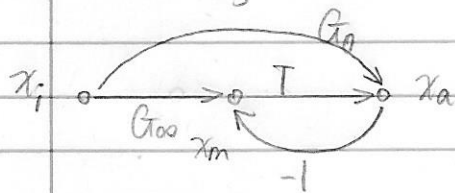


Lect 8 ECE264A Asymptotic Gain Relation

1. block diagram



$$\Delta = 1 + T$$

$$\textcircled{1} G_1 \Delta_1 = G_{00} T$$

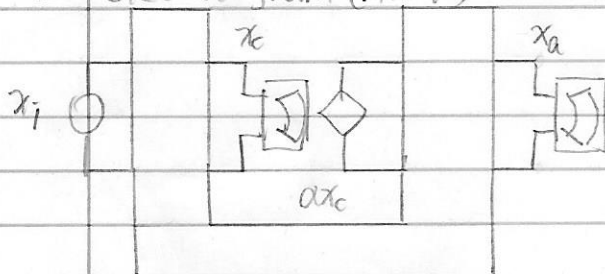
$$\textcircled{2} G_2 \Delta_2 = G_0$$

$$G = \frac{1}{\Delta} (G_1 \Delta_1 + G_2 \Delta_2)$$

$$= G_{00} \frac{T}{1+T} + G_0 \frac{1}{1+T}$$

T is the return ratio

2. ckt diagram (ntwk)



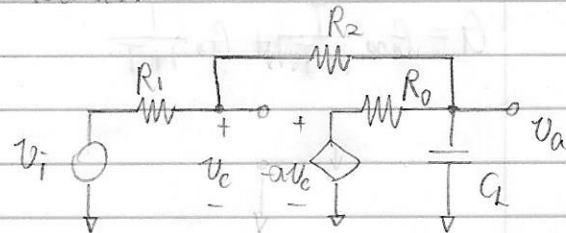
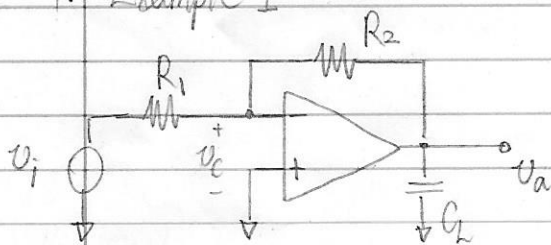
$$G = \frac{x_a}{x_i}$$

3. compare the two

$$T = -\alpha \frac{x_c}{x_x}$$

$$G_{00} = G|_{\alpha=\infty}, G_0 = G|_{\alpha=0}$$

4. Example 1



$$\textcircled{1} G_0 = \frac{R_0 // \frac{1}{sC_L}}{R_1 + R_2 + (R_0 // \frac{1}{sC_L})} = \frac{R_0}{(R_1 + R_2)(1 + sC_L R_0) + R_0}$$

KCL at v_a

$$(sC_L + \frac{1}{R_0} + \frac{1}{R_2}) v_a = \frac{1}{R_2} v_c - \frac{1}{R_0} \alpha v_c$$

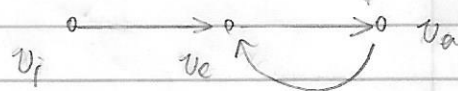
KCL at v_c

$$(\frac{1}{R_1} + \frac{1}{R_2}) v_c = \frac{1}{R_1} v_i + \frac{1}{R_2} v_a$$

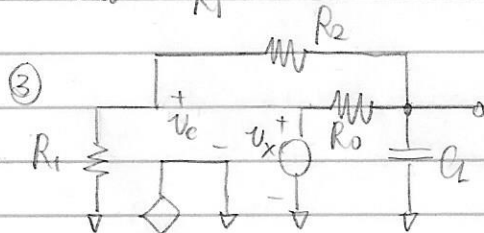
$$(*) v_a = \frac{1}{sC_L + \frac{1}{R_0} + \frac{1}{R_2}} (\frac{1}{R_2} - \frac{\alpha}{R_0}) v_c$$

