Ministry of Higher Education
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تكنولوجيا الكهرباء

Electrical Technology

Lecture 4

Lecture Name: TRANSFORMER

By

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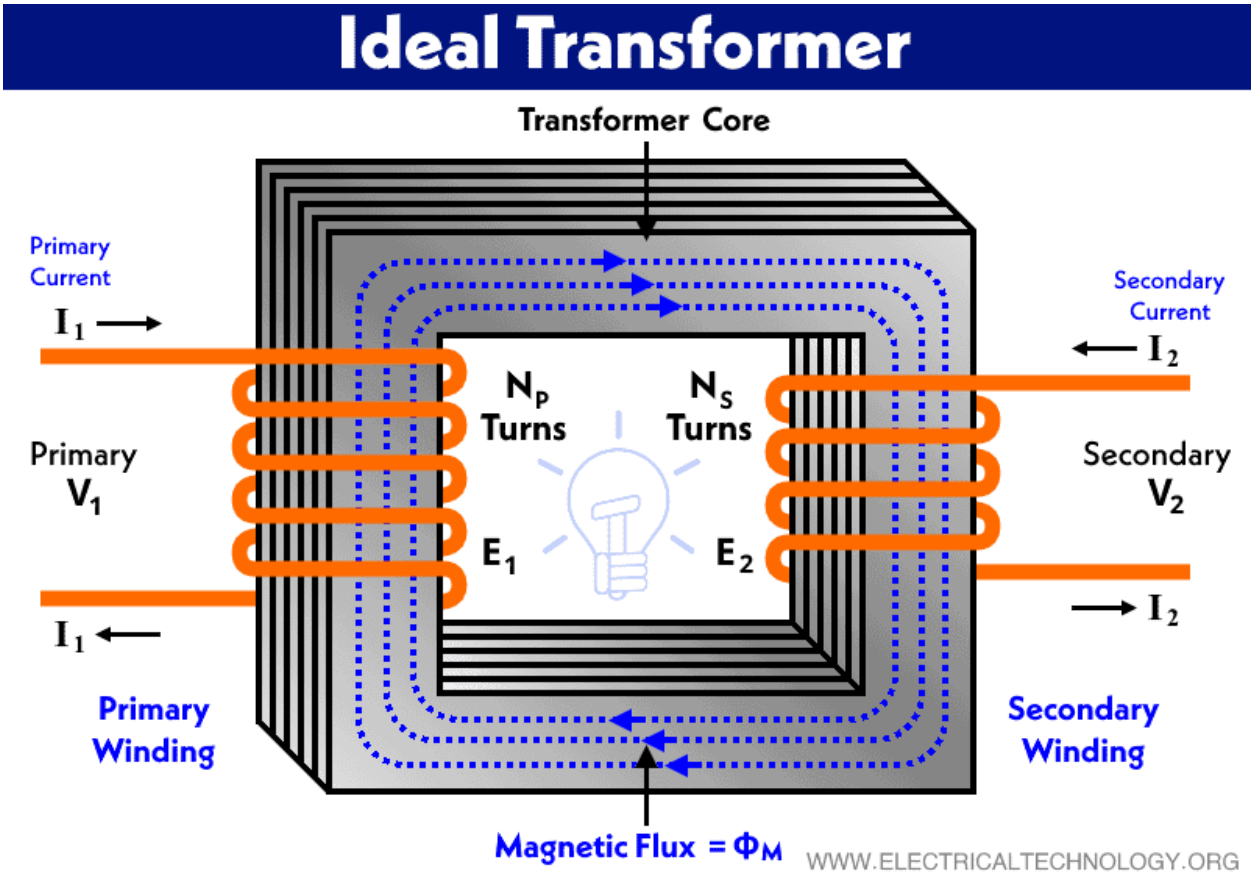
TRANSFORMER

SINGLE PHASE TRANSFORMER and CONSTRUCTION IDEAL TRANSFORMERS



A transformer is said to be ideal if it satisfies following properties:

1) It has no losses.

2) Its windings have zero resistance.

3) Leakage flux is zero i.e. 100 % flux produced by primary links with the secondary.

4) Permeability of core is so high that negligible current is required to establish the flux in it.

NOTE: For an ideal transformer, the primary applied voltage V1 is same as the primary induced emf E1 as there are no voltage drops.

Exp 1.

An ideal transformer has a turns ratio of 15:1 and is supplied at 180 V when the primary current is 4 A. Calculate the secondary voltage and current.

N1 / N2 =15/1, V1 = 180 v, and I_1 = 4A

$$\frac{V1}{V2} = \frac{N1}{N2}$$

$$\frac{180}{V2} = \frac{15}{1}$$

15 V_2 =180

V_2 = 180/15 =12 V

$$\frac{I1}{I2} = \frac{N2}{N1}$$

$$\frac{4}{I2} = \frac{1}{15}$$

I_2=4*15=60A

Exp 2.

A step-down transformer having a turns ratio of 20:1 has a primary voltage of 4 kV and a load of 10 kW.

Neglecting losses, calculate the value of the secondary current.

$$\frac{V1}{V2} = \frac{N1}{N2}$$

$$\frac{4000}{V2} = \frac{20}{1}$$

V2=200V

Secondary power = V_2 I_2 = 10000 W

i.e. 200 I_2 = 10000

I_2=50A

Exp 3.

A transformer has a primary-to-secondary turns ratio of 1:15. Calculate the primary voltage necessary to supply a 240 V load. If the load current is 3 A determine the primary current. Neglect any losses.

$$\frac{V1}{V2} = \frac{N1}{N2}$$

$$\frac{V1}{240} = \frac{1}{15}$$

V1=16 V

$$\frac{I1}{I2} = \frac{N2}{N1}$$

$$\frac{I1}{3} = \frac{15}{1}$$

I_1=45A

Exp 4.

A 10 kVA, single-phase transformer has a turns ratio of 12:1 and is supplied from a 2.4 kV supply. Neglecting losses, determine (a) the full load secondary current, (b) the minimum value of load resistance which can be connected across the secondary winding without the kVA rating being exceeded, and (c) the primary current.

10000 =V_1 I_1=V_2 I_2

$$\frac{V1}{V2} = \frac{N1}{N2}$$

$$\frac{2400}{V2} = \frac{12}{1}$$

V_2= 200V

10000 =V_2 I_2=200 I_2

I_2=50A

(b) Load resistance R_L =V_2/I_2

R_L = 200/50 =4A

primary current

$$\frac{I1}{I2} = \frac{N2}{N1}$$

$$\frac{I1}{50} = \frac{1}{12}$$

I_1 = 4.17 A

Home work:

Exp 5.

A 20 Ω resistance is connected across the secondary winding of a single phase power transformer whose secondary voltage is 150 V. Calculate *the primary voltage* and *the turns ratio* if the supply current is 5 A, neglecting losses

V1= 225 V

$$\frac{N1}{N2}$$

3:2

Exp 6. A 500 V/100 V, single-phase transformer takes a full load primary current of 4 A. Neglecting losses, determine (a) the full load secondary current, and (b) the rating of the transformer.

I_2=20A

Transformer rating =2000 VA = 2 kVA