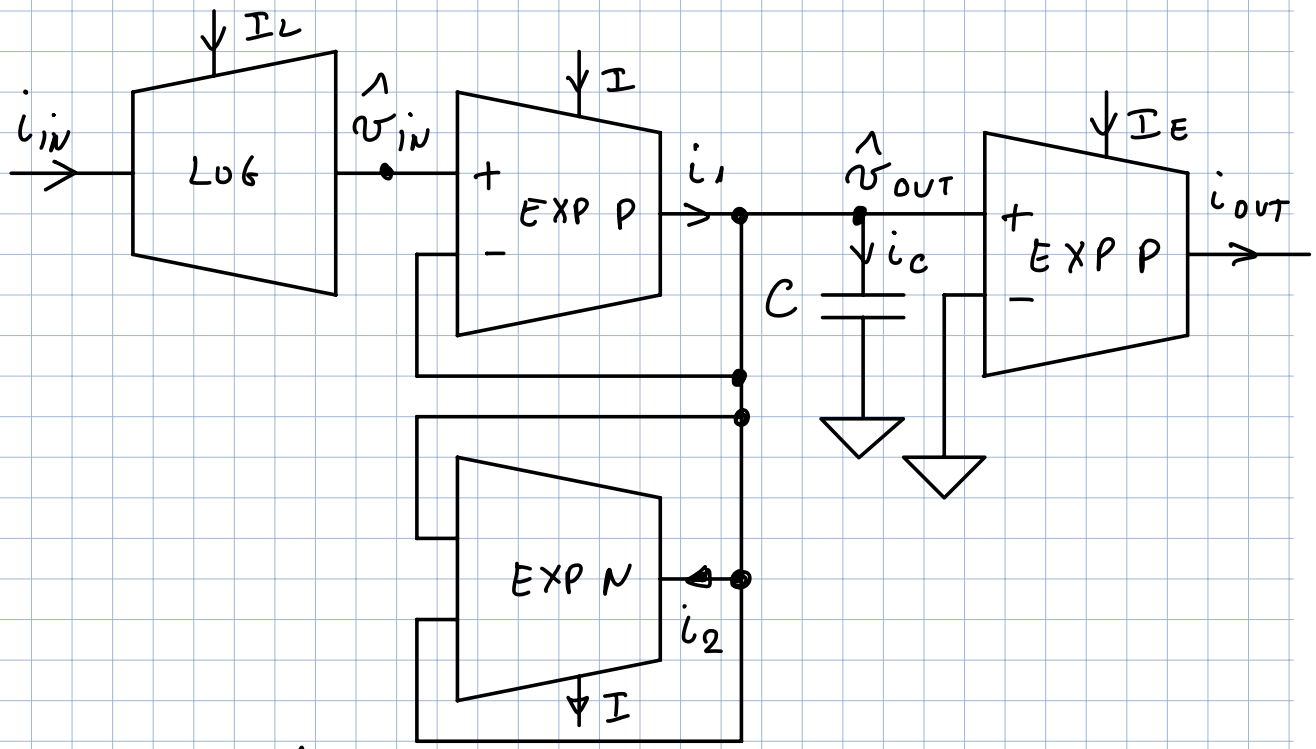
LABORATOR 6



$$i_C = C \frac{d\hat{V}_{OUT}}{dt}$$

$$i_C = i_1 - i_2$$

$$i_1 = I \exp\left(\frac{\hat{v}_{IN} - \hat{v}_{OUT}}{2U_T}\right) - I$$

$$i_2 = I \exp\left(\frac{\hat{v}_{OUT} - \hat{v}_{OUT}}{2U_T}\right) - I$$

$$C \frac{d\hat{v}_{OUT}}{dt} = I \exp\left(\frac{\hat{v}_{IN} - \hat{v}_{OUT}}{2U_T}\right) - I - I \exp\left(\frac{\hat{v}_{OUT} - \hat{v}_{OUT}}{2U_T}\right) + I$$

$$C \frac{d\hat{v}_{out}}{dt} = I \exp\left(\frac{\hat{v}_{IN} - \hat{v}_{OUT}}{2U_T}\right) - I \exp\left(\frac{\hat{v}_{OUT} - \hat{v}_{out}}{2U_T}\right)$$

$$C \underbrace{\frac{d\hat{v}_{out}}{dt} \exp\left(\frac{\hat{v}_{out}}{2V_T}\right)}_{u'(t)\cdot\exp(u(t))} = I\exp\left(\frac{\hat{v}_{in}}{2V_T}\right) - I\exp\left(\frac{\hat{v}_{out}}{2V_T}\right)$$

$$2V_T \cdot C \frac{d}{dt}\left(\exp\left(\frac{\hat{v}_{out}}{2V_T}\right)\right) = I\exp\left(\frac{\hat{v}_{in}}{2V_T}\right) - I\exp\left(\frac{\hat{v}_{out}}{2V_T}\right)$$

$$\frac{d}{dt}\left(\exp\left(\frac{\hat{v}_{out}}{2V_T}\right)\right) = \frac{I}{2V_T\cdot C}\exp\left(\frac{\hat{v}_{in}}{2V_T}\right) - \frac{I}{2V_T\cdot C}\exp\left(\frac{\hat{v}_{out}}{2V_T}\right)$$

$$s\exp\left(\frac{\hat{v}_{out}}{2V_T}\right) + \frac{I}{2V_T\cdot C}\exp\left(\frac{\hat{v}_{out}}{2V_T}\right) = \frac{I}{2V_T\cdot C}\exp\left(\frac{\hat{v}_{in}}{2V_T}\right)$$

$$\exp\left(\frac{\hat{v}_{out}}{2V_T}\right)\left(s + \frac{I}{2V_T C}\right) = \exp\left(\frac{\hat{v}_{in}}{2V_T}\right)\cdot\frac{I}{2V_T C}$$

$$\frac{\exp\left(\frac{\hat{v}_{out}}{2V_T}\right)}{\exp\left(\frac{\hat{v}_{in}}{2V_T}\right)} = \frac{\frac{I}{2V_T C}}{s + \frac{I}{2V_T\cdot C}}$$

$$\hat{v}_{out} = 2V_T \ln\left(\frac{i_{in}}{I_L}\right) \quad \Big| \quad i_{in} = i_{in} + I_L$$

$$\hat{v}_{in} = 2V_T \ln\left(\frac{i_{out}}{I_E}\right) \quad \Big| \quad i_{out} = i_{out} + I_E$$

$$\frac{\exp\left(\frac{2V_T \ln\left(\frac{i_{OUT}}{I_E}\right)}{2V_T}\right)}{\exp\left(\frac{2V_T \ln\left(\frac{i_{in}}{I_C}\right)}{2V_T}\right)} = \frac{\frac{I}{2U_T \cdot C}}{s + \frac{I}{2U_T \cdot C}}$$

$$\frac{\exp\left(\ln\left(\frac{i_{OUT}}{I_E}\right)\right)}{\exp\left(\ln\left(\frac{i_{in}}{I_C}\right)\right)} = \frac{1}{\frac{s}{\frac{I}{2U_T \cdot C}} + 1}$$

$$\frac{i_{OUT}}{i_{in}} = \frac{\frac{I_E}{I_C}}{1 + \frac{s}{\frac{I}{2U_T \cdot C}}} = H(s) = \frac{A_0}{1 + \frac{s}{\omega_0}}$$

$$A_0 = \frac{I_E}{I_C}$$

$$\omega_0 = \frac{I}{2U_T \cdot C}$$