Transformer: Introduction and Principle of Working

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INTRODUCTION:

Transformer is a static device (having no moving parts) which transfers electric energy from one circuit to another circuit at the same frequency by the process of electromagnetic induction.

The transformer has two or more stationary electrical circuits which are coupled magnetically.

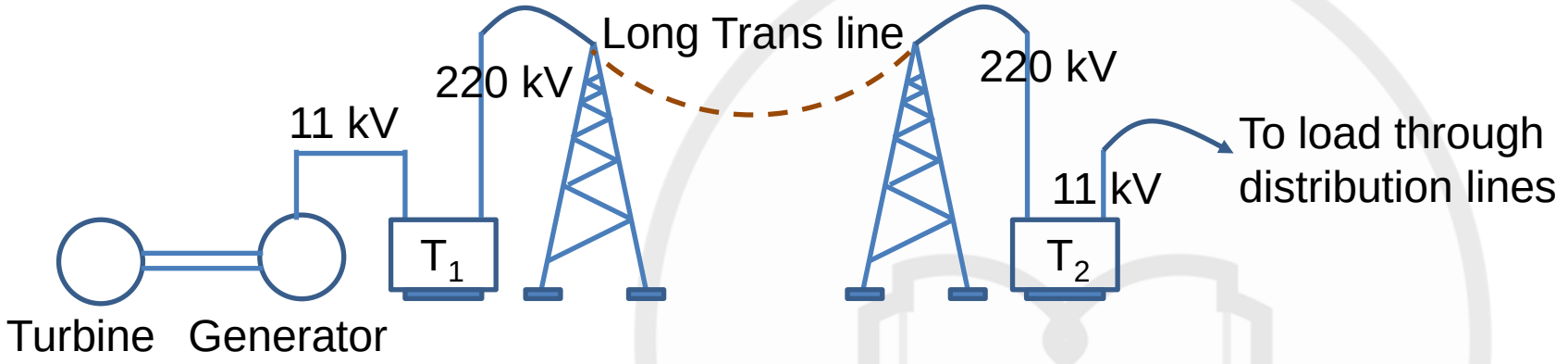
It interchanges the electric energy from one circuit to another circuit with changed values of voltage and current.

Transformer is not an energy converting machine.

However, it is an important machine in many energy conversion systems.

Transformer is not a rotating machine, but its analysis involves many principles necessary to study rotating machines.

APPLICATIONS OF TRANSFORMERS:



In AC power system, transformer is used to change the current and voltage levels easily.

A transformer steps up the voltage generated by a generator for transmission purpose and again steps down the voltage at various levels for proper distribution and utilization.

In communication system, transformers perform multiple functions like –

- Input transformer
- Output transformer
- Impedance matching device for improved power transfer
- Isolation device for blocking the DC signal etc.

APPLICATIONS OF TRANSFORMERS:

Transformers are used in circuits of various voltage levels: from microvolt in electronic circuits to very high voltage levels of 765 kV in high power transmission system.

In many electronic circuits and equipment, low voltage AC or DC supply is required. It is obtained by a step-down transformer of lower capacity.

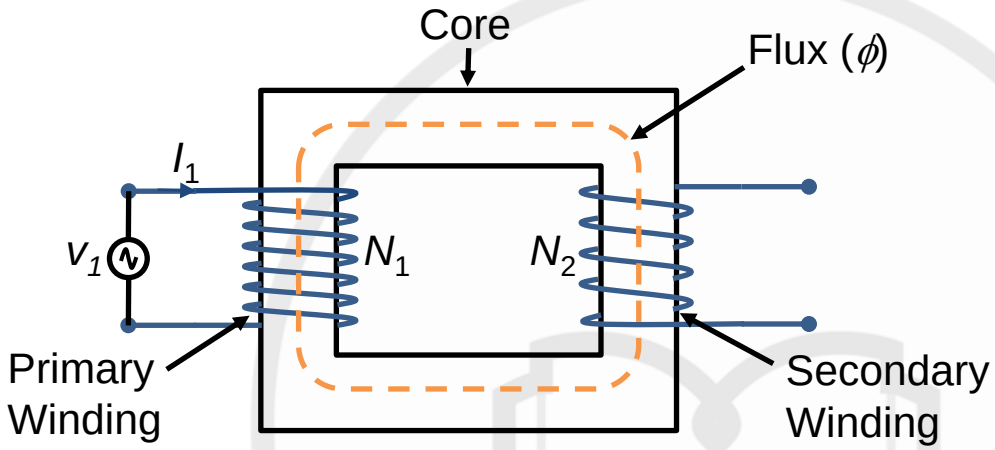
Thus, transformers find wide applications in electrical and electronics engineering field.

It is impossible to imagine an AC system without a transformer.

SINGLE PHASE TRANSFORMERS:

- Principle of working
- EMF Eqaution and transformation ratio
- Concept of an ideal transformer
- Winding resistance and leakage reactance of transformer
- Equivalent circuit and phasor diagram of transformer
- Losses, efficiency and regulation of transformer
- Testing of transformers – Direct loading test, OC and SC test and Back-to-back test
- Parallel operation of transformers
- Auto-transformer
- Numerical problems

PRINCIPLE OF WORKING:



Transformer in its simplest form consists of two windings insulated from each other and wound on a common core made up of magnetic material.

Alternating voltage is connected across one of the windings called as primary winding.

