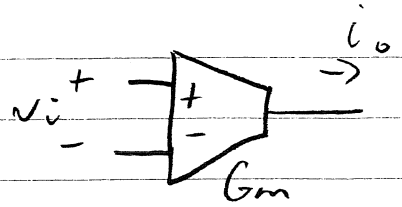
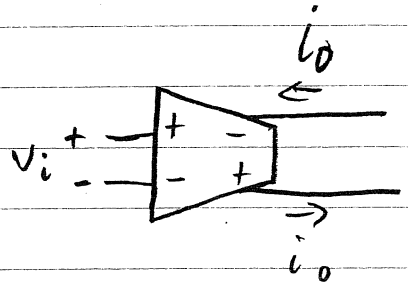
TRANSCONDUCTANCE FILTERS ELEMENT REPLACEMENT

TRANSCONDUCTOR



$$i_o = G_m v_i$$

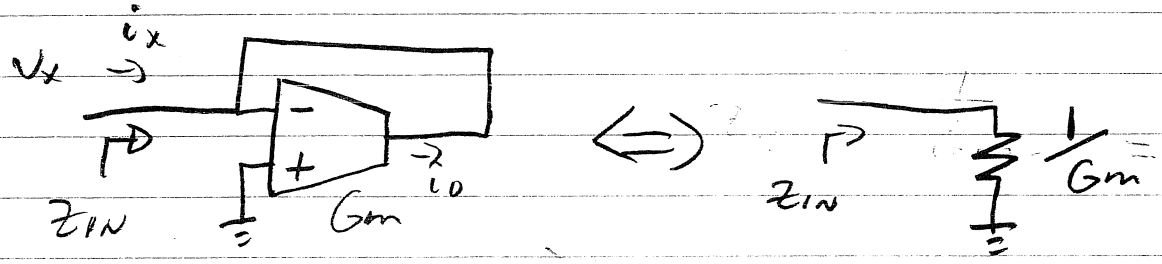
SINGLE-ENDED



$$i_o = G_m v_i$$

FULLY DIFFERENTIAL

RESISTOR EQUIVALENCE

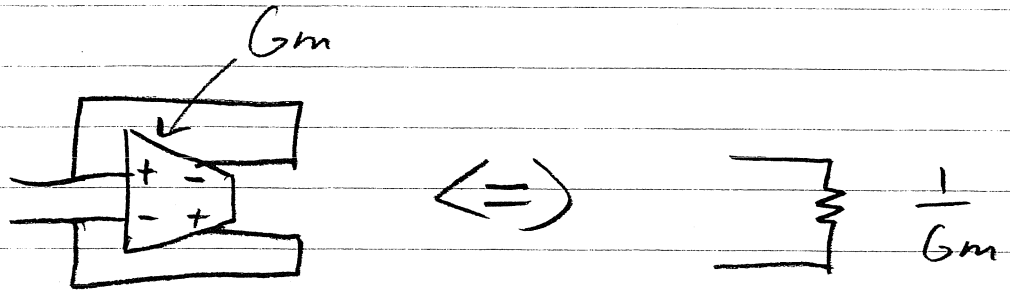


$$i_o = -i_x$$

$$i_o = G_m(-v_x)$$

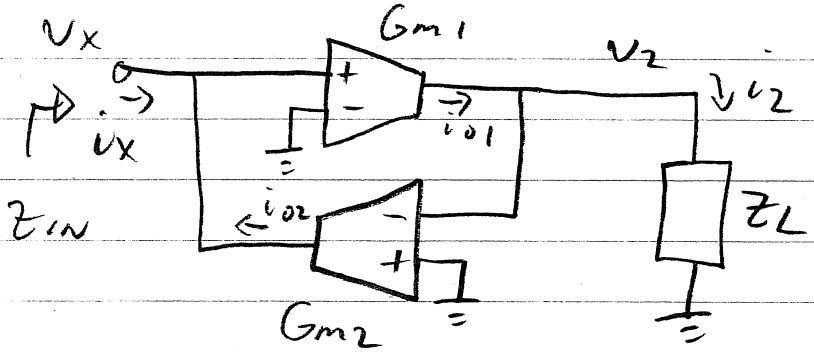
$$-i_x = -G_m v_x$$

$$Z_{IN} \equiv \frac{v_x}{i_x} = \frac{1}{G_m}$$



FULLY DIFF

IMPEDANCE INVERTER (GYRATOR)



