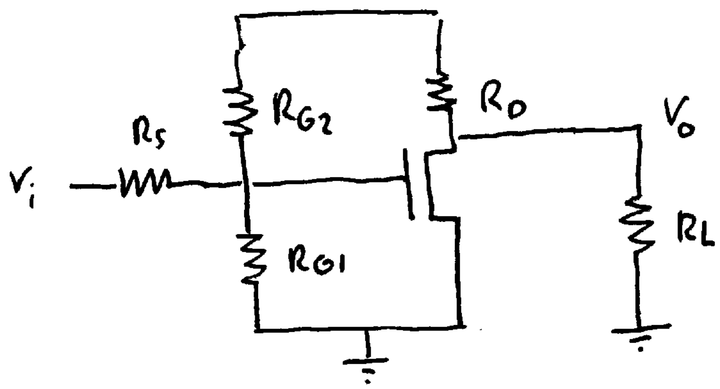
Folha de problemas 4

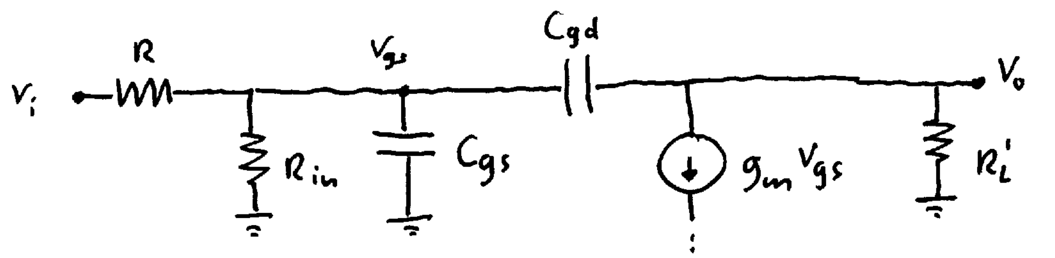


$R = R_S$

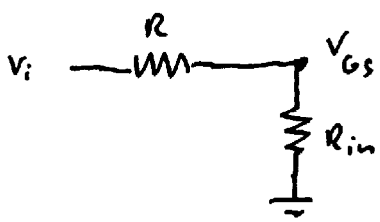
$R_{in} = R_{G1} // R_{G2}$

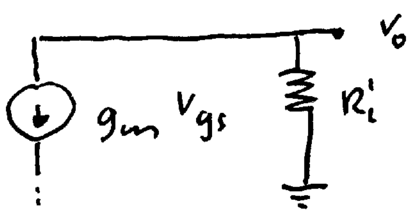
$R_L' = R_L // R_D // r_o$

⇓ small-signal equivalent circuit



a) mid band gain: capacitors do not limit gain: For coupling and bypass circuit capacitors: short circuit. For intrinsic capacitors: open circuit.



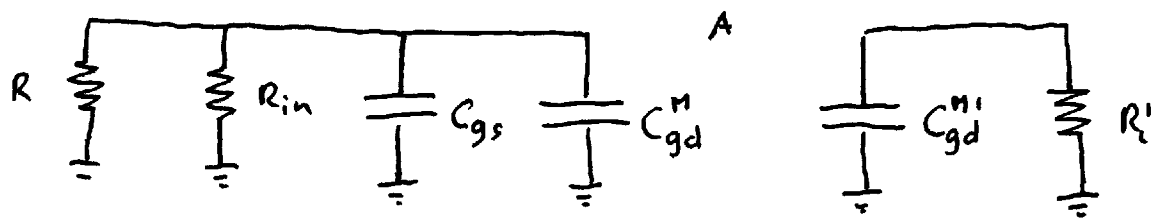


$$\frac{V_o}{V_i} = \frac{V_o}{V_{GS}} \times \frac{V_{GS}}{V_i} = \frac{-g_m \cdot R_L' \cdot V_{GS}}{V_{GS}} \times \frac{R_{in}}{R_{in} + R}$$

$$= -4\ mA/V \times 3.33\ k\Omega \times \frac{420\ k\Omega}{420\ k\Omega + 100\ k\Omega} = -10.8\ V/V$$

b) • To find cut-off frequencies: signal sources are ground.

• Miller effect: capacitors are multiplied by $(1-A)$, with A the gain they feel (not the entire gain of the circuit)



does not suffer from Miller effect because $A=0$

$A = -g_m R_i'$

$= -13.33$ V/V

$C_{gs} = 1\,pF$

$C_{gd}^{M} = (1-A)\cdot 1\,pF$

$= 14.33\,pF$

$C_{gd}^{M'} = (1-\frac{1}{A})\cdot 1\,pF = 1.08\,pF$

$\tau_{in} = (C_{gs} + C_{gd}^{M}) \times [R // R_{in}]$

$= 15.33\,pF \times (100\,k\Omega // 420\,k\Omega)$

$= 15.33\,pF \times 80.8\,k\Omega$

$= 1.24\,\mu s \qquad (f_{H_{in}} = \frac{1}{2\pi\tau_{in}} = 128\,kHz)$

$\tau_{out} = C_{gd}^{M'} \times R_i'$

$= 1.08\,pF \times 3.33\,k\Omega =$

$= 3.6\,ns \qquad (f_{H_{out}} = \frac{1}{2\pi\tau_{out}} = 4.4\,MHz)$

$\tau_{tot} = \tau_{in} + \tau_{out} = 1.24\,\mu s$

$f_H = \frac{1}{2\pi\tau_{tot}} = 128\,kHz$

$\Delta f = 128\,kHz - 0\,Hz = 128\,kHz$