Constants/Conventions

ε	$8.85\text{x}10^{-12}$
r'	$0.7788 \cdot r$
D_{SL}	$\sqrt{D_S \cdot d}$ $\sqrt[3]{D_S \cdot d^2}$ $1.091\sqrt[4]{D_S \cdot d^3}$
D_{SC}	$\sqrt{r \cdot d}$ $\sqrt[3]{r \cdot d^2}$ $1.091\sqrt[4]{r \cdot d^3}$

General

Single Phase $\overline{S}$: $\overline{S} = \overline{V} \cdot \overline{I}^*$

Q for L and C: $Q_L = \frac{V^2}{X_L}$ $\quad Q_C = \frac{V^2}{X_C}$

Y Connection: $\overline{V_{ll}} = \sqrt{3}\angle 30^o \cdot \overline{V_\phi}$

Δ Connection: $\overline{I_l} = \sqrt{3}\angle{-30^o} \cdot \overline{I_\phi}$

3 Phase Power: $\overline{S_{3\phi}} = 3 \cdot \overline{V_\phi} \cdot \overline{I_\phi^*}$

$S = \sqrt{3} \cdot V_{ll} \cdot I_l$

$P = S \cdot pf$ $\quad S^2 = P^2 + Q^2$

Per Unit

Single Phase:

$S_{\text{base},1\phi} = P_{\text{base},1\phi} = Q_{\text{base},1\phi}$

$I_{\text{base}} = \frac{S_{\text{base},1\phi}}{V_{\text{base,L-N}}}$

$Z_{\text{base}} = R_{\text{base}} = X_{\text{base}}$

$Z_{\text{base}} = \frac{V_{\text{base,L-N}}}{I_{\text{base}}} = \frac{V^2_{\text{base,L-N}}}{S_{\text{base},1\phi}}$

Three Phase:

$S_{\text{base},3\phi} = 3 \cdot S_{\text{base},1\phi}$

$V_{\text{base,L-L}} = \sqrt{3}V_{\text{base,L-N}}$

$I_{\text{base}} = \frac{S_{\text{base},3\phi}}{\sqrt{3}V_{\text{base,L-L}}}$

$Z_{\text{base}} = \frac{V^2_{\text{base,L-L}}}{S_{\text{base},3\phi}}$

Change of Base: $Z_{\text{pu,new}} = Z_{\text{pu,old}} \left(\frac{V_{\text{base,old}}}{V_{\text{base,new}}}\right)^2 \frac{S_{\text{base,new}}}{S_{\text{base,old}}}$

Transmission Lines

Line Inductance:

$L = 2\text{x}10^{-7} \cdot \ln\frac{D}{D_s}$

or $L = 2\text{x}10^{-7} \cdot \ln\frac{D_{eq}}{D_S}$

or $L = 2\text{x}10^{-7} \cdot \ln\frac{D_{eq}}{D_{SL}}$

Line Capacitance:

$C_{an} = \frac{2\pi\varepsilon}{\ln\frac{D}{r}}$

or $C_{an} = \frac{2\pi\varepsilon}{\ln\frac{D_{eq}}{r}}$

or $C_{an} = \frac{2\pi\varepsilon}{\ln\frac{D_{eq}}{D_{SC}}}$

Line Equations:

$\gamma = \sqrt{z \cdot y}$

$Z_c = \sqrt{\frac{z}{y}}$

$$I(x) = I_R \cosh(\gamma x) + \frac{V_R}{Z_c} \cdot \sinh(\gamma x)$$

$$V(x) = V_R \cosh(\gamma x) + I_R Z_c \sinh(\gamma x)$$

Nominal π Model:

$A = D = 1 + \frac{YZ}{2}$

$B = Z$

$C = Y(1 + \frac{YZ}{4})$

Eq π Model:

$Z' = Z\,\frac{\sinh(\gamma l)}{(\gamma l)}$

$\frac{Y'}{2} = \frac{Y}{2}\,\frac{\tanh\frac{(\gamma l)}{2}}{\frac{(\gamma l)}{2}}$

For: $x = a + jb$,

$$\cosh(x) = \cosh(a)\cos(b) + j\sinh(a)\sin(b)$$

$$\sinh(x) = \sinh(a)\cos(b) + j\cosh(a)\sin(b)$$