency of alternating supply for which capacitive reactance becomes equal to the inductive reactance.

**Notes :** In the case of a parallel L and C circuit, the resonance occurs when  $X_L = X_C$   $\therefore v_0 = 1/2\pi\sqrt{LC}$  but under this condition  $I = 0$  i. e. at resonance a parallel L and C circuit does not allow any current to flow.



19. **Quality Factor (Q-factor) of Resonance Circuit** is defined as  $2\pi$  times the ratio of the energy stored in the circuit to the energy dissipated in resistance per cycle of a.c. supply.

$$\text{i.e. } Q = \frac{2\pi \times \text{energy stored in the circuit per cycle}}{\text{energy dissipated per cycle}}$$

20. **True power in an a.c. circuit.** It is the product of r.m.s. value of voltage  $E_r$ , and r.m.s. value of the current component ( $I_r \cos \phi$ ) in phase with voltage i.e.

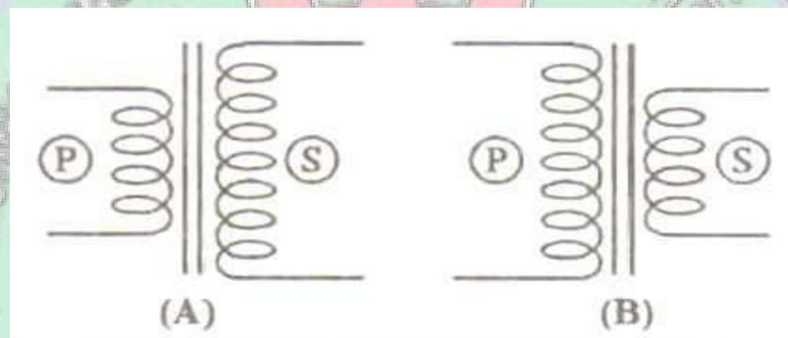
$$P_r = E_r I_r \cos \phi$$

21. **Power factor.** It is the ratio of true power  $P_r$  and virtual power  $P$  in an a.c. circuit i.e.

$$P.F. = \cos \phi = \frac{P_r}{P}$$

22. **Wattless Current.** It is that component of circuit current due to which the power consumed in the circuit is zero.

23. **Wattful Current.** It is that component of the circuit current due to which power is consumed in the circuit.
24. **Choke.** It is basically an iron cored wire wound inductor used to control current in an a.c. circuit without much loss of energy.
25. **Transformer** is a device used to convert low alternating voltage at higher current into high alternating voltage at lower current and vice-versa. In other words, a transformer is an electrical device used to increase or decrease alternating voltage.
26. **Step-up transformer.** The transformer which converts low alternating voltage at higher current into a high alternating voltage at lower current is called step-up transformer [Figure(A)].
27. **Step-down transformer.** The transformer which converts high alternating voltage at lower current into a low alternating voltage at higher current is called step-down transformer [Figure(B)].



28. **A.C. generator (Alternator).** An electrical machine used to convert mechanical energy into electrical energy is called alternator.

Note : if any mistake on this, kindly inform on the mail id :

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Your Observation! Our Correction !!