1.1 A 1.2 E 1.3 C 1.4 A 1.5 D

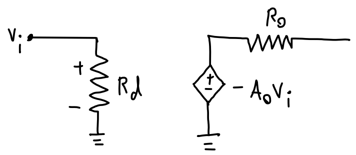
II

a) Paralelo - Paralelo

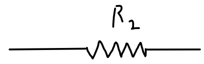
Transimpedância

b)

A



β



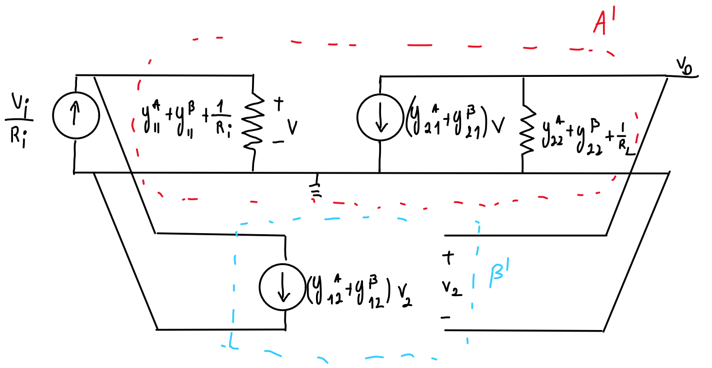
$$y_{11} = \frac{I_1}{V_1}\bigg|_{V_2=0} = \frac{1}{R_d} = 2\mu S \qquad y_{12} = \frac{I_1}{V_2}\bigg|_{V_1=0} = 0$$

$$y_{21} = \frac{I_2}{V_1}\bigg|_{V_2=0} = \frac{A_o}{R_o} = 100S \qquad y_{22} = \frac{I_2}{V_2}\bigg|_{V_1=0} = \frac{1}{R_o} = 100\mu S$$

$$y_{11} = \frac{I_1}{V_1}\bigg|_{V_2=0} = \frac{1}{R_2} = 10\mu S \qquad y_{12} = \frac{I_1}{V_2}\bigg|_{V_1=0} = -\frac{1}{R_2} = -10\mu S$$

$$y_{21} = \frac{I_2}{V_1}\bigg|_{V_2=0} = -\frac{1}{R_2} = -10\mu S \qquad y_{22} = \frac{I_2}{V_2}\bigg|_{V_1=0} = \frac{1}{R_2} = 10\mu S$$

c)



$$A' = \frac{-(y_{21}^A + y_{21}^B)}{\left(y_{22}^A + y_{22}^B + \frac{1}{R_L}\right)\left(y_{11}^A + y_{11}^B + \frac{1}{R_i}\right)} = -21{,}65\,G\Omega$$

$$\beta' = y_{12}^A + y_{12}^B = -10\mu S$$

d) $A_f = \dfrac{A'}{1 + A'\beta'} = -100K$

$$K_V = \frac{V_o}{V_i} = \frac{V_o}{\frac{V_i}{R_i}} \cdot \frac{1}{R_i} = \frac{V_o}{i_i} \cdot \frac{1}{R_i} = \frac{A_f}{R_i} = -1$$

$$Z_i' = \frac{1}{y_{11}^A + y_{11}^B + \frac{1}{R_i}} = 45{,}45\,K\Omega \qquad Z_{if}' = \frac{Z_i'}{1 + A'\beta'} = 210\,m\Omega \qquad Z_{if} = \frac{1}{\frac{1}{Z_{if}'} - \frac{1}{R_i}} = 0{,}21\,\Omega$$

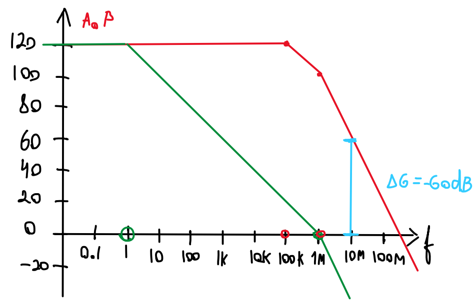
e) $A_o = 140\,dB$

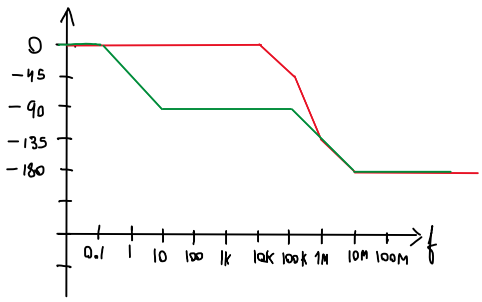
$\omega_{p_1} = 2\pi \times 10^3\ rad/s$

