



ELEMENTS OF ELECTRICAL ENGINEERING

Course Code : UE25EE141A/B

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ELEMENTS OF ELECTRICAL ENGINEERING

SINGLE PHASE TRANSFORMERS : CONSTRUCTION & PRINCIPLE OF OPERATION

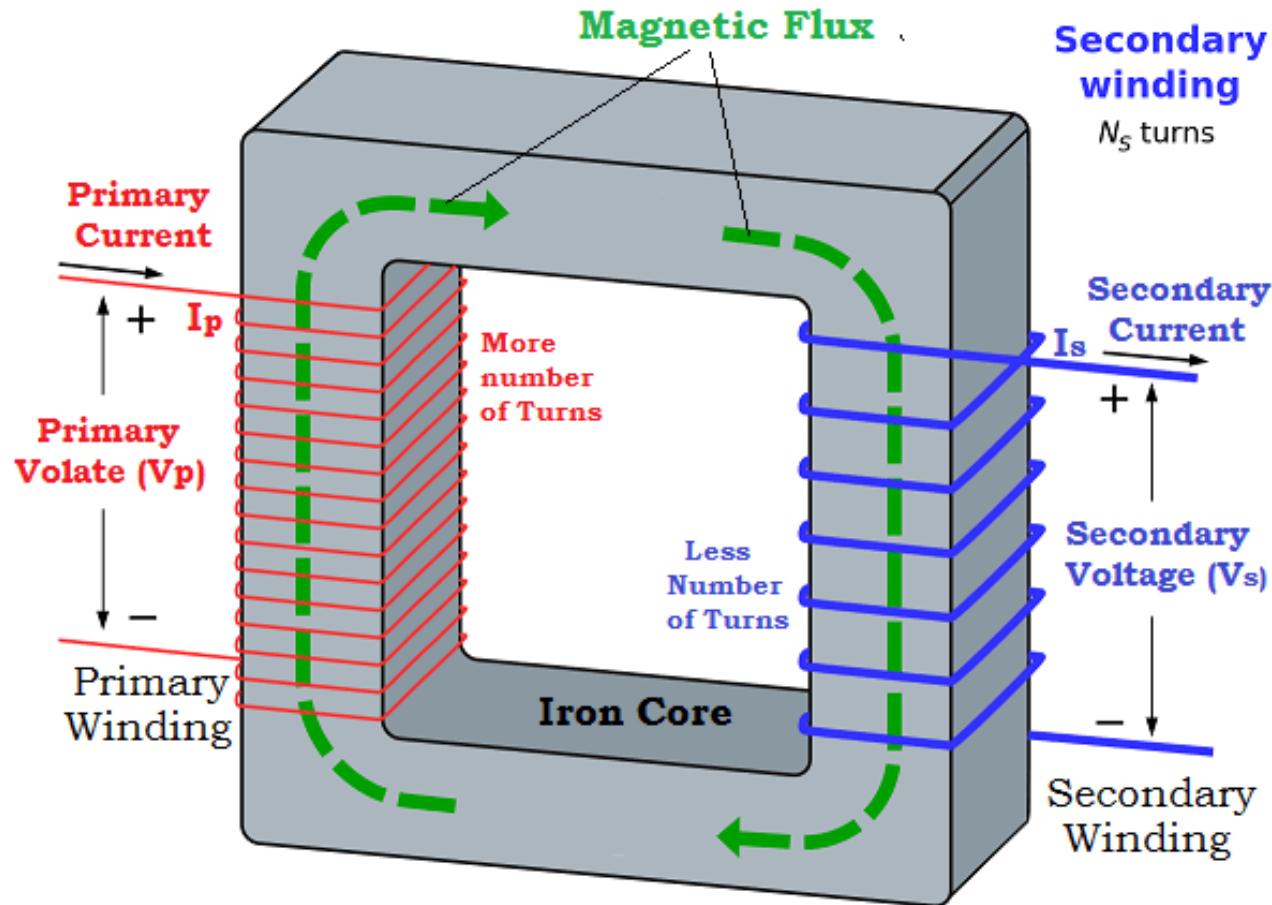
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Transformers

