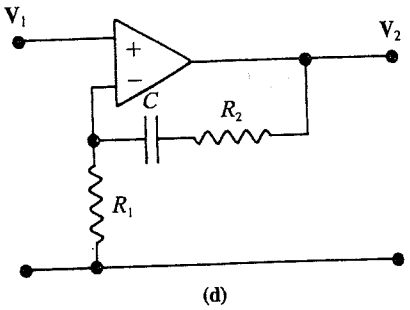


(d)

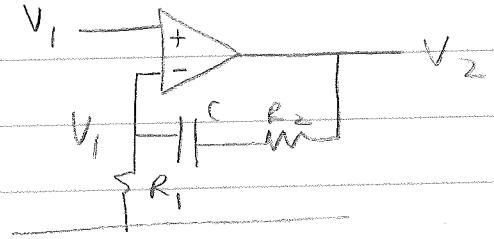
Find $G(j\omega)$, corner frequency

Sketch Bode plot

Ideal op-Amp Rules (w/ feedback) : $V_+ = V_-$

$I_+ = I_- = 0$

8.6) a) Find $G(jw)$ for



sketch $|G|$

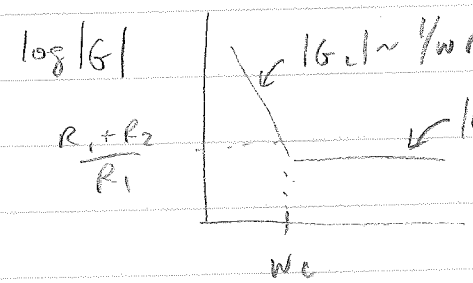
Find corner frequency

$$V_1 = \frac{R_1}{R_1 + R_2 + \frac{1}{jwC}} V_2$$

$$G(jw) = \frac{V_2}{V_1} = \frac{R_1 + R_2 + \frac{1}{jwC}}{R_1} = \frac{1 + (R_1 + R_2) jwC}{jwR_1C}$$

For w small $G_L \sim \frac{1}{jwR_1C}$

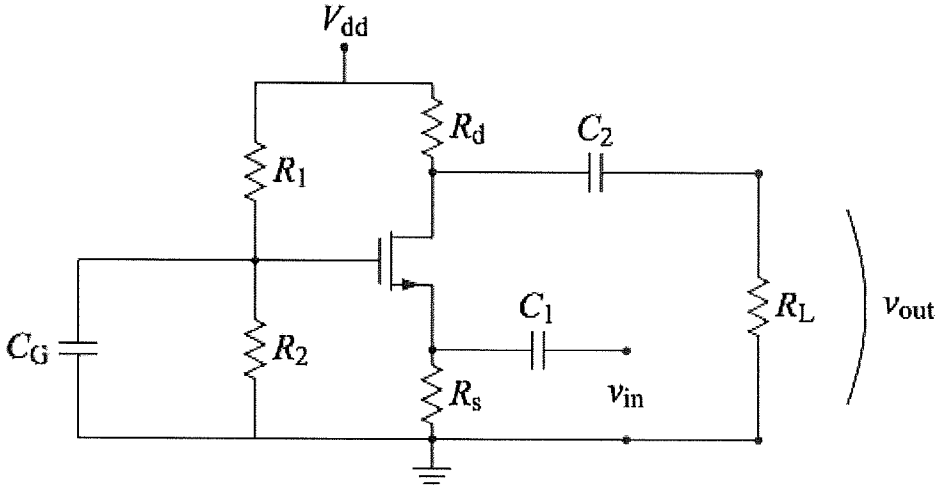
For w large $G_H \sim \frac{R_1 + R_2}{R_1}$



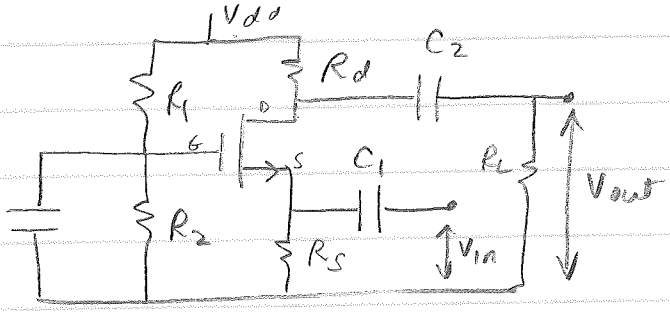
↑ corner for $\frac{R_1 + R_2}{R_1} = \frac{1}{wR_1C}$

$$w_c = \frac{1}{(R_1 + R_2)C}$$

Derive the expressions for the voltage gain a, the current gain g, the input impedance Z_{in}, and the output impedance Z_{out} for the common-gate amplifier.

