Ministry of Higher Education

and Scientific Research

Al- Mustaqbal University College

Department of Medical Instrumentation Techniques Engineering

تكنولوجيا الكهرباء

Electrical Technology

Lecture 7

Lecture Name: TRANSFORMER

By

Dr. Jaber Ghaib Talib

# Types of Losses in a Transformer.

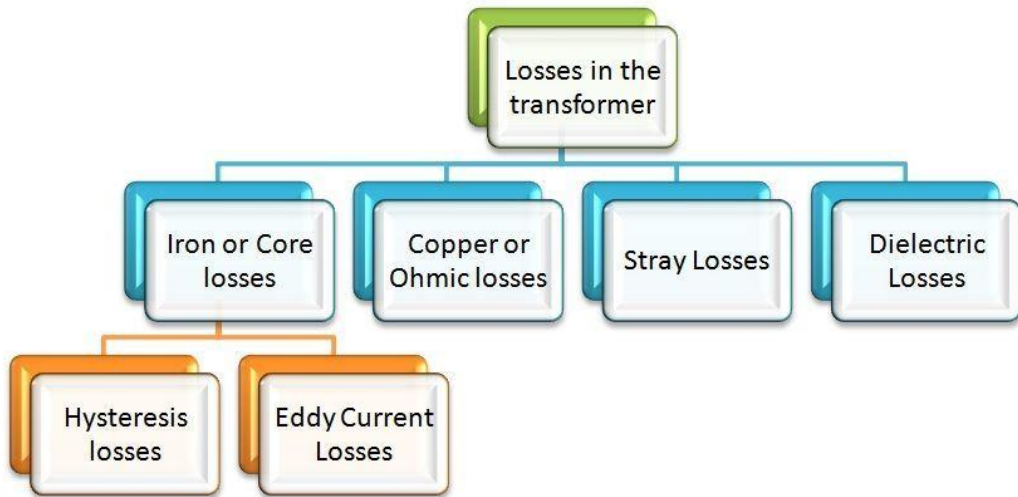**Contents:**

**Iron Losses** •

**Hysteresis Loss** •

**Eddy Current Loss** •

**Copper Loss Or Ohmic Loss** •

**Stray Loss** •

**Dielectric Loss** •

**block diagram**حفظ



## Copper Loss Or Ohmic Loss

$$P_c = I_1^2 R_1 + I_2^2 R_2$$

Iron or Core losses, $P_i$ = Hysteresis loss + Eddy current loss

$$= \text{Constant losses}$$

Hence, total losses in a transformer are:

Total losses in a transformer = $P_1 + P_C$

$$= \text{Constant losses} + \text{Variable losses}$$

## Efficiency of a Transformer

Like any other electrical machine, the efficiency of a transformer is defined as the ratio of output power (in watts or kW) to input power (watts or kW) i.e.

$$\text{Efficiency} = \frac{\text{Output power}}{\text{Input power}}$$

In practice, open-circuit and short-circuit tests are carried out to find the efficiency,

$$\text{Efficiency} = \frac{\text{Output}}{\text{Input}} = \frac{\text{Output}}{\text{Output} + \text{Losses}}$$

**Exp: A single-phase transformer is rated at 40 kVA. The transformer has full-load copper losses of 800 W and iron losses of 500 W. Determine the transformer efficiency at full load and 0.8 power factor.**

$$\text{Efficiency} = \frac{\text{output power}}{\text{input power}} = \frac{\text{input power} - \text{losses}}{\text{input power}} = 1 - \frac{\text{losses}}{\text{input power}}$$