- Static Device
- Transfers energy from one circuit other circuit.
- Step up Transformer
- Step down Transformer
- Efficiency is 95%-98%



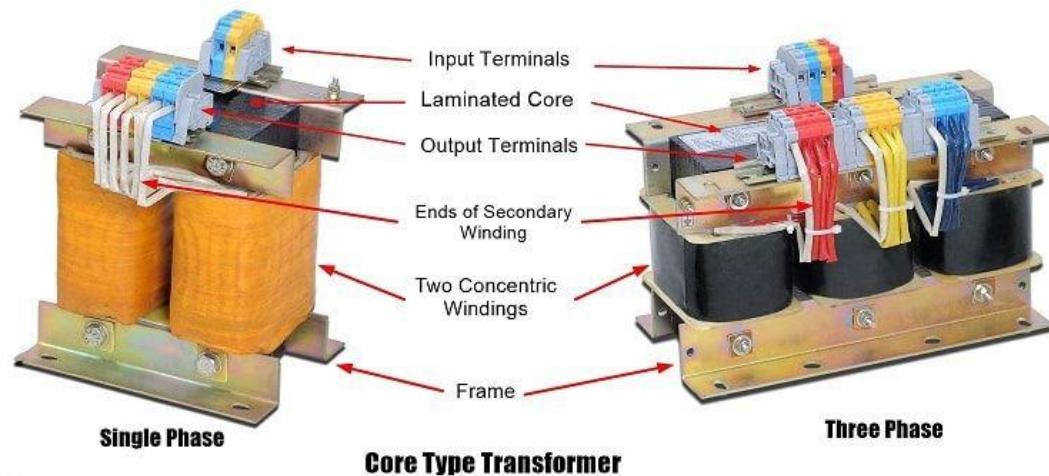
Construction of Transformers



Types of Transformer

Depending on the way in which windings are wound on the core, Transformers are classified as

