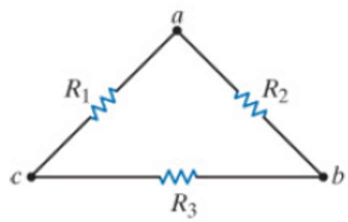
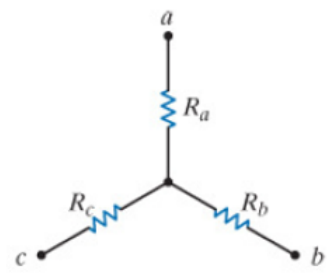
ELEC 1370 Circuits et mesures : Formulaire

1. Dualité étoile-triangle

$$R_1 = \frac{R_aR_b + R_bR_c + R_aR_c}{R_b}$$
$$R_a = \frac{R_1R_2}{R_1+R_2+R_3}$$





2. Equation caractéristique du second ordre

- Forme générale et solutions : $H = 1 + 2j\xi\frac{\omega}{\omega_0} - \left(\frac{\omega}{\omega_0}\right)^2 = \left(1+j\frac{\omega}{\omega_1}\right)\left(1+j\frac{\omega}{\omega_2}\right) \quad \Rightarrow \quad \omega_{1,2} = \xi\omega_0 \pm \omega_0\sqrt{\xi^2-1}$
- Pour des circuits résonants ($\xi < 1$)
  - Facteur de qualité $Q = \dfrac{1}{2\xi}$
  - Bande passante $= \dfrac{\omega_0}{Q} = 2\xi\omega_0$

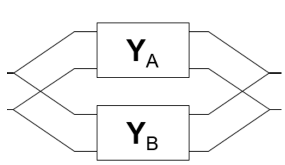
3. Convention entre les représentations Y, Z, H et G

$\begin{bmatrix} v_i \\ v_o \end{bmatrix} = \begin{bmatrix} z_i & z_r \\ z_f & z_o \end{bmatrix}\begin{bmatrix} i_i \\ i_o \end{bmatrix}$	$Z = \frac{1}{\Delta^Y}\begin{bmatrix} y_o & -y_r \\ -y_f & y_i \end{bmatrix}$	$Z = \frac{1}{h_o}\begin{bmatrix} \Delta^h & h_r \\ -h_f & 1 \end{bmatrix}$	$Z = \frac{1}{g_i}\begin{bmatrix} 1 & -g_r \\ g_f & \Delta^g \end{bmatrix}$
$Y = \frac{1}{\Delta^Z}\begin{bmatrix} z_o & -z_r \\ -z_f & z_i \end{bmatrix}$	$\begin{bmatrix} i_i \\ i_o \end{bmatrix} = \begin{bmatrix} y_i & y_r \\ y_f & y_o \end{bmatrix}\begin{bmatrix} v_i \\ v_o \end{bmatrix}$	$Y = \frac{1}{h_i}\begin{bmatrix} 1 & -h_r \\ h_f & \Delta^h \end{bmatrix}$	$Y = \frac{1}{g_o}\begin{bmatrix} \Delta^G & g_r \\ -g_f & 1 \end{bmatrix}$
$H = \frac{1}{z_o}\begin{bmatrix} \Delta^Z & z_r \\ -z_f & 1 \end{bmatrix}$	$H = \frac{1}{y_i}\begin{bmatrix} 1 & -y_r \\ y_f & \Delta^Y \end{bmatrix}$	$\begin{bmatrix} v_i \\ i_o \end{bmatrix} = \begin{bmatrix} h_i & h_r \\ h_f & h_o \end{bmatrix}\begin{bmatrix} i_i \\ v_o \end{bmatrix}$	$H = \frac{1}{\Delta^G}\begin{bmatrix} g_o & -g_r \\ -g_f & g_i \end{bmatrix}$
$G = \frac{1}{z_i}\begin{bmatrix} 1 & -z_r \\ z_f & \Delta^Z \end{bmatrix}$	$G = \frac{1}{y_o}\begin{bmatrix} \Delta^Y & y_r \\ -y_f & 1 \end{bmatrix}$	$G = \frac{1}{\Delta^H}\begin{bmatrix} h_o & -h_r \\ -h_f & h_i \end{bmatrix}$	$\begin{bmatrix} i_i \\ v_o \end{bmatrix} = \begin{bmatrix} g_i & g_r \\ g_f & g_o \end{bmatrix}\begin{bmatrix} v_i \\ i_o \end{bmatrix}$