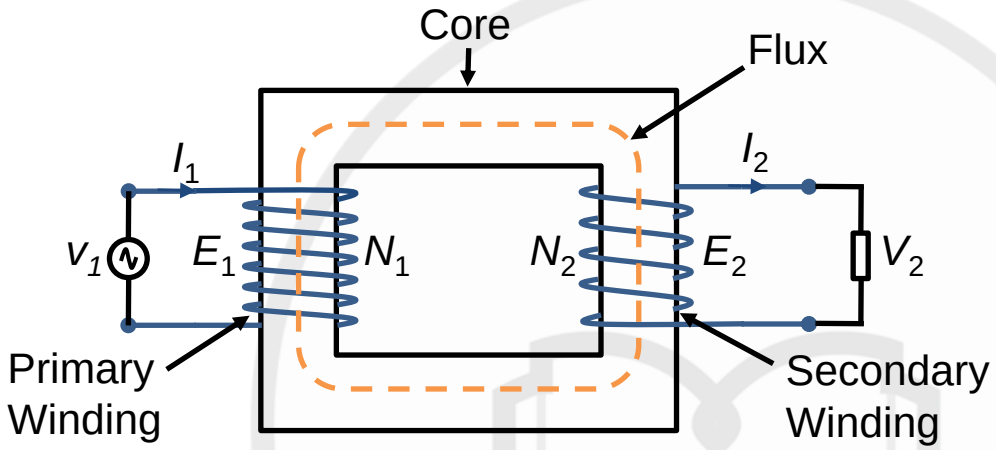
The second winding is called as secondary winding.

When primary winding is connected to an AC source, an exciting current I_1 Amp flows through the primary number of turns N_1.

It will produce an alternating flux in the core which will be linked with both the primary and secondary windings.

The flux in the core will alternate at the same frequency as the frequency of the supply voltage.

PRINCIPLE OF WORKING:



The alternating flux cuts the primary turns N_1 and produces self induced emf of E_1 volts in the primary winding according to Faraday's law of electromagnetic induction.

The induced emf in the primary winding E_1 is almost equal to the applied voltage V_1 and it will oppose the applied voltage.

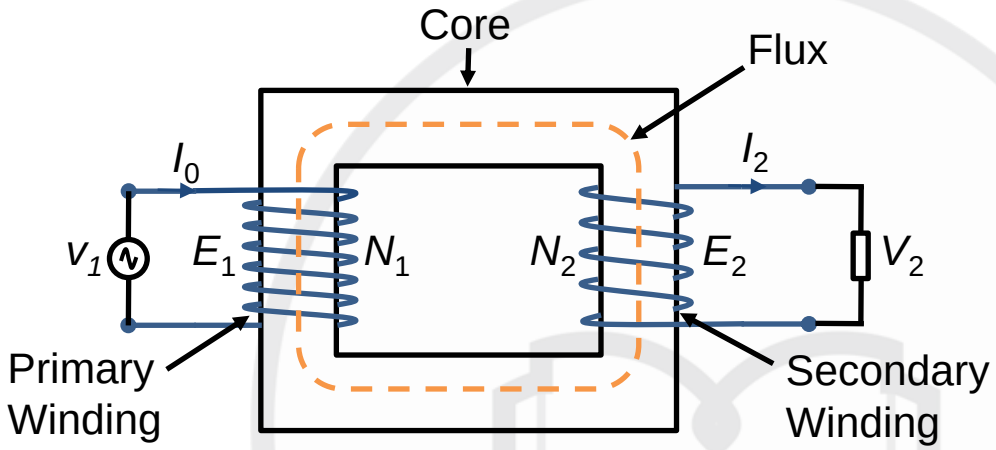
Similarly, mutually induced emf of E_2 volts is indued in the secondary winding.

This emf can be utilized to deliver the power to load which is connected across secondary winding.

Thus, the power is transferred from the primary to the secondary circuit by electromagnetic induction.

The induced emfs in the windings will also have the same frequency as the frequency of the supply voltage.

PRINCIPLE OF WORKING:



The magnitude of emf induced in the secondary winding depends on the number of turns N_2 in the secondary winding.

So, if the number of turns in the secondary winding N_2 is greater than the number of turns in the primary winding N_1, a higher voltage can be produced.

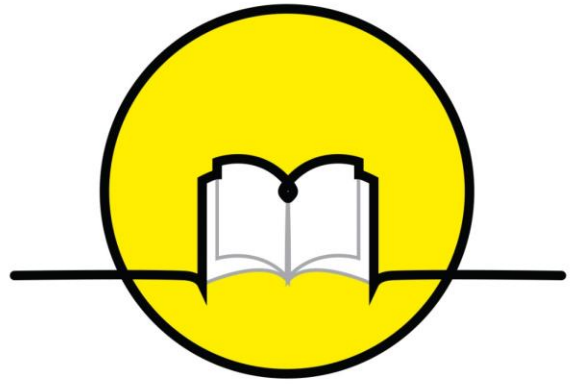
Such a transformer is called as step-up transformer.

If the secondary turns are less than the primary, it leads to a lower output voltage.

Such a transformer is called step-down transformer.

However, a transformer can be used as step-up or step-down depending on the way it is connected.

If the low voltage winding is used as primary it can be used as step-up, while it can be used as step-down if the high voltage winding is used as primary.



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