- **CORE TYPE**

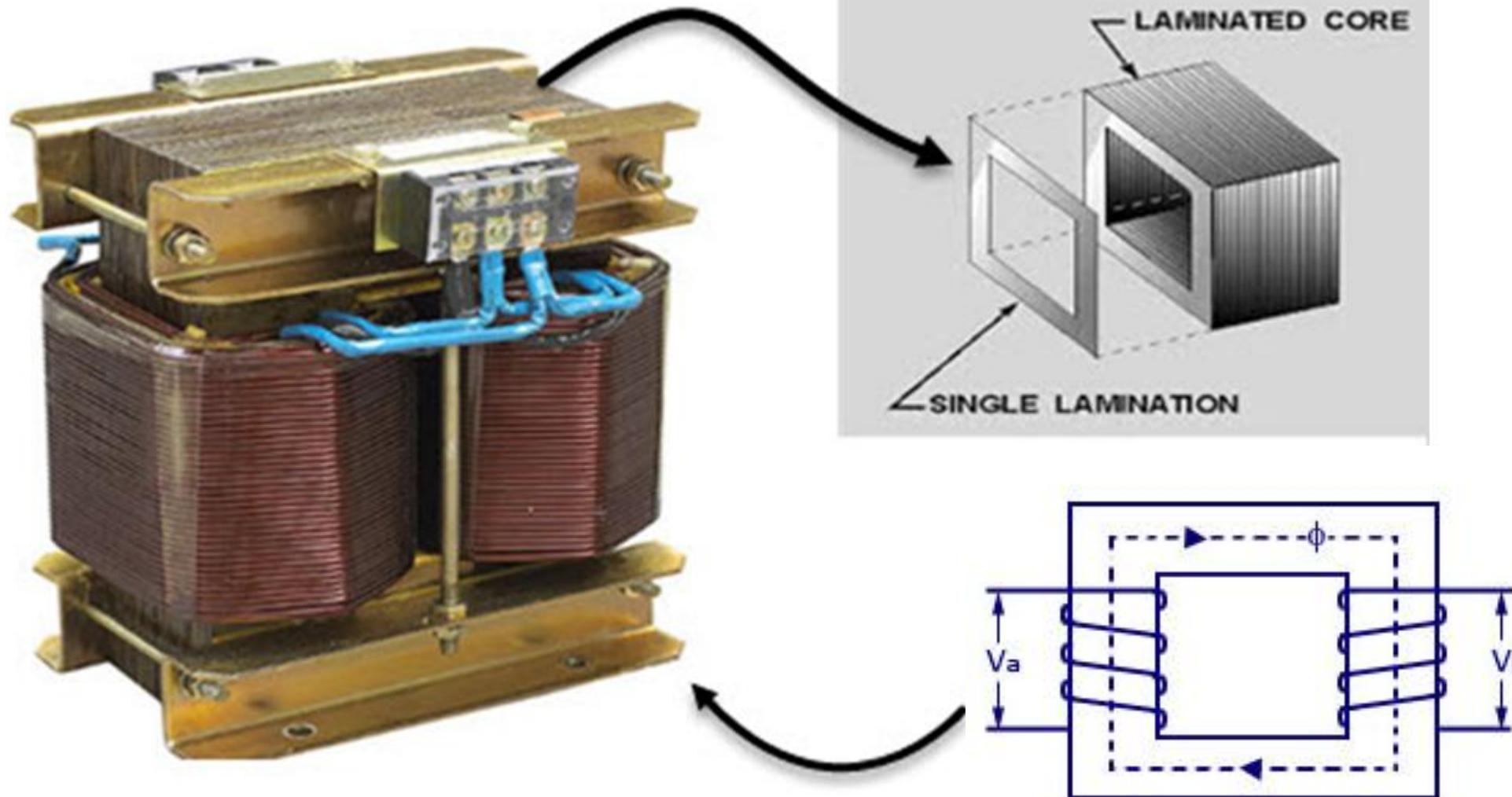


- **SHELL TYPE**

