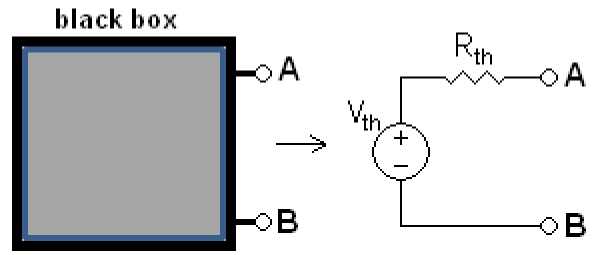
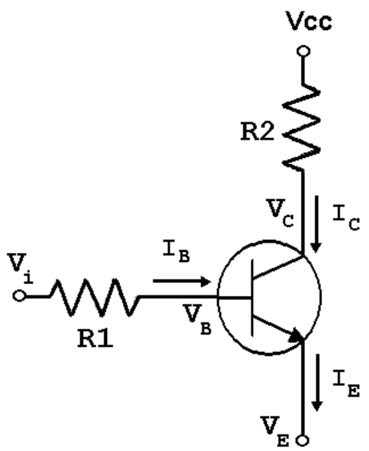
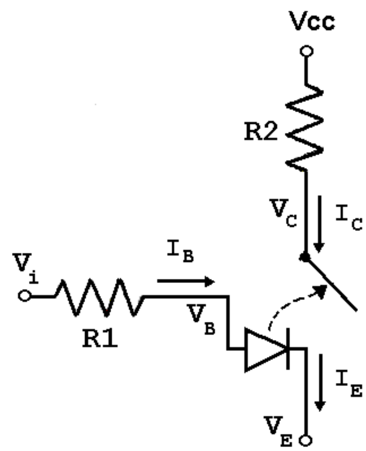
Thevenin Voltage Sources

Find V_{th}	Set load between A and B to open and find $V_A - V_B$	
Find R_{th}	Set voltage sources to shorts and find combined resistance between A and B.	
	$V_L = \frac{R_L}{R_{th} + R_L} V_{th}$	

Experimental Method: Measure output voltage for open circuit (no load) or very large load to obtain V_{th}. Measure output voltage for a series of load resistances. Use the output voltage near $V_{th}/2$ to find R_{th}. Check your answer with another measurement.

Transistor as a switch

Transistor circuit	Transistor model	
		if $(V_i - V_E) < 0.7$ * transistor is off * switch is open * $I_C = 0$ mA * $V_C = V_{CC}$ if $(V_i - V_E) > 0.7$ * transistor is on * switch is closed * $I_C >> I_B$ * $(V_B - V_E) = 0.7$ * $V_{R1} = (V_i - (0.7 + V_E))$ * $V_C = V_E$

Complex Polar Coordinates

Complex numbers: $z = x + jy = re^{j\theta}$ ($j = \sqrt{-1}$, 1/j = -j)

Polar to Cartesian transform: $x = r\cos\theta$, $y = r\sin\theta$

Cartesian to Polar transform: $r = \sqrt{x^2 + y^2}$ $\quad \theta = \tan^{-1}\left(\frac{y}{x}\right)$

$$\tilde{V} = \frac{x_1 + jy_1}{x_2 + jy_2} \quad \left|\tilde{V}\right| = \frac{\sqrt{x_1^{\,2} + y_1^{\,2}}}{\sqrt{x_2^{\,2} + y_2^{\,2}}} \quad \angle\tilde{V} = \tan^{-1}\left(\frac{y_1}{x_1}\right) - \tan^{-1}\left(\frac{y_2}{x_2}\right)$$

$$\tilde{V} = Ae^{j(\omega t + \phi)} = A\cos(\omega t + \phi) + jA\sin(\omega t + \phi)$$

	phases
A	0
-A	π or $-\pi$
jA	$\pi/2$
-jA	$-\pi/2$
$\tan^{-1}(1)$	$\pi/4$ or $-3\pi/4$
$\tan^{-1}(-1)$	$-\pi/4$ or $3\pi/4$
x+jy	$\tan^{-1}(y/x)$

where A is a constant

Exponential & Trig Functions

Euler's Identity $e^{j\theta} = \cos\theta + j\sin\theta$	$V(t) = V_o e^{-t/\tau}$ $\quad \tau = RC$ & $\tau = \frac{L}{R}$	$\frac{d}{dx}e^x = e^x$; $\frac{d}{dx}e^{f(x)} = f'(x)e^{f(x)}$
$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots$	$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} + \ldots$	$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} \ldots$

ECSE-1010 **Formula Sheet** **Quiz 2**
DO NOT WRITE ON THIS SHEET **RETURN SHEET AFTER QUIZ**

Phasor Notation & Analysis	
$V(t) = V_o \cos(\omega t + \varphi) = \mathrm{Re}\left(V_o e^{j\varphi} e^{j\omega t}\right)$	**Phasor:** $\tilde{V} = V_o e^{j\varphi}$
$V(t) = V_o e^{-\alpha t} \cos(\omega t + \varphi) = \mathrm{Re}\left(V_o e^{-\alpha t} e^{j\varphi} e^{j\omega t}\right)$	**Phasor:** $\tilde{V} = V_o e^{-\alpha t} e^{j\varphi}$

Transfer Functions		
$\tilde{V} = \tilde{I} Z$	$H(j\omega) = \dfrac{\tilde{V}_{out}}{\tilde{V}_{in}}$	$H(j\omega) = \dfrac{Z_2}{Z_1 + Z_2}$ *series circuit only*
Combining Impedances	$Z_{eq} = Z_1 + Z_2 + \ldots + Z_N$ *series*	$\dfrac{1}{Z_{eq}} = \dfrac{1}{Z_1} + \dfrac{1}{Z_2} + \ldots + \dfrac{1}{Z_N}$ *parallel*
Using Transfer Functions	$A_{out} = \lvert H \rvert \cdot A_{in}$	$\phi_{out} = \angle H + \phi_{in}$

Decibel Notation	
$dB = 10\log_{10}\left(P/P_o\right) = 20\log_{10}\left(V/V_o\right)$	$P = P_o 10^{\frac{dB}{10}}$
$dBm = 10\log_{10}\left(P/1mW\right)$	$P = (1mW)10^{\frac{dBm}{10}}$
$dBW = 10\log_{10}\left(P/1W\right)$	$P = 10^{\frac{dBW}{10}}$

Load Lines	
A load line represents the I-V curve for the combination of the source and resistor. It is used to graphically determine the operating point for devices with nonlinear I-V curves like diodes and transistors.