$\omega_{p_2} = 2\pi \times 10^6\ rad/s$

$A_f = 20\,dB = \frac{1}{\beta} \iff \beta = -20\,dB$

$A_o \cdot \beta = 120\,dB$





III a) $A_p = 3\,dB$

$\omega_p = 10\times10^3 \times 2\pi$ rad/s $\rightarrow \Omega_p = 1$

$A_s = 20\,dB$

$\omega_s = 40\times10^3 \times 2\pi$ rad/s $\rightarrow \Omega_s = 4$

Aplanamento máximo $\Rightarrow$ Butterworth

$$A(\Omega) = 10\log(1+\varepsilon^2\Omega^{2m})$$

$$A(1) = A_p = 10\log(1+\varepsilon^2) = 3\,dB \Rightarrow \varepsilon = 1$$

$$A(4) = A_s = 10\log(1+4^{2m}) \geq 20\,dB \Rightarrow m = 2$$

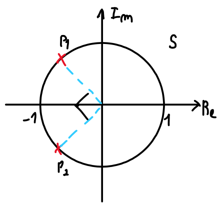
$\varepsilon = 1$ e $m = 2$

$$H(s) = s^2 + 1.414s + 1$$

$$T(s) = \frac{1}{H(s)}\bigg|_{s=\frac{s}{\omega_p}} = \frac{1}{\frac{s^2}{\omega_p^2} + 1.414\frac{s}{\omega_p} + 1} = \frac{\omega_p^2}{s^2 + 1.414\omega_p s + \omega_p^2}$$

$$T(s) = \frac{3.95\times10^9}{s^2 + 88.84\times10^3 s + 3.95\times10^9}$$

Polos



b) Para ordem $m = 2$

$$A_C(\Omega) = 10\log(1+\varepsilon^2(2\Omega^2-1)^2$$

$$A_B(\Omega) = 10\log(1+\varepsilon^2\Omega^4)$$

$$A_C - A_B = 10\log\left(\frac{1+\varepsilon^2(2\Omega^2-1)^2}{1+\varepsilon^2\Omega^4}\right) = 10\log\left(\frac{1+\varepsilon^2(4\Omega^4-4\Omega^2+1)}{1+\varepsilon^2\Omega^4}\right) \xrightarrow{\Omega=\infty} 10\log_{10}(4) = 6dB$$

c) A transformação bilinear mantem a estabilidade

Analogio $0 \rightarrow \infty$

Digita $0 \rightarrow \frac{f_s}{2}$

Logo 30KHz temos que a atenuação é maior no digital

d) Para simular elementos flutuantes são precisos 2 GIC e é complexo

Os filtros passa banda podem ter bobines flutuantes, logo é pouco adequado.

IV a) Oscilador em ponte de Wien

$$\beta = -\frac{s\frac{1}{C_pR_s}}{s^2 + s\left(\frac{1}{C_pR_s} + \frac{1}{C_pR_p} + \frac{1}{C_sR_s}\right) + \frac{1}{C_pR_pC_sR_s}}$$

A $\rightarrow$ Varia

$A\beta = -1$

$$A = -\beta \Leftrightarrow A = sC_pR_s + \left(1 + \frac{R_s}{R_p} + \frac{C_p}{C_s}\right) + s^{-1}\frac{1}{C_sR_p}$$

$$j\omega C_pR_s - j\frac{1}{\omega}\frac{1}{C_sR_p} = 0 \Leftrightarrow \omega^2 C_pR_s = \frac{1}{C_sR_p} \Leftrightarrow$$

$$\omega = \sqrt{\frac{1}{C_sC_pR_sR_p}} \Rightarrow \omega = \frac{1}{RC} = 6{,}25\times10^3 \rightarrow 995Hz$$

$$A = 1 + \frac{R_s}{R_p} + \frac{C_p}{C_s} = 1+1+1 = 3 \,//$$

b) Diodos - Limitam a amplitude das oscilações

Tirar em v_o - Tem menos distorção, já que β filtra!

c) Ler as DRAM faz com que se perca a tensão do condensador, ou seja é misturada com a tensão da linha de leitura

d) Programar

- Aplicar tensões elevados no gate para aprisionar cargas no gate flutuante
- Isto aumenta o V_{GS}, logo não é como não houvesse transistor

Apagar

- Aplicar tensões muito negativas no gate para soltar cargas