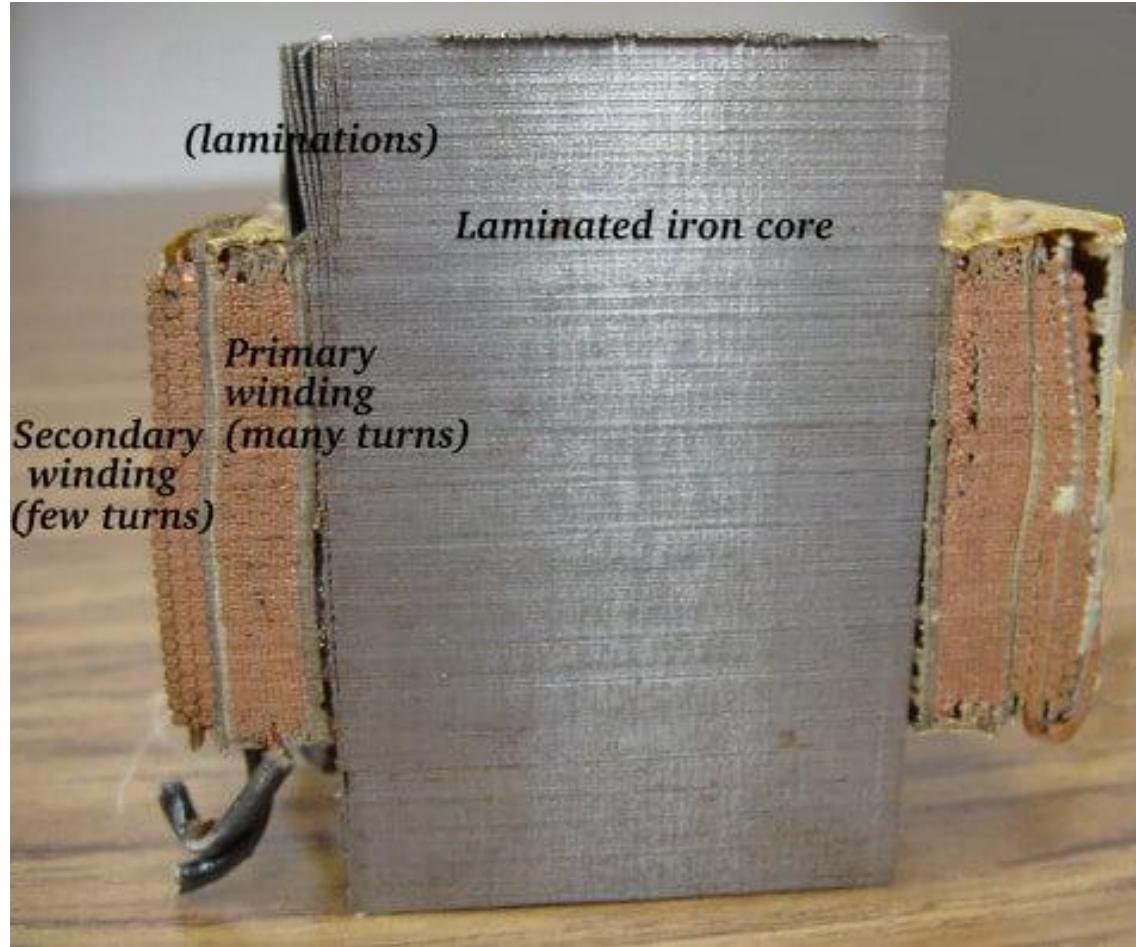
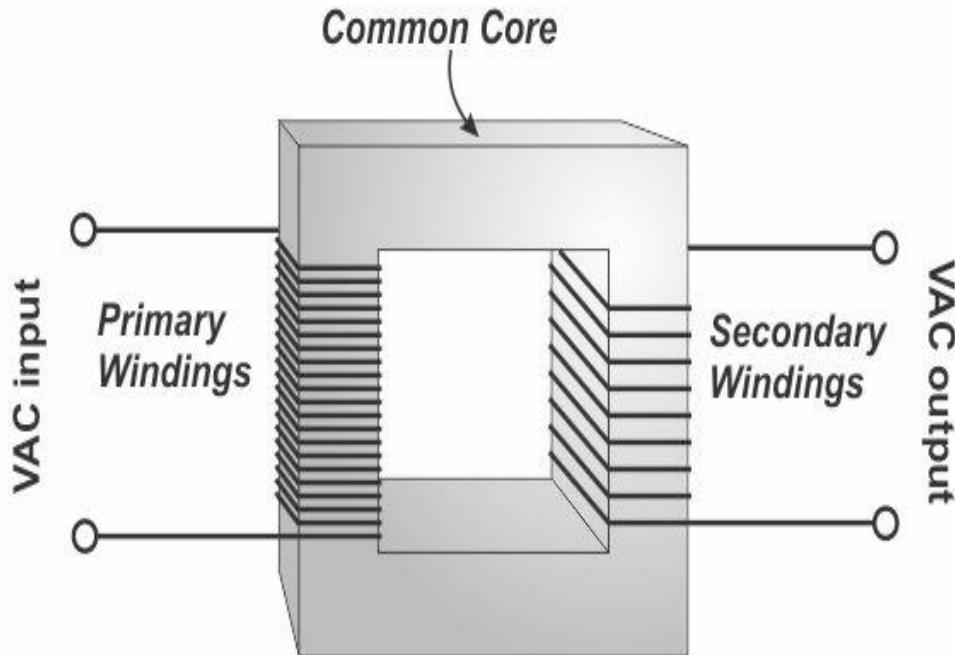