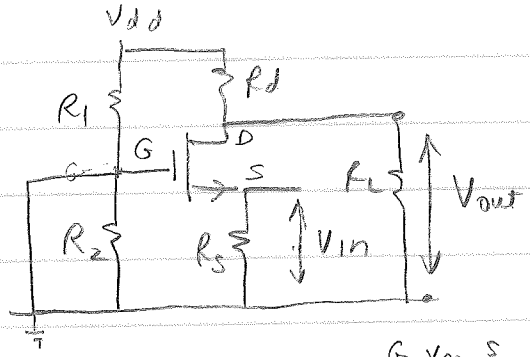


Common gate amplifier



How to

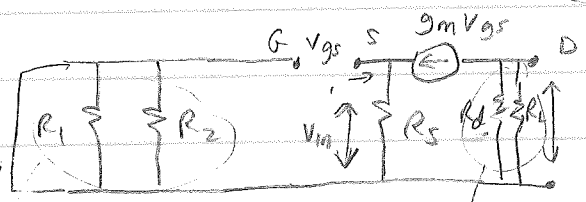
Short caps

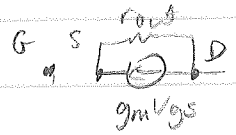


Ignore r_{out}

Short supply to gnd,

insert transistor model

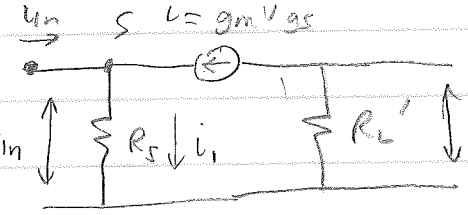




shorted out due to shorted cap

$R_L = R_d \| R_L$

$V_{in} = -V_{gs}$



$V_{out} =$

$$a = \frac{V_{out}}{V_{in}} = \frac{-g_m V_{gs} R_L'}{-V_{gs}} = g_m R_L'$$

$$i_1 = \frac{V_{in}}{R_S} = \frac{-V_{gs}}{R_S}$$

$$= g_m V_{gs} + i_{in}$$

$$\Rightarrow i_{in} = -\frac{V_{gs}}{R_S} - g_m V_{gs}$$

$$g = \frac{i_{out}}{i_{in}} = \frac{V_{out}/R_L}{-\frac{V_{gs}}{R_S} - g_m V_{gs}}$$

$$= \frac{-g_m V_{gs} R_L'/R_L}{-\frac{V_{gs}}{R_S} - g_m V_{gs}} = \frac{g_m R_L'/R_L}{g_m + 1/R_S}$$

$$Z_{in} = \frac{V_{in}}{i_{in}} = \frac{-V_{gs}}{-V_{gs}(g_m + 1/R_S)}$$

$$= \frac{R_S}{1 + g_m R_S}$$

$(R_L \to \infty)$

$$Z_{out} = \frac{V_{out}}{i_{out}} = \frac{-g_m V_{gs} R_d}{-g_m V_{gs}}$$

$$= R_d$$

The three-input OR gate follows the Boolean statement Q=A+B+C

a. Write a truth table for this gate.
b. Write the Boolean statement for $\overline{Q}$ and implement the result using 2-input NAND gates and inverters.

3 - input OR

$Q = A + B + C$ Want in terms of NAND's

a)

A	B	C	Q
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

b) De Morgan $Q = \overline{A + B + C} = \overline{A + B} \cdot \overline{C}$

$= (\overline{A} \cdot \overline{B}) \cdot \overline{C}$

$= \overline{\overline{A} \cdot \overline{B}} \cdot \overline{C}$ → NAND

$= \overline{\overline{\overline{A} \cdot \overline{B}} \cdot C}$ NAND