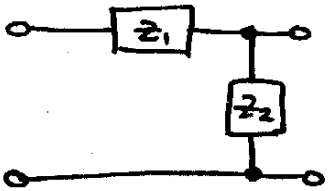
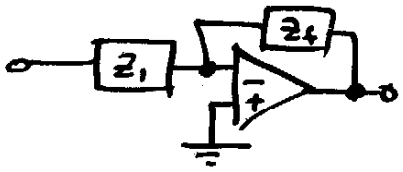
s-Domain Tinker Toys

* NOTE: $H(s) = \frac{V_{OUT}(s)}{V_{IN}(s)}$ = transfer function (zero-state frequency response)

Step 1: Choose a network:

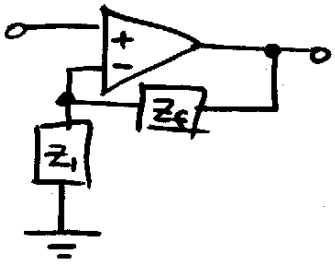


$H(s) = \frac{Z_2}{Z_1 + Z_2}$



$H(s) = -\frac{Z_f}{Z_1}$

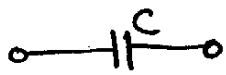
This method is easiest for designing circuits with inductors



$H(s) = 1 + \frac{Z_f}{Z_1} = \frac{Z_1 + Z_f}{Z_1}$

Step 2: Choose appropriate impedance elements:

$Z = R$

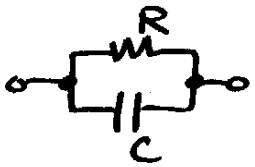


$Z = \frac{1}{C}\frac{1}{s}$

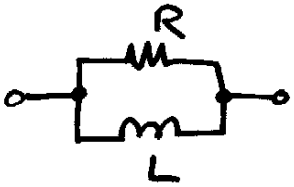
$Z = Ls$

$Z = R + \frac{1}{C}\frac{1}{s}$

$Z = R + Ls$



$Z = \frac{1}{\frac{1}{R} + Cs} = \frac{1/C}{s + 1/RC}$

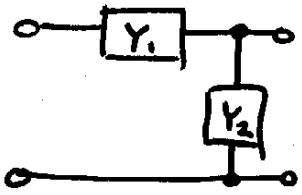


$Z = \frac{1}{\frac{1}{R} + \frac{1}{Ls}} = R\frac{s}{s + R/L}$

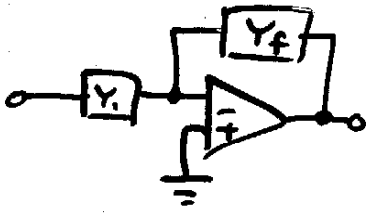
(OVER →)

{Best method for capacitors ⇒ work with admittances:

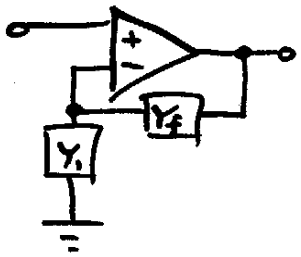
Step 1 : Choose a network:



$$H(s) = \frac{\frac{1}{Y_2}}{\frac{1}{Y_1}+\frac{1}{Y_2}} = \frac{\frac{1}{Y_2}}{\frac{Y_2+Y_1}{Y_1 Y_2}} = \frac{Y_1}{Y_1+Y_2}$$



$$H(s) = -\frac{\frac{1}{Y_f}}{\frac{1}{Y_1}} = -\frac{Y_1}{Y_f}$$

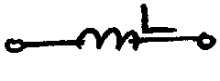


$$H(s) = 1 + \frac{\frac{1}{Y_f}}{\frac{1}{Y_1}} = 1 + \frac{Y_1}{Y_f} = \frac{Y_f + Y_1}{Y_f}$$

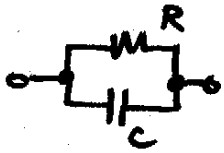
Step 2 : Choose appropriate admittance elements:

$Y = \frac{1}{R}$

$Y = Cs$

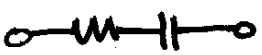


$Y = \frac{1}{L}\frac{1}{s}$



$Y = \frac{1}{R} + Cs$

$Y = \frac{1}{R} + \frac{1}{L}\frac{1}{s}$



$Y = \frac{1}{R+\frac{1}{Cs}} = \frac{Cs}{RCs+1} = \frac{1}{R}\frac{s}{s+1/RC}$ } dual of parallel RL

$Y = \frac{1}{R+Ls} = \frac{1/L}{s+R/L}$ } dual of parallel RC