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Core Type

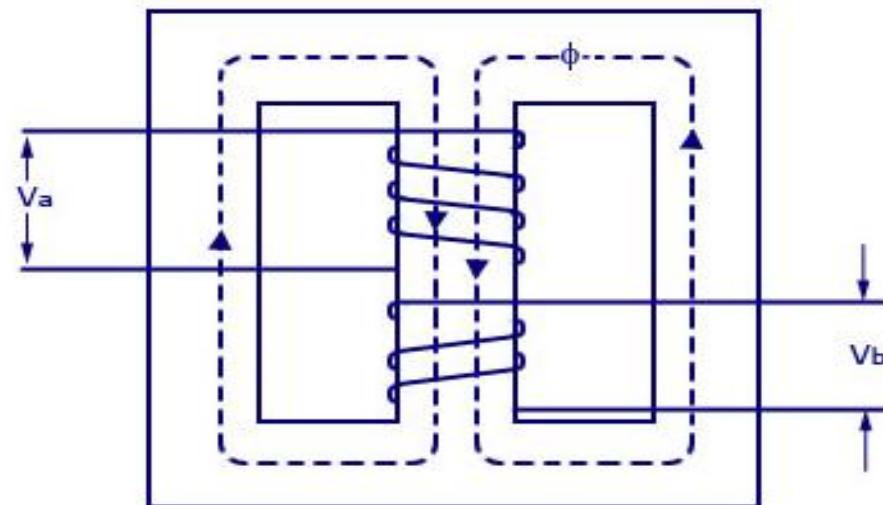
