

ENERGY CONVERSION-I

[TH-1]

4TH SEM ELECTRICAL ENGG.

Under SCTE&VT, Odisha

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SINGLE PHASE TRANSFORMER

(4th semester Electrical, E.C-1)

What is a Transformer?

- As the name suggest, Transformer transfers electrical power from one electrical circuit to another electrical circuit. It does not change the value of power.
- Transformer doesn't change the the circuit frequency during operation.
- Transformer works through on electric i.e. mutual induction.
- Transformer operates when both circuits take effect of mutual induction.
- Transformer can't step-up or step-down the level of DC voltage or DC Current.
- Transformer only step-up or step-down the level of AC voltage or AC Current.
- Transformer doesn't change the value of flux.
- Transformer won't operate on DC Voltage.

Without transformers the electrical energy generated at generating stations won't probably be sufficient enough to power up a city. Just imagine that there are no transformers. How many power plants do you think have to be set up in order to power up a city? It's not easy to set up a power plant. It is expensive.

Numerous power plant have to be set up in order to have sufficient power. Transformers help by amplifying the Transformer output (stepping up or down the level of voltage or current).

When the number of turns of the secondary coil is greater than that of primary coil, such a transformer is known as step up transformer.

Likewise when the number of turns of coil of primary coil is greater than that of secondary transformer, such a transformer is known as step down transformer.

Main Parts of a Transformer

Several parts of the transformer are given different function with the works as follow.

1. Laminated Iron Core
2. Winding of the Transformer
3. Insulating Material
4. Tap Changer
5. Transformer Tank
6. Oil Conservator Tank
7. Breather
8. Buchholz Relay
9. Bushing
10. Cooling Tube and Radiator
11. Explosion Vent

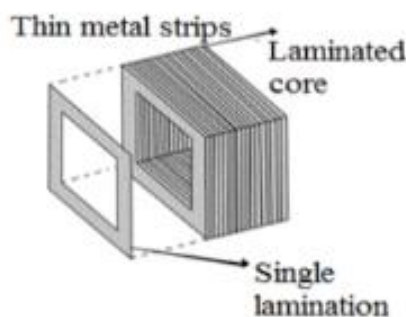


1. Laminated Iron Core

A core of the transformer is made up of iron or silicon steel or ferromagnetic materials.

The main function of Core to support the winding and to provide a flux flowing path in the magnetic circuit.

The soft iron core which made by the thin metal strips lamination. Each metal strip has thickness near about the 0.5mm. In the below figure, you can see the number of metal strips connected to each other with the lamination layer and form a single core.



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It provides a low reluctance path and high permeability for the flux in the magnetic circuit. And this lamination of the core helps to reduce the eddy current loss and hysteresis loss.

2. The winding of the Transformer

The transformer winding is consists of several turns of the copper coil. It is wrapped around the limb or core with the lamination. These windings laminated by the insulation coating because it prevents the short circuit condition.

The winding of the transformer is separated by the primary side and secondary side.

On the bases of supply two types as

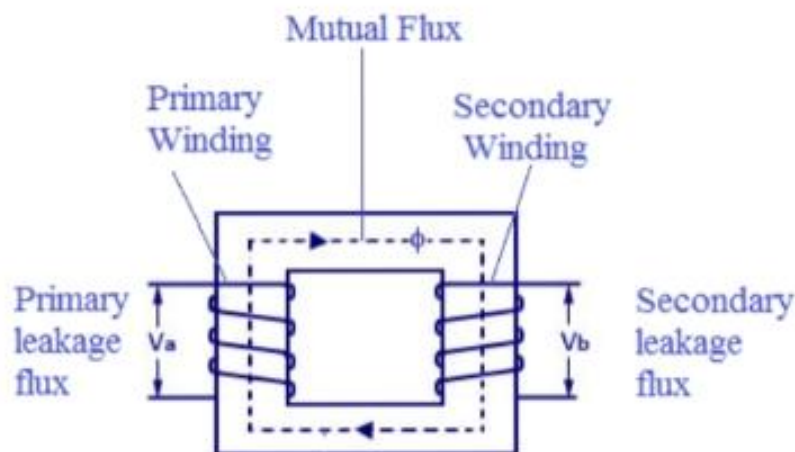
- High voltage winding
- Low voltage winding

Simply two types of winding are used as

- Concentric types winding
- Sandwich types winding

I. Concentric types of Winding(CORE TYPE)

Concentric types of windings are generally used in core types of transformer. It contains the only single path for mutual flux (Φ). And these flowing flux are equally distributed on the side limbs of the core.



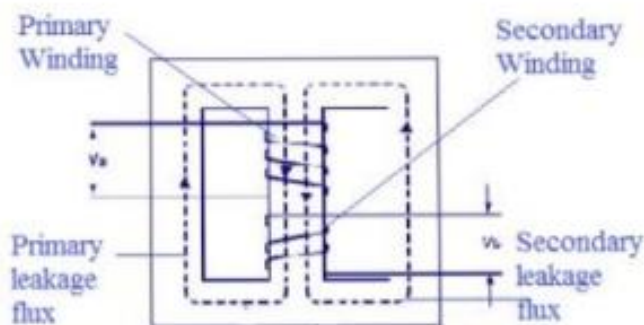
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In these core types of the transformer, windings are surrounded by the core. So, it requires a huge amount of copper coil and laminated materials.

II. Sandwich types of the Winding(SHELL TYPE)

Sandwich types of winding are used in shell types winding. In shell-type winding, the primary and secondary winding is placed on the central limb.

This central limb carries two flux paths (mutual flux and leakage flux) in the magnetic circuit.



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You can see the above diagram, in shell types of the transformer, the core surround by the winding.

3. Insulating Material

In the transformer, insulating materials rely on their voltage rating. Different types of insulating materials are used in the transformer.

These insulating materials maybe a transformer oil, insulating paper, wood, the insulating glass material, tap changer insulating coil from grounding, etc.

4. Tap Changer

Tap changer to regulate supply voltage or load and maintain both conditions by changing the variable turn.

The tap changer is easily removed the first turn and connect the next turn ratio. Tap changers can occur on the primary side or secondary side.

Generally, tap changer use in the high voltage winding side because it reduces load current.

Classification of Tap Changer –

It is classified into two following category,

- No-load tap changer
- On-load tap changer

5. Transformer Tank

The transformer tank is a cylindrically shaped tank. It is made of steel metal with a high thickness. Core and transformer winding is placed in the transformer tank.

The transformer tank is needed to store the oil especially mineral oil. This oil provides insulation and cooling to the transformer winding.

6. Oil Conservator Tank

The oil conservator tank looks like a rectangular tank. It stores the extra oil and directly connected with the transformer tank.

The oil conservator tank is played an important role in the transformer.

The purpose of the conservator tank is to protect the expansion of oil in the main tank of the transformer. The oil is used in the transformer two purposes-

- Insulation
- Cooling

When the oil level reduces due to losses or leakage, the conservator will be delivering oil to the transformer. Thus, It acts as reservoir oil.

7. Breather

Breather is connected with the conservator tank. It is a cylindrical vessel which filled blue color silica gel.

They have two purposes -remove the moisture from the air and to have the capacity to absorb the moisture in a transformer.

It plays a role to act as the air filter and provide the free moisturizing air to the conservator tank.