$$Z = Y^{-1} \quad Y = Z^{-1} \quad G = H^{-1} \quad H = G^{-1}$$

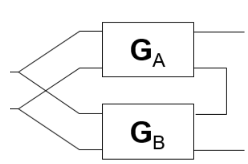
4. Associations de quadripôles

connexion parallèle/parallèle



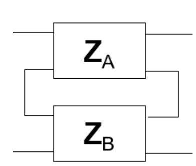
$[Y] = [Y_A] + [Y_B]$

connexion parallèle/série



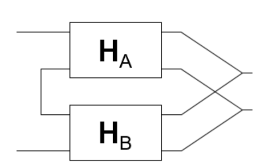
$[G] = [G_A] + [G_B]$

connexion série/série



$[Z] = [Z_A] + [Z_B]$

connexion série/parallèle



$[H] = [H_A] + [H_B]$

5. Table des caractéristiques externes

		y	Z	H	G
$y_r, z_r, h_r, g_r = 0$	$A_{vf,0}$	$-y_f z_L \left(\frac{1}{1+y_o z_L} \right)$	$\frac{z_f}{z_i} \frac{z_L}{z_L + z_o}$	$-\frac{h_f}{h_i} z_L \frac{1}{1+h_o z_L}$	$g_f \frac{z_L}{z_L + g_o}$
$y_r, z_r, h_r, g_r \neq 0$	$A_{vf,r}$	A_{vf0}	$\frac{A_{vf0}}{1-\frac{z_r}{z_L} A_{vf,0}}$	$\frac{A_{vf,0}}{1+h_r A_{vf,0}}$	A_{vf0}
$y_r, z_r, h_r, g_r = 0$	$A_{if,0}$	$\frac{y_f}{y_i} \frac{1}{1+y_o z_L}$	$-\frac{z_f}{z_o + z_L}$	$h_f \left(\frac{1}{1+h_o z_L} \right)$	$-\frac{g_f}{g_i} \frac{1}{z_L + g_o}$
$y_r, z_r, h_r, g_r \neq 0$	$A_{if,r}$	$\frac{A_{if,0}}{1-\frac{y_r}{z_L} A_{if,0}}$	A_{if0}	A_{if0}	$\frac{A_{if,0}}{1+g_r A_{if,0}}$
	Z_{in}	$\frac{1}{y_i} \frac{1}{1+\frac{y_r}{y_i} A_{vf,0}}$	$z_i \left(1+\frac{z_r}{z_i} A_{if,0} \right)$	$h_i \left(1+h_r A_{vf,0} \right)$	$\frac{1}{g_i} \frac{1}{1+g_r A_{if,0}}$
	Z_{out}	$\frac{1}{y_o - y_r \frac{y_f z_G}{1+y_i z_G}}$	$z_o - z_r \frac{z_f}{z_G + z_i}$	$\frac{1}{h_o - h_r \frac{h_f}{z_G + h_i}}$	$g_o - g_r \frac{g_f z_G}{1+g_i z_G}$
	$A_{pf,0}$	$y_f^2 z_L \frac{1}{y_i \left(1+y_o z_L \right)^2}$	$z_f^2 z_L \frac{1}{z_i \left(z_o + z_L \right)^2}$	$h_f^2 z_L \frac{1}{h_i \left(1+h_o z_L \right)^2}$	$g_f^2 z_L \frac{1}{g_i \left(g_o + z_L \right)^2}$

6. Transformées de Laplace

Signal	Transformée	ROC
$\delta(t)$	1	$\forall s$
$u(t)$	$\frac{1}{s}$	$\mathfrak{Re}\{s\} > 0$
$-u(-t)$	$\frac{1}{s}$	$\mathfrak{Re}\{s\} < 0$
$\frac{t^{n-1}}{(n-1)!} u(t)$	$\frac{1}{s^n}$	$\mathfrak{Re}\{s\} > 0$
$-\frac{t^{n-1}}{(n-1)!} u(-t)$	$\frac{1}{s^n}$	$\mathfrak{Re}\{s\} < 0$
$e^{-\alpha t} u(t)$	$\frac{1}{s+\alpha}$	$\mathfrak{Re}\{s\} > -\alpha$
$-e^{-\alpha t} u(-t)$	$\frac{1}{s+\alpha}$	$\mathfrak{Re}\{s\} < -\alpha$
$\frac{t^{n-1}}{(n-1)!} e^{-\alpha t} u(t)$	$\frac{1}{(s+\alpha)^n}$	$\mathfrak{Re}\{s\} > -\alpha$
$-\frac{t^{n-1}}{(n-1)!} e^{-\alpha t} u(-t)$	$\frac{1}{(s+\alpha)^n}$	$\mathfrak{Re}\{s\} < -\alpha$
$\delta(t-T)$	e^{-sT}	$\forall s$
$[\cos \omega_0 t] u(t)$	$\frac{s}{s^2 + \omega_0^2}$	$\mathfrak{Re}\{s\} > 0$
$[\sin \omega_0 t] u(t)$	$\frac{\omega_0}{s^2 + \omega_0^2}$	$\mathfrak{Re}\{s\} > 0$
$[e^{-\alpha t} \cos \omega_0 t] u(t)$	$\frac{s+\alpha}{(s+\alpha)^2 + \omega_0^2}$	$\mathfrak{Re}\{s\} > -\alpha$
$[e^{-\alpha t} \sin \omega_0 t] u(t)$	$\frac{\omega_0}{(s+\alpha)^2 + \omega_0^2}$	$\mathfrak{Re}\{s\} > -\alpha$