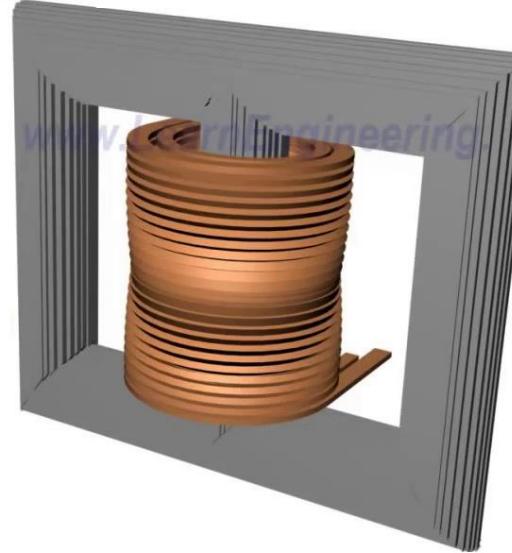
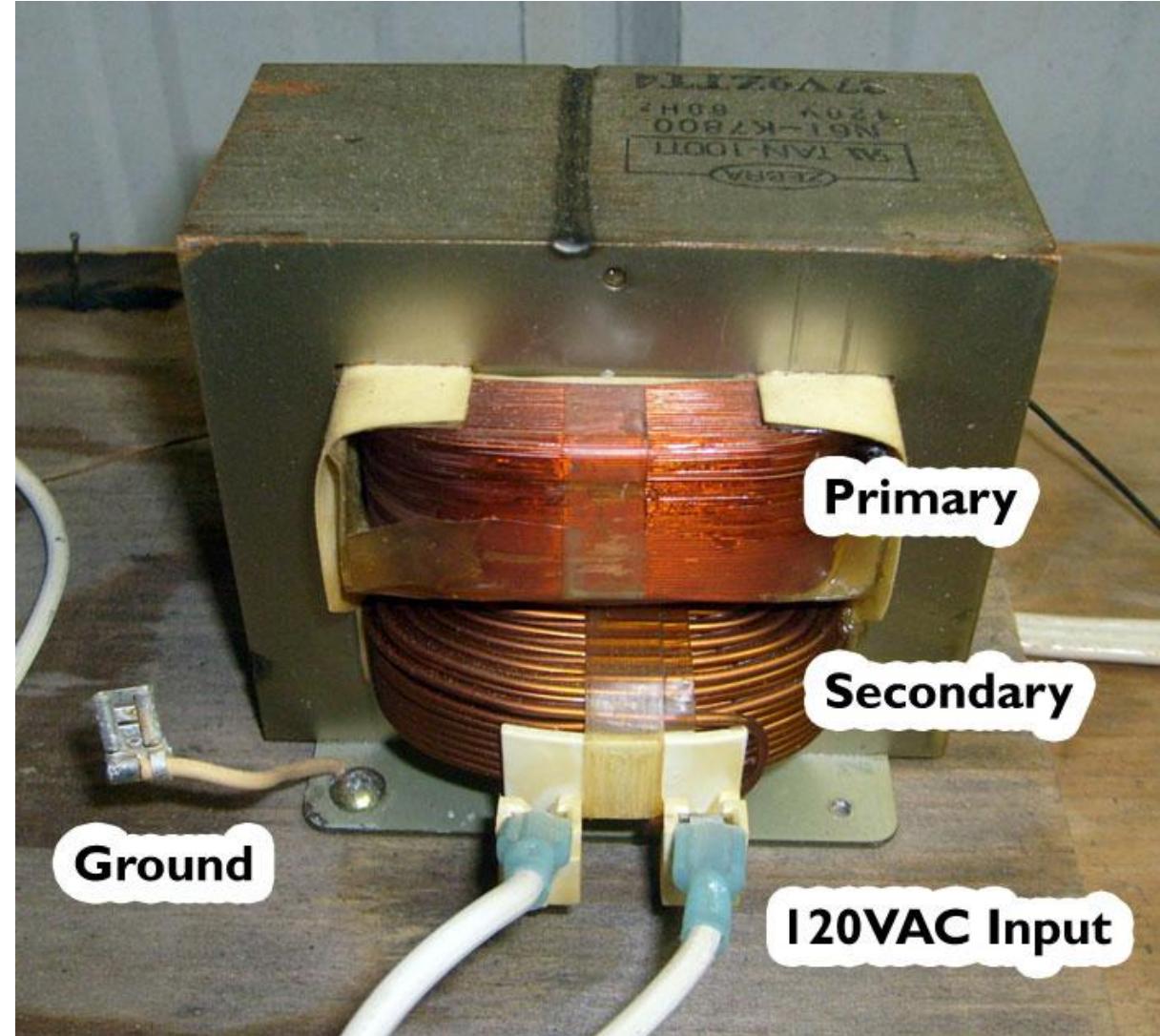