$$Z_L = \frac{v_2}{i_2}$$

$$Z_{IN} \equiv \frac{v_x}{i_x}$$

$$i_2 = i_{01} = G_{m1} v_x \quad (1)$$

$$i_x = -i_{02} = -G_{m2}(-v_2)$$

$$i_x = G_{m2} v_2 \quad (2)$$

$$(1) \div (2) \quad \frac{G_{m1} v_x}{i_x} = \frac{i_2}{G_{m2} v_2}$$

$$Z_{IN} = \frac{v_x}{i_x} = \frac{1}{G_{m1} G_{m2} \left(\frac{v_2}{i_2}\right)} = \frac{1}{G_{m1} G_{m2} Z_L}$$

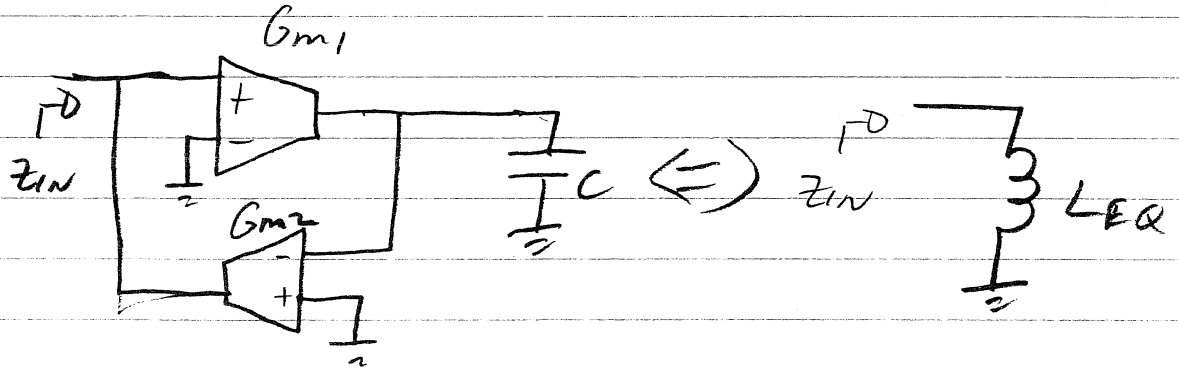
$$Z_{IN} = \frac{1}{G_{m1} G_{m2} Z_L}$$

LET $Z_L = \frac{1}{sC}$ (A CAPACITOR)

$$Z_{IN} = \frac{sC}{G_{m1} G_{m2}} \equiv s L_{EQ}$$

$$L_{EQ} = \frac{C}{G_{m1} G_{m2}}$$

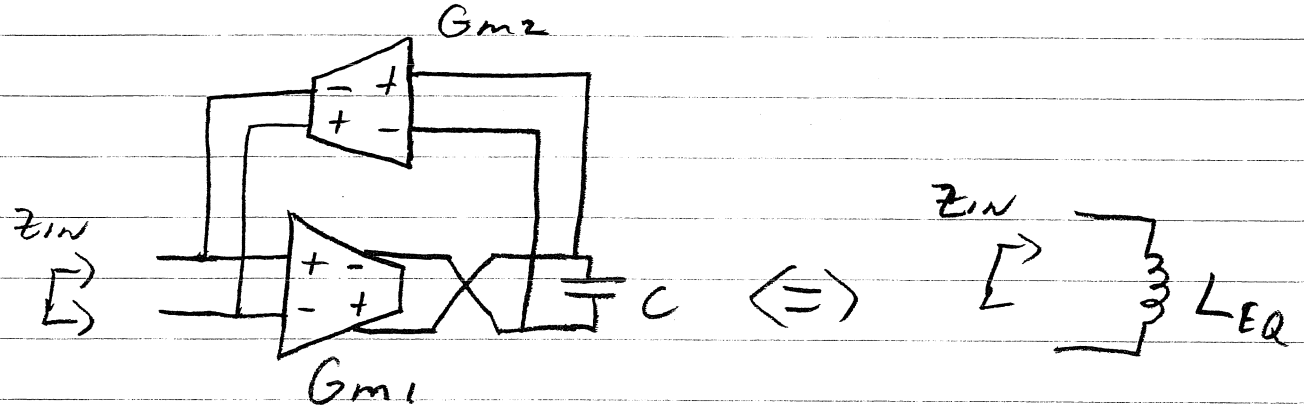
SO EQUIVALENT TO AN INDUCTOR OF SIZE L_{EQ}



