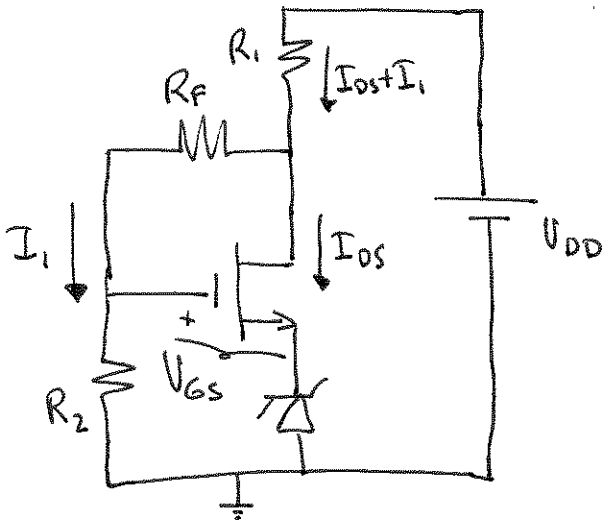
Solución Ejercicio Refuerzo MOS 4

a) Circuito en DC



Supongo Zener en ruptura:

Supongo NMOS en saturación:

$I_{DS} = \frac{k}{2}\frac{W}{L}(V_{GS}-V_T)^2$ ①

$V_{DS} > V_{GS}-V_T$

$V_{GS} > V_T$

MALLA G-S $\quad V_{DD} = (I_1 + I_{DS})R_1 + I_1 R_F + V_{GS} + V_z$

$I_1 R_2 = V_{GS} + V_z$ → $V_{DD} = \left(\frac{V_{GS}+V_z}{R_2} + I_{DS}\right)R_1 + \frac{V_{GS}+V_z}{R_2}R_F + V_{GS} + V_z$ →

→ $18 = \frac{5}{3}V_{GS} + I_{DS}$ $\quad \left\{ 0'4\,V_{GS}^2 + \frac{13}{15}V_{GS} - 17'6 = 0 \right.$

① → $I_{DS} = 0'4\,(V_{GS}-1)^2$

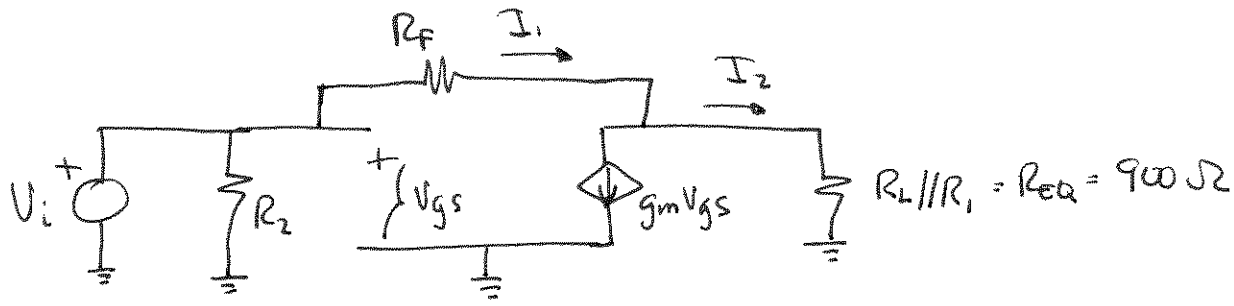
$\Rightarrow V_{GS} = \begin{cases} 5'64\ V \longrightarrow I_{DS} = 8'6\,mA \\ -7'8 < V_T \quad \times \end{cases}$ $\qquad I_1 = \frac{V_{GS}+V_z}{R_2} = 3'08\,mA$

MALLA D-S $\quad V_{DD} = (I_{DS} + I_1)R_1 + V_{DS} + V_z$

→ $V_{DS} = 8'72\ V > V_{GS} - V_T$ OK SATURACIÓN

b) $I_z = I_{DS} = 8'6\,mA \begin{cases} > I_{z,min} = 4\,mA \\ < I_{zMax} = \frac{P_{MAX}}{|V_z|} = 27'8\,mA \end{cases}$ OK

c)



d) $V_{gs} = V_i$

$$I_1 = g_m V_{gs} + I_2 \longrightarrow \frac{V_i - V_o}{R_F} = g_m V_i + \frac{V_o}{R_{EQ}} \longrightarrow$$

$$\longrightarrow V_i \left(\frac{1}{R_F} - g_m \right) = V_o \left(\frac{1}{R_F} + \frac{1}{R_{EQ}} \right) \longrightarrow$$

$$\longrightarrow \frac{V_o}{V_i} = \frac{\frac{1}{R_F} - g_m}{\frac{1}{R_F} + \frac{1}{R_{EQ}}} = \frac{1 - g_m R_F}{1 + \frac{R_F}{R_{EQ}}} = -1'28$$

$$g_m = \sqrt{2K \frac{W}{L} I_{DS}} = 3'71\ m\Omega/V$$