Windings of Transformers



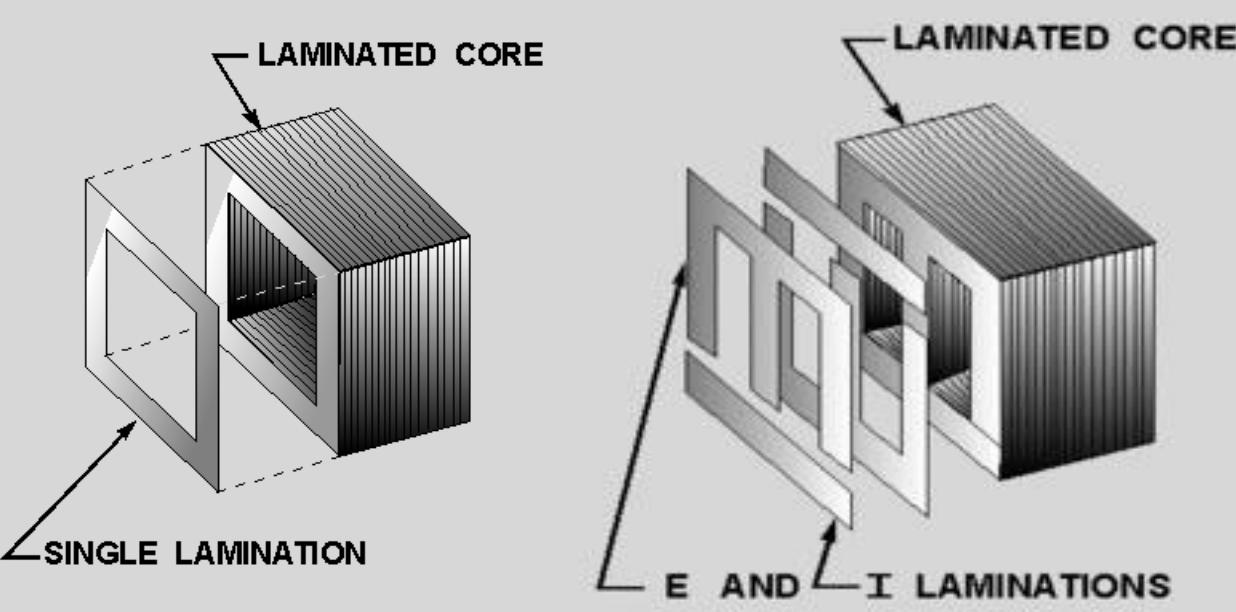
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Shell Type



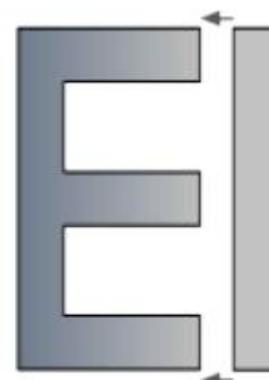
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Core of Transformer



Shell-type Laminations

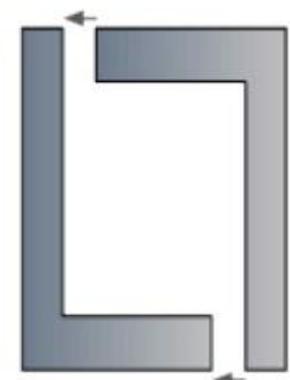
Core-type Laminations



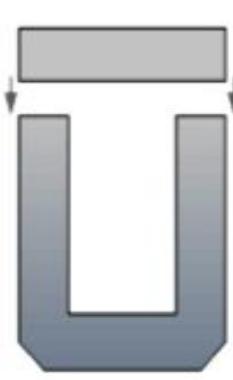
"E-I" Laminations



"E-E" Laminations



"L" Laminations



"U-I" Laminations

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DIFFERENCES BETWEEN CORE & SHELL TYPE

CORE TYPE	SHELL TYPE
The winding encircles the core	The core encircles the most part of the winding
It has single magnetic path	It has two magnetic paths
The core has two limbs	The core has three limbs
The windings are uniformly distributed on two limbs hence natural cooling is effective	The natural cooling does not exist since windings are surrounded by the core
The coils can be easily removed for maintenance	The coils cannot be removed easily
Preferred for High Voltage transformers	Preferred for Low Voltage transformers

Construction Details of Transformer

A transformer is a static device which transforms AC electrical power from one voltage level to another without change in frequency.

CONSTRUCTION DETAILS:

It basically consists of two windings wound on a common magnetic core.

