**Transformer :→** A Transformer is a static device which is used to transform the voltage from one level to another level.

Transformer contains two windings which are wound on a common magnetic core.

These windings are known as :

primary winding :→ This winding is connected to the source (AC source)

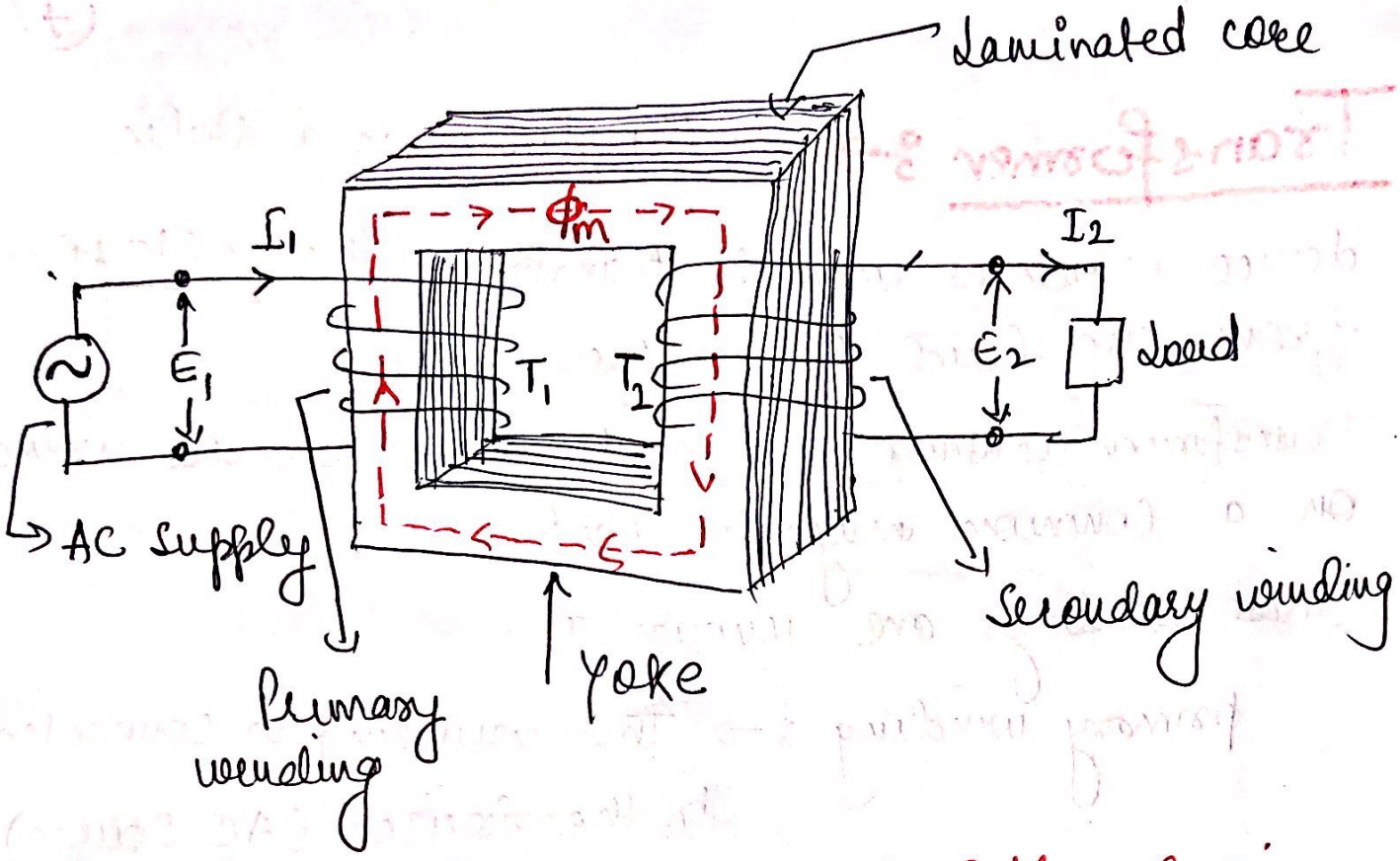
Secondary winding :- This winding is connected to the load. (or load is connected to the secondary winding)

Broadly, a transformer contains three major parts :

→ windings → primary
→ secondary

→ core :- made up of thin laminated sheets of the magnetic material.

