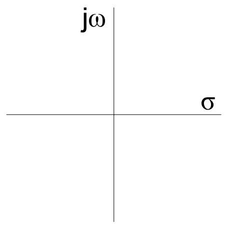
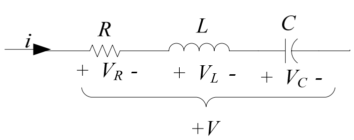
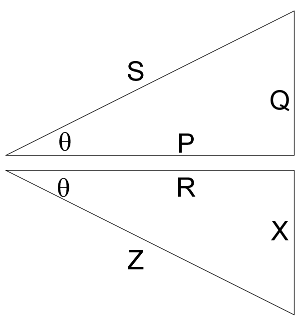
Chapter 13 – Overview

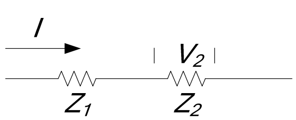
13.1 Overview

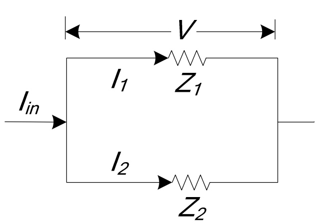
The table is an overview of techniques to resolve network problems.





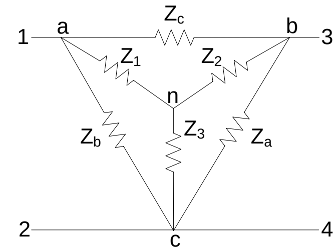


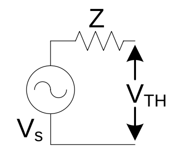


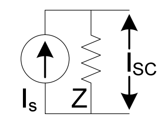


Name	Form 1	Form 2
Laplace	$s=\sigma+j\omega$	$-j=\frac{1}{j}$
Durham frequency ratio	$\psi=\frac{s}{\omega}$	$\psi\big\|_{\sigma=0}=j$
Durham electromagnetic energy Law	$W=\frac{pq}{t}$	$W=\frac{pq}{t}\frac{b_{YS}d_T s_Y}{s_S s_T s_Y}$
3 Measures	$V,\ I,\ t$	Voltage, Current, Time
Apparent power	$S=VI^*$	Product
Ohm's Law	$Z=\frac{V}{I}$	Ratio
Time delay	$t_d=t_V-t_I$	$\theta=\angle V-\angle I=\angle Z=\angle S$ $=\cos^{-1}pf=2\pi ft$
3 Elements	$Z(s)=R+sL+\frac{1}{sC}$	$Z(j\omega)=R+j\omega L+\frac{1}{j\omega C}$
Complex impedance	$Z(s)=R+\psi(X_L-X_C)$	$Z(j\omega)=R+j(X_L-X_C)$
Complex power	$S(s)=P+\psi(Q_L-Q_C)$	$S(j\omega)=P+j(Q_L-Q_C)$
Reactance	$X_L=\omega L$	$X_C=\frac{1}{\omega C}$
Kirchhoff Laws Mesh / nodal analysis	KVL $\Sigma V=0$ around mesh or loop Substitute Ohm $V=IZ$ for V Solve for unknown I	KCL $\Sigma I=0$ at node or point Substitute Ohm $I=V/Z$ for I Solve for unknown V
One-Port Single-phase Independent sources	Series Same I, V divides across Z $Z_{Total}=\Sigma Z$ $V_Z=V_{Source}\frac{Z_{Adjacent}}{\Sigma Z}$	Parallel Same V, I divides through Z $\frac{1}{Z_{Total}}=\Sigma\frac{1}{Z}$ $I_Z=I_{In}\frac{Z_{Opposite}}{\Sigma Z}$

Two-Port 3-phase A phase is an impedance Dependent sources	<u>Delta or Pi (Δ – Π)</u> $Z_P = \frac{V_P}{I_P}$ $V_{Line-Line} = V_{Phase}$ $I_{Line} = \sqrt{3} I_{Phase}$ $S_{3Ph} = \sqrt{3} V_L I_L = 3 V_P I_P$	<u>Wye or Tee (Y – T)</u> $Z_P = \frac{V_P}{I_P}$ $V_{Line-Line} = \sqrt{3} V_{Phase}$ $I_{Line} = I_{Phase}$ $S_{3Ph} = \sqrt{3} V_L I_L = 3 V_P I_P$
Delta-Wye conversion	<u>Delta-Wye</u> $Z_1 = \frac{Z_b Z_c}{Z_a + Z_b + Z_c}$	<u>Wye-Delta</u> $Z_a = \frac{Z_1 Z_2 + Z_2 Z_3 + Z_3 Z_1}{Z_1}$
Equivalent source Find Z_{EQ} at terminals Replace source by internal Z Combine Z into equivalent $Z_{EQ} = \frac{V_{TH}}{I_{SC}}$	<u>Thevenin</u> Find V_{TH} at terminals Open circuit terminals. Calculate *V* across Z at terminals	<u>Norton</u> Find I_{SC} at terminals Short circuit terminals. Calculate *I* that bypasses Z at terminals
		Dr. Marcus O. Durham, PhD, PE www.DrMod.com March 13, 2007







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universal engineering symbol

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engineering trade-offs