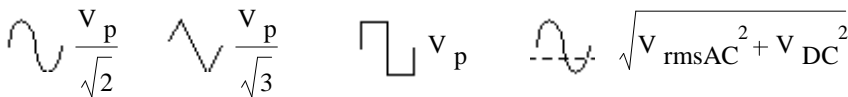


ECE 3600 Exam 1 Information



$$V_{rms} = \sqrt{\frac{1}{T} \int_0^T (v(t))^2 dt}$$

Square
Root Mean (average)

All voltages and current are RMS unless given as peak or as time function

$$pf = \cos(\theta) = \frac{P}{|S|}$$

$$\text{Efficiency } \eta = \frac{P_{out}}{P_{in}} \cdot 100\% = \frac{P_{in} - P_{loss}}{P_{in}} \cdot 100\% = \frac{P_{out}}{P_{out} + P_{loss}} \cdot 100\%$$

$$P = (|I_R|)^2 \cdot R = \frac{(|V_R|)^2}{R} \text{ for resistors.}$$

$$\text{OR } P = |V| \cdot |I| \cdot \cos(\theta) = (|I|)^2 \cdot |Z| \cdot \cos(\theta) = \frac{(|V|)^2}{|Z|} \cdot \cos(\theta)$$

capacitors -> -Q $Q_C = (|I_C|)^2 \cdot X_C = \frac{(|V_C|)^2}{X_C} = -(|V_C|)^2 \cdot (\omega \cdot C)$ $X_C = -\frac{1}{\omega \cdot C}$ and is a negative number causes leading pf

inductors -> +Q $Q_L = (|I_L|)^2 \cdot X_L = \frac{(|V_L|)^2}{X_L}$ $X_L = \omega \cdot L$ and is a positive number causes lagging pf

or $Q = \text{Reactive "power"} = |V| \cdot |I| \cdot \sin(\theta)$

units: VAR, kVAR, etc. "volt-amp-reactive"

$S = \text{Complex "power"} = \underset{\substack{\uparrow \\ \text{complex conjugate}}}{V} \cdot I = P + jQ = |V| |I| \angle \theta = |S| \angle \theta$

units: VA, kVA, etc. "volt-amp"

$S = \text{Apparent "power"} = |S| = |V| \cdot |I| = \sqrt{P^2 + Q^2}$

units: VA, kVA, etc. "volt-amp"

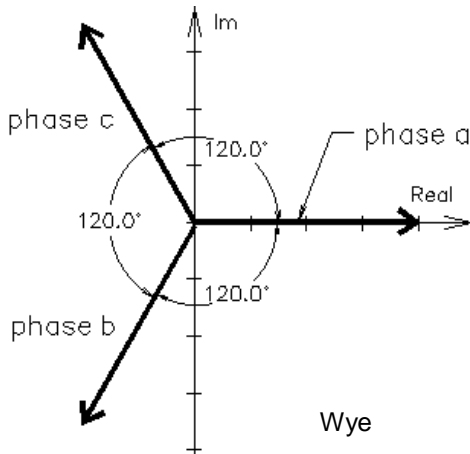
Wye connection:

Connect each load or generator phase between a line and ground.

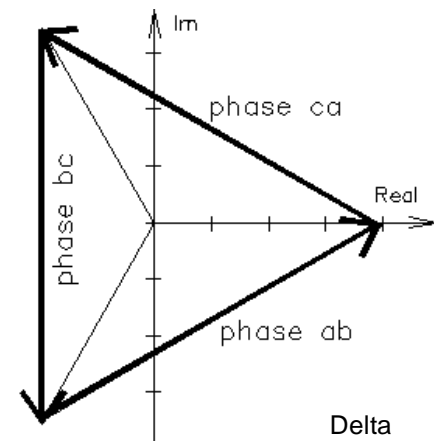
3-Phase

Delta connection:

Connect each load or generator phase between two lines.



Wye



Delta

$$V_{LN} = \frac{V_{LL}}{\sqrt{3}} \quad I_L = \sqrt{3} \cdot I_{LL} \quad (\Delta\text{-connection})$$

$$V_{LL} = \sqrt{3} \cdot V_{LN} \quad I_{LL} = \frac{I_L}{\sqrt{3}}$$

I_L is always the line current, same as would flow in a Y-connected device.

