Ministry of Higher Education

and Scientific Research

Al- Mustaqbal University College

Department of Medical Instrumentation Techniques Engineering

تكنولوجيا الكهرباء

Electrical Technology

Lecture 9

Lecture Name: TRANSFORMER

By

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أمثلة وحلول Example and Solution

Exp:

A three-phase transformer bank is to handle (600 KVA) and have a (34.5/13.8 KV) voltage ratio. Find the rating of each individual transformer in bank (high voltage, low voltage, turns ratio, and apparent power) if the transformer bank is connected to (a) Y - Y (b) Δ - Δ (c) Δ - Y (d) Y -Δ?

Solution:

For Y - Y connection

Primary voltage $= \frac{34.5}{\sqrt{3}} = 19.9$ KV ,**Secondary voltage** $= \frac{13.8}{\sqrt{3}} = 7.97$ KV

Turns ratio $= \frac{19.9}{7.97} = 2.5$

For Δ - Δ connection

Primary voltage =34.5 KV , **Secondary voltage** =13.8 KV

Turns ratio $= \frac{34.5}{13.8} = 2.5$

For Δ - Y connection

Primary voltage =34.5 KV , **Secondary voltage** $= \frac{13.8}{\sqrt{3}} = 7.97$ KV

$$\text{Turns ratio} = \frac{34.5}{7.97} = 4.33$$

For Y -Δ connection

Primary voltage $= \frac{34.5}{\sqrt{3}} = 19.9$ KV , **Secondary voltage** =13.8 KV

$$\text{Turns ratio} = \frac{19.9}{13.8} = 1.44$$

$$\textbf{Apparent power} = \frac{1}{3}(600) = 200\ \textbf{KVA}$$

Exp 2:

A three-phase transformer has 600 primary turns and 150 secondary turns. If the supply voltage is 1.5 kV determine the secondary line voltage on no-load when the windings are connected:

(a) delta-star, (b) star-delta.

(a) For a delta connection, $V_L = V_P$

hence, primary phase voltage, $V_{P_1} = 1.5\text{ kV} = 1500\text{ V}$

Secondary phase voltage, $V_{P_2} = V_{P_1}\left(\frac{N_2}{N_1}\right) = (1500)\left(\frac{150}{600}\right) = 375\text{ V}$

For a star connection, $V_L = \sqrt{3}\,V_P$

hence, **secondary line voltage** $= \sqrt{3}(375) =$ **649.5 V**

(b) For a star connection, $V_L = \sqrt{3}\,V_P$ or $V_P = \frac{V_L}{\sqrt{3}}$

Primary phase voltage, $V_{P_1} = \frac{V_{L_1}}{\sqrt{3}} = \frac{1500}{\sqrt{3}} = 866.0\text{ V}$

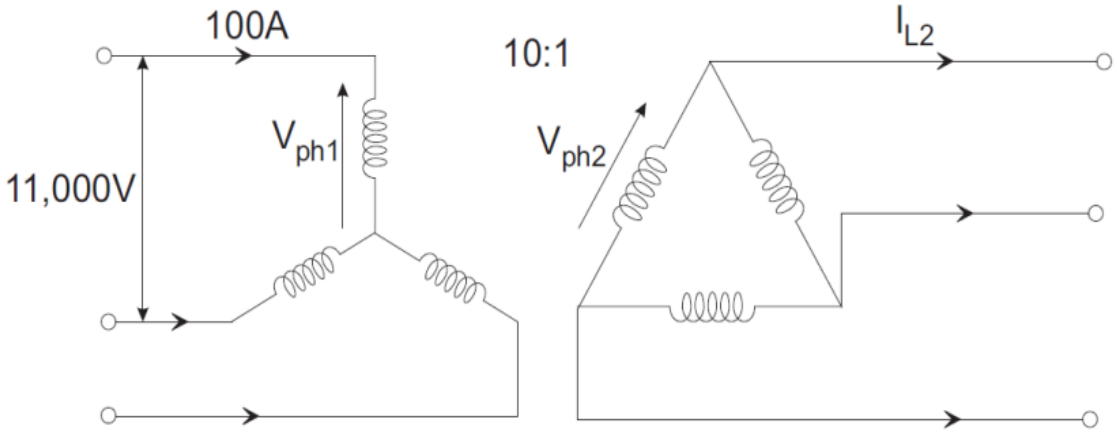
For a delta connection, $V_L = V_P$

$\frac{N_1}{N_2} = \frac{V_1}{V_2}$ from which, secondary phase voltage,

$V_{P_2} = V_{P_1}\left(\frac{N_2}{N_1}\right) = (866.0)\left(\frac{150}{600}\right)$

= 216.5 V = secondary line voltage

Exp 3: A 3-phase transformer bank consisting of three single phase transformers is used to step-down the voltage of a 3-phase, 11000V transmission line. If the primary line current is 100A, calculate the secondary line voltage for Y/Δ connection. The turns ratio is 10. Neglect losses. Solution



Phase voltage on the primary side, $V_{ph1} = \frac{11,000}{\sqrt{3}} = 6.35kV$

Secondary side phase voltage, $V_{ph2} = \frac{6.35}{10} = 0.635kV$

Secondary side line voltage = Secondary side phase voltage

Secondary side line voltage, $V_{LL2} =$ **0.635 kV**

Three single phase transformers of rating 50 kVA, 2000V/1000V are connected in Δ / Δ. Find the current in

Exp 4:

the primary windings of the transformer, when supplying a balanced three phase load of 40kW at 1000V and 0.8 power factor lagging?

Solution

$$\sqrt{3}V_L I_L \cos(\phi) = 40,000W$$

$$\sqrt{3} \times 1000 \times I_L \times 0.8 = 40,000W$$

$$I_L = \frac{40,000}{\sqrt{3} \times 1000 \times 0.8} = 28.86A$$

The current in the windings of the transformer secondary, $I_{ph2} = \frac{28.86}{\sqrt{3}} = 16.66A$

Current in the primary windings of the transformer, $I_{ph1} = 16.66 \times \frac{1000}{2000} = \mathbf{8.33A}$

Exp 5:

three phase step down transformer is connected to 3300V supply. The turns ratio per phase is 12 and it draws a current of 5 A from the mains. Calculate the

secondary line voltage and line current if transformer is deltastar connected. Solution

Delta-Star connection

$$\text{Secondary phase voltage} = \frac{3300}{12} = 275V$$

$$\therefore \text{Secondary line voltage} = \text{Secondary phase voltage} \times \sqrt{3}$$

$$= \mathbf{476.31\ V}$$

$$\therefore \text{Secondary line current} = \text{Secondary phase current (since, seconday is star)}$$

$$\text{Secondary phase current} = (\text{Primary phase current} \times 12)$$

$$\text{Primary phase current} = \frac{\text{Primary line current}}{\sqrt{3}}$$

$$\therefore \text{Secondary line current} = \frac{5}{\sqrt{3}} \times 12$$

$$= \mathbf{34.64\ A}$$

Exp 6: three phase step down transformer is connected to 3300V supply. The turns ratio per phase is 12 and it draws a current of 5 A from the mains. Calculate the secondary line voltage and line current if transformer is stardelta connected. Solution