- 1) The core of a transformer must have the following desirable properties:
 - a) High permeability in order to setup stronger magnetic field with less MMF
 - b) Low Hysteresis Coefficient to reduce Hysteresis Losses
 - c) Must be made of thin laminations to reduce eddy current Losses

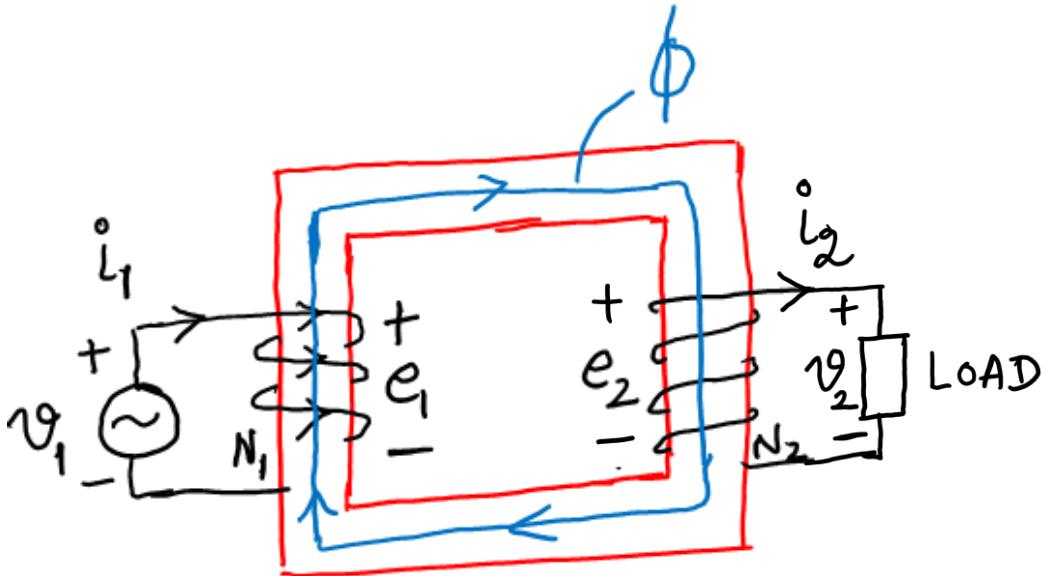
The widely used material to make the core of power transformers is silicon steel

Construction Details of Transformer (Contd..)

- 2) The windings are made of good conducting materials such as copper or aluminium. The windings are insulated from each other and also from the core

The core and windings are placed inside a closed chamber filled with an insulating oil called 'Transformer oil'. Transformer oil not only acts as insulating medium but also absorbs the heat dissipated from core and windings when the transformer is under operation.

Principle of Operation of Transformer



$$\overset{\circ}{i}_1 = \overset{\circ}{i}_0 + \overset{\circ}{i}_2'$$

$\overset{\circ}{i}_0$ = Magnetising Current

$\overset{\circ}{i}_2'$ = Load component of Primary current

v_1 = Supply Voltage

e_1 = Primary induced EMF

i_1 = Primary current

e_2 = Secondary induced EMF

v_2 = Load Voltage

i_2 = Secondary current

Principle of Operation of Transformer (Contd..)

Its principle is based on Electromagnetic Induction.

When an AC current flows in the primary winding, it sets up an MMF in the primary winding i.e., $N_1 I_0$ which in turn creates a time varying magnetic flux Φ in the core. This changing flux Φ linking with the primary winding sets up a self-induced EMF E_1 in the primary winding according to Faraday's laws of Electromagnetic Induction. This flux through the common magnetic core links the secondary winding also and induces a mutually induced EMF E_2 in it.

Text Book:

1. "Basic Electrical Engineering" S.K Bhattacharya, 1st Edition Pearson India Education Services Pvt. Ltd., 2017
2. "Basic Electrical Engineering", D. C. Kulshreshtha, 2nd Edition, McGraw-Hill. 2019
3. "Special Electrical Machines" E G Janardanan, PHI Learning Pvt. Ltd., 2014

Reference Books:

1. "Engineering Circuit Analysis" William Hayt, Jack Kemmerly, Jamie Phillips and Steven Durbin, 10th Edition McGraw Hill, 2023
2. "Electrical and Electronic Technology" E. Hughes (Revised by J. Hiley, K. Brown & I.M Smith), 12th Edition, Pearson Education, 2016.



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THANK YOU

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