→ Enclosure :- The core and windings are enclosed.




$\Phi_m$ = peak value of the mutual flux linking the two windings

$T_1, T_2$ → No. of turns of primary and secondary windings respectively

$E_1, E_2$ → emfs induced in primary and secondary windings respectively.

$E_1$ induces due to self induction in primary winding

$E_2$ is induced due to MUTUAL induction in secondary winding

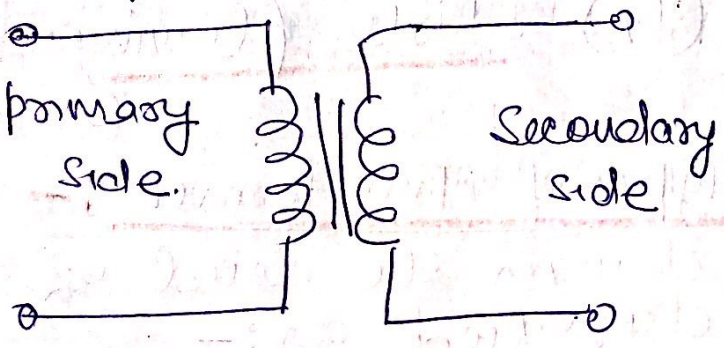
$I_1, I_2$ → currents in primary and secondary windings respectively.

the important point about transformer is that it only changes the level of the voltage. It does not changes the frequency of the signal. That means, the frequency of the signal at primary side and frequency of the signal at the secondary side of the transformer remains same.

## Working of Transformer :→

Transformer works on the principle of mutual Induction.

However, basic principle is based on Faraday's law of Electro-Magnetic Induction. The working of a transformer can be understood through following steps:




* The AC supply is given at primary side of the transformer.
* Because the nature of AC supply is sinusoidal. (i.e time varying). This time varying voltage generates flux in the core at primary side. (flux generated is also time varying).
* The flux generated at the primary side of core travels through the yoke and reaches to the secondary side of the core.
* The flux then gets linked with the secondary

winding.

(*) The nature of this flux is also sinusoidal (i.e time varying).

(*) Due to this time varying flux ~~(ϕ)~~, emf ($E_2$) is induced in the secondary winding of the transformer by the principle of mutual induction.

The induced emf is given by:

$$e_2 = -T_2 \frac{d\phi}{dt}$$

$e_2 \Rightarrow$ Instantaneous value of $E_2$.

(*) Eventually, when load is connected to the secondary side of the transformer, current ($I_2$) starts flowing.

**Types of Transformer:-** Because, a transformer changes the level of the voltage, so, it is classified as:-

→ Step up Transformer: In this, the output voltage is greater than input voltage.

→ Step down Transformer: In this, the output voltage is less than the input voltage.

**Ideal Transformer :→** An ideal transformer is an imaginary transformer with following properties:

1) **Zero Resistance :→** In ideal transformer, the primary and secondary winding have zero resistance.

2) **Infinite Permeability :→** The core of an ideal transformer is infinite. This means that negligible mmf is sufficient to establish the significant flux in the core.

3) **No Losses :→** Because the windings of the transformer do not have resistance, Hence ideal transformer does not have losses due to resistance. Also, ideal transformer does not have hysteresis and eddy current losses.

4) **Efficiency :-** Because the ideal transformer does not have any type of losses. So, it has 100% efficiency.

5) **No flux leakage :-** An ideal transformer does not have any flux leakage and leakage inductance. This means that the entire flux (established in core) remains within the core.

However, a practical transformer does not possess all these characteristics. But the operation of an ideal transformer is close to an ideal ~~transfo~~ transformer. So, we can say that, a practical transformer has or must have:

1) minimum winding resistance and hence minimum losses due to winding resistances.
2) High permeability
3) Minimum losses due to eddy currents and hysteresis.
4) High or good efficiency
5) Minimum flux leakage.