V_L The line voltage, is always the line-to-line voltage, same as across a Δ -connected device.

Unless otherwise stated, assume voltage given for a 3-phase system is the line voltage (V_{LL}).

When a single phase is taken from a 3-phase panel, then the line voltage (V_L) of that single phase is the line-to-neutral voltage of the 3-phase input to that panel, so the value of V_L changes in the panel.

Powers (all types) are for all 3 phases, unless clearly stated otherwise.

To get equivalent line currents with equivalent voltages

$$Z_Y = \frac{Z_{\Delta}}{3} \quad Z_{\Delta} = 3 \cdot Z_Y$$

Exam 1 info

Ideal Transformer:
$$\frac{N_1}{N_2} = \frac{V_1}{V_2} = \frac{I_2}{I_1} \quad Z_{eq} = \left(\frac{N_1}{N_2}\right)^2 \cdot Z_2$$

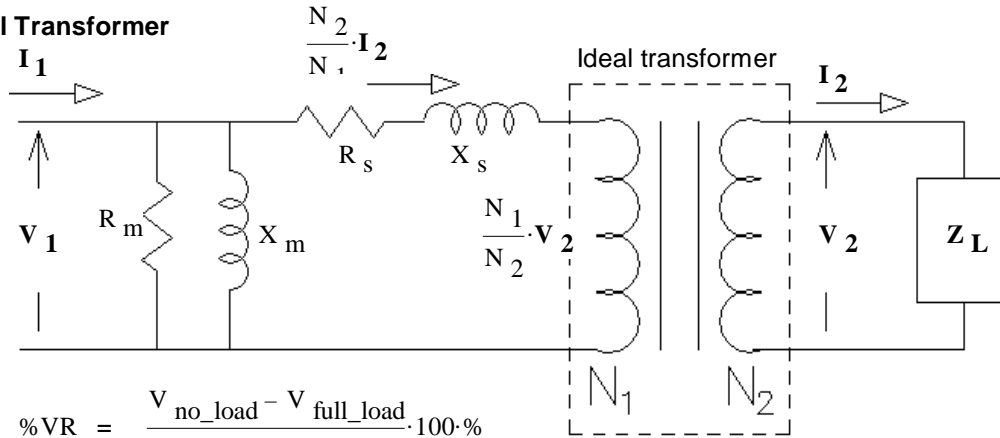
Both RMS

Transformers are rated in VA Transformer Rating (VA) = (rated V) x (rated I) , on either side.

Don't allow voltages over the rated V , regardless of the actual current.

Don't allow currents over the rated I , regardless of the actual voltage.

Model of non-ideal Transformer



Voltage regulation
$$\%VR = \frac{V_{no_load} - V_{full_load}}{V_{full_load}} \cdot 100\%$$

Tests of non-ideal Transformer

Open-circuit test: V = rated voltage Measure: I P Calculate: Q Rm Xm

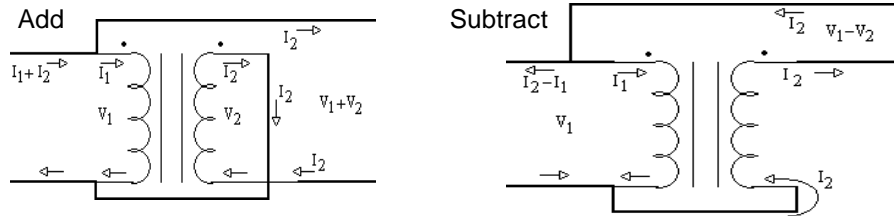
Short-circuit test I = rated current Measure: V P Neglect: Rm Xm Calculate: Q Rs Xs

Special Sensing Transformers PT or VT, **P**otential or **V**oltage **T**ransformer, to monitor voltage.

CT, **C**urrent **T**ransformer, to monitor current. The secondary must always be shorted or nearly shorted.

Autotransformers

Single winding, High-current (low voltage) side carries more current than any part of the winding.



Three-Phase transformers

May be 2 individual transformers wired as open Δ or T. May be 3 individual transformers. May share a single core. Lower-voltage side is usually connected Δ, so that 3rd harmonic currents can flow around the Δ side without affecting external current waveforms. These connections cause a 30° phase shift. Δ - Y is usually step-up Y - Δ is usually step-down

Phase-Shifting Transformers are used to control the direction of power flow on the network.