$$Z_{IN} = \frac{sC}{G_{m1} G_{m2}} = s L_{EQ}$$

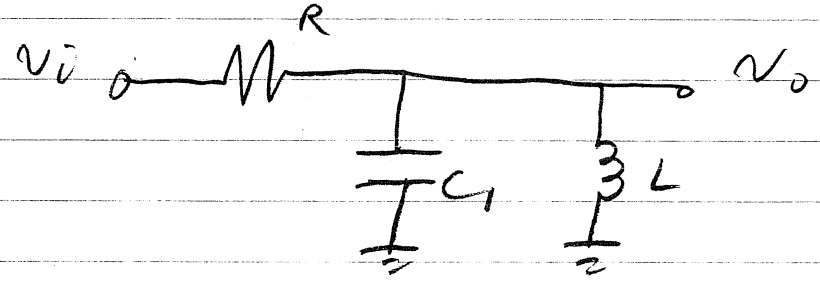
$$L_{EQ} = \frac{C}{G_{m1} G_{m2}}$$

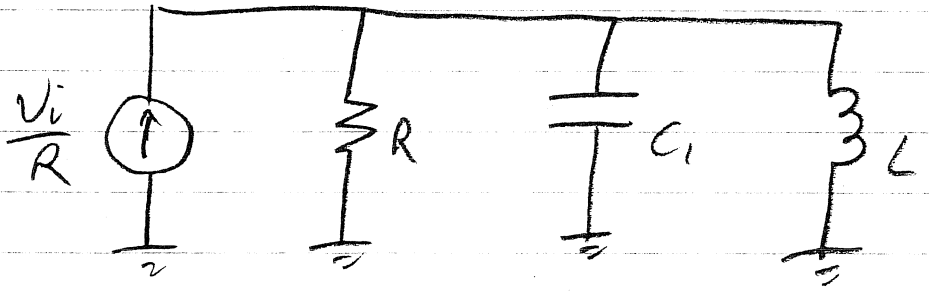
FULLY DIFF

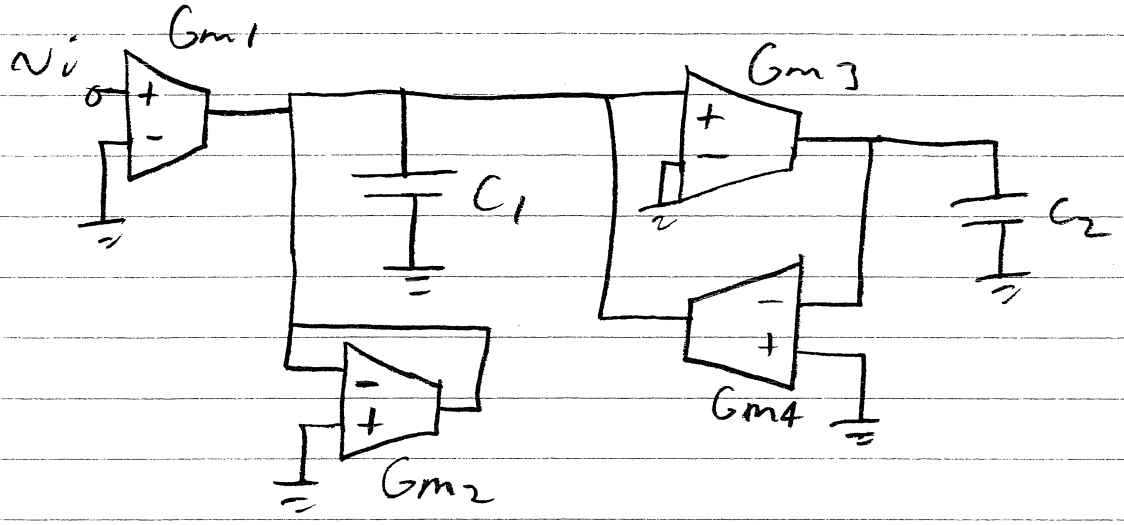


$$Z_{IN} = \frac{s\,C}{G_{m1}\,G_{m2}} = s\,L_{EQ}$$

2ND ORDER BANDPASS FILTER







$$Gm_1 = Gm_2 = \frac{1}{R} \qquad L = \frac{C_2}{Gm_3\, Gm_4}$$