Full-load output power = V I cos $\phi$ = (40)(0.8) = 32 kW

Total losses = 800 + 500 = 1.3 kW

Input power = output power + losses = 32 + 1.3 = 33.3 kW

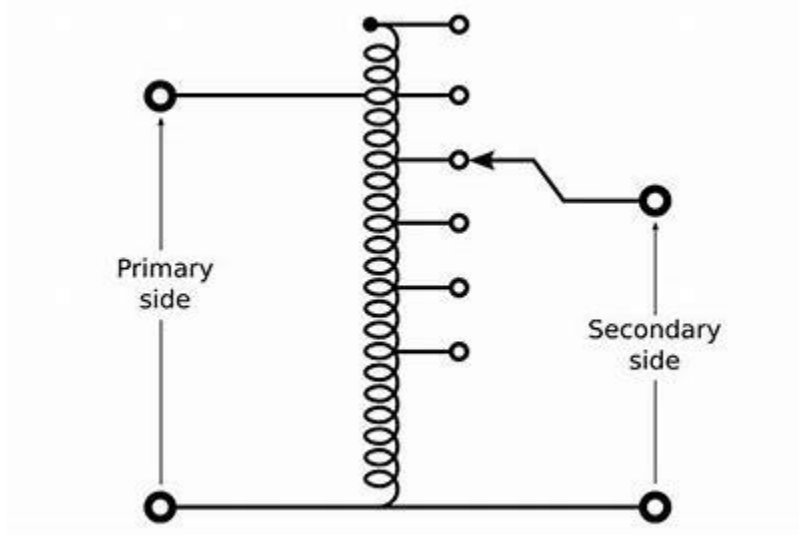Hence, **efficiency,** $\eta = 1 - \dfrac{1.3}{33.3} = 0.961$   or   **96.10%**

**What is Autotransformer : Working Principle, Construction & Applications**

**Autotransformer is a single winding <u>transformer</u> that works on the principle of Faraday's Law of electromagnetic induction.**

**Autotransformer can be single and three-phase.**

# Autotransformer Working Principle
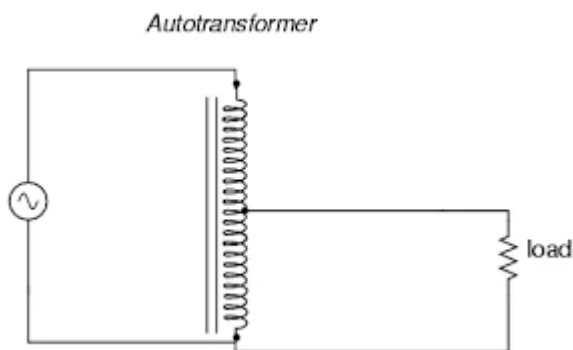


Autotransformer

The emf equation of induced emf is given as

$E = 4.44 \emptyset N f$

This can be generalized for both primary winding emf and secondary winding emf. If we take ratio we get as

$E_1/E_2 = N_1/N_2 = k$

**Properties of Autotransformer**

**The properties are**

- Auto Transformer is electrically and magnetically coupled device

- In Autotransformer, power is constant

- In autotransformer, overall flux is constant

- In autotransformer, frequency is constant

- Voltage and current vary based on a number of turns.

- Autotransformer is also called a phase-shifting device

- The losses are less in autotransformer as compared to two winding transformer due to single winding

- The efficiency of the autotransformer is more as compared to two winding transformers

- Both iron and copper losses are less an autotransformer

**Advantages and Disadvantages of Autotransformer**

**The advantages are**

- Losses in Autotransformer are less

- The efficiency of the autotransformer is more

- Copper Requirement is less

- The core requirement is less

**The disadvantages are**

- Autotransformers cannot be used for high voltages. Since any discontinuity in the primary winding would result in complete primary voltage on the secondary side, therefore it cannot be used for high voltages

- The insulation requirement is more. Since autotransformer is both electrically and magnetically coupled, the requirement of insulation is more.

- Because of common winding, a neutral connection is difficult.

**FAQs**( اسئلة واجوبتها )

**1). Does Auto Transformer work in DC**

No, the autotransformer cannot work in DC

**2). Does autotransformer have two windings?**

No, autotransformer has an only single winding

**3). Is autotransformer an electrically isolated device?**

No, autotransformer is electrically and magnetically coupled device.

**4). Is the efficiency of autotransformer more than two winding transformers?**

The efficiency of the autotransformer is more than two winding transformer

**5). Do we use autotransformers for high voltage applications?**

No, autotransformers are used for low voltage applications ( 420 V). Beyond that, special measures are taken while designing.