$$(**) v_c = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} (\frac{1}{R_1} v_i + \frac{1}{R_2} v_a)$$

$$v_a = R_2 (\frac{1}{R_1} + \frac{1}{R_2}) v_c - \frac{1}{R_1} v_i$$



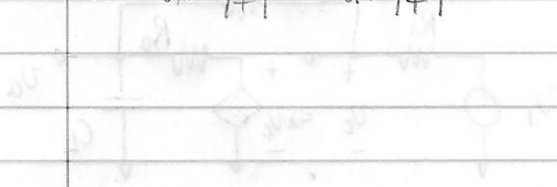
$$\textcircled{2} G_{00} = -\frac{R_2}{R_1}$$



$$v_c = \frac{\frac{R_1}{R_1 + R_2} \frac{1}{sC_L}}{R_0 + (R_1 + R_2) // \frac{1}{sC_L}} v_x = \frac{R_1 R_2}{R_0 (1 + s(R_1 + R_2)C_L) + R_1 + R_2} v_x$$

$$T = -\frac{\alpha v_c}{v_x} = -\frac{\alpha R_1}{R_0 (1 + s(R_1 + R_2)C_L) + R_1 + R_2}$$

$$G = G_{\infty} \frac{T}{1+T} + G_0 \frac{1}{1+T}$$



$$v_o = \frac{v_i}{1 + G_{\infty} F} + \frac{G_0 F}{1 + G_{\infty} F} v_i$$

$$\begin{aligned} \text{① } G_{\infty} &= \lim_{s \rightarrow \infty} G(s) \\ \text{② } G_0 &= G(s)|_{s=0} \end{aligned}$$

$$\frac{1}{1+T} = \frac{1}{1+G_{\infty} F} + \frac{G_0 F}{1+G_{\infty} F}$$

$$G_{\infty} F = \lim_{s \rightarrow \infty} G(s) F(s)$$

$$G_0 F = G(s) F(s)|_{s=0}$$

$$\frac{1}{1+T} = \frac{1}{1+G_{\infty} F} + \frac{G_0 F}{1+G_{\infty} F}$$

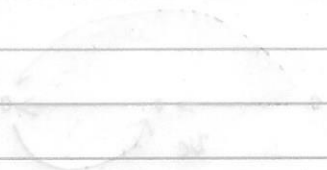
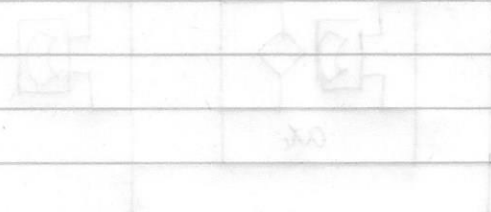
$$\frac{1}{1+T} = \frac{1}{1+G_{\infty} F} + \frac{G_0 F}{1+G_{\infty} F}$$

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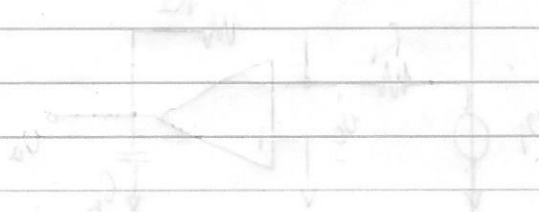
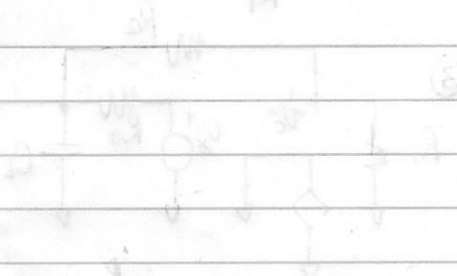
$$G = \frac{v_o}{v_i}$$

$$G_{\infty} = \lim_{s \rightarrow \infty} G(s)$$

$$G_0 = G(s)|_{s=0}$$

$$T = G_{\infty} F$$

$$G_0 F = G(s) F(s)|_{s=0}$$



$$T = G_{\infty} F$$