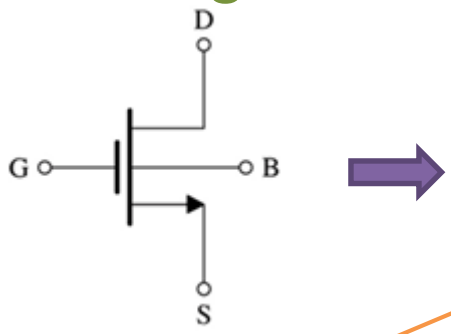
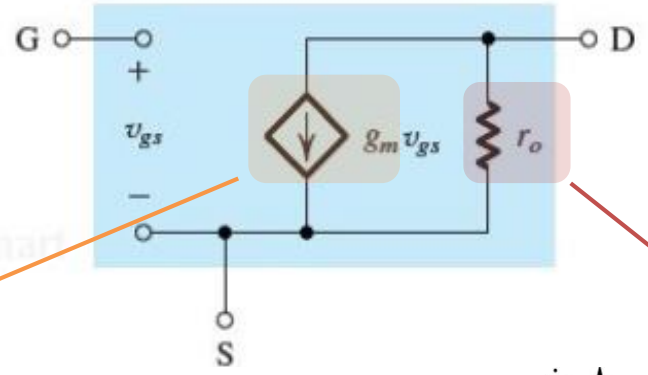
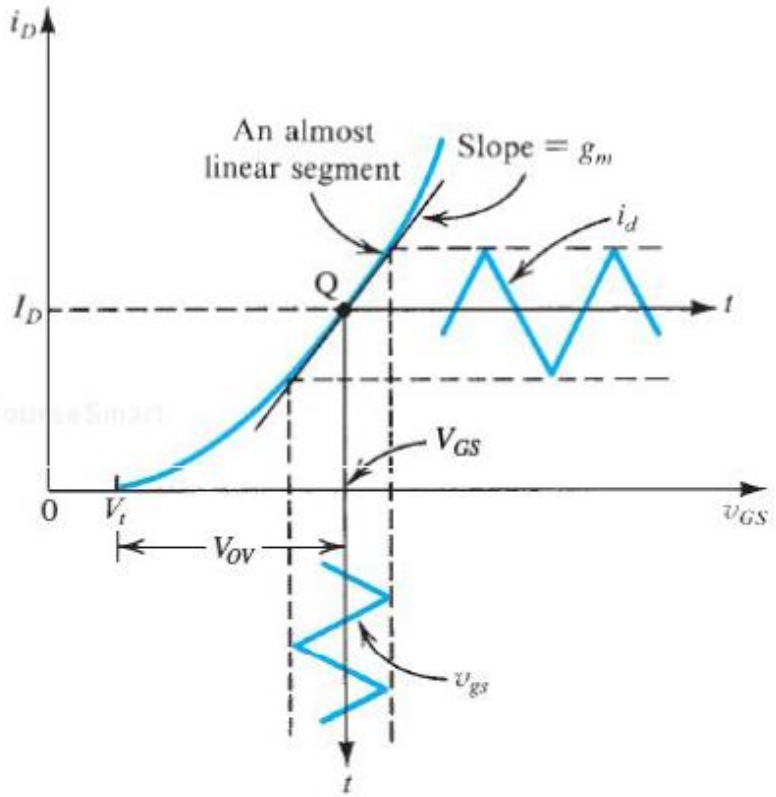
Last Lecture → MOS Small Signal Circuit

→ **Trans-conductance (g_m)**
→ **Output Impedance (r_o)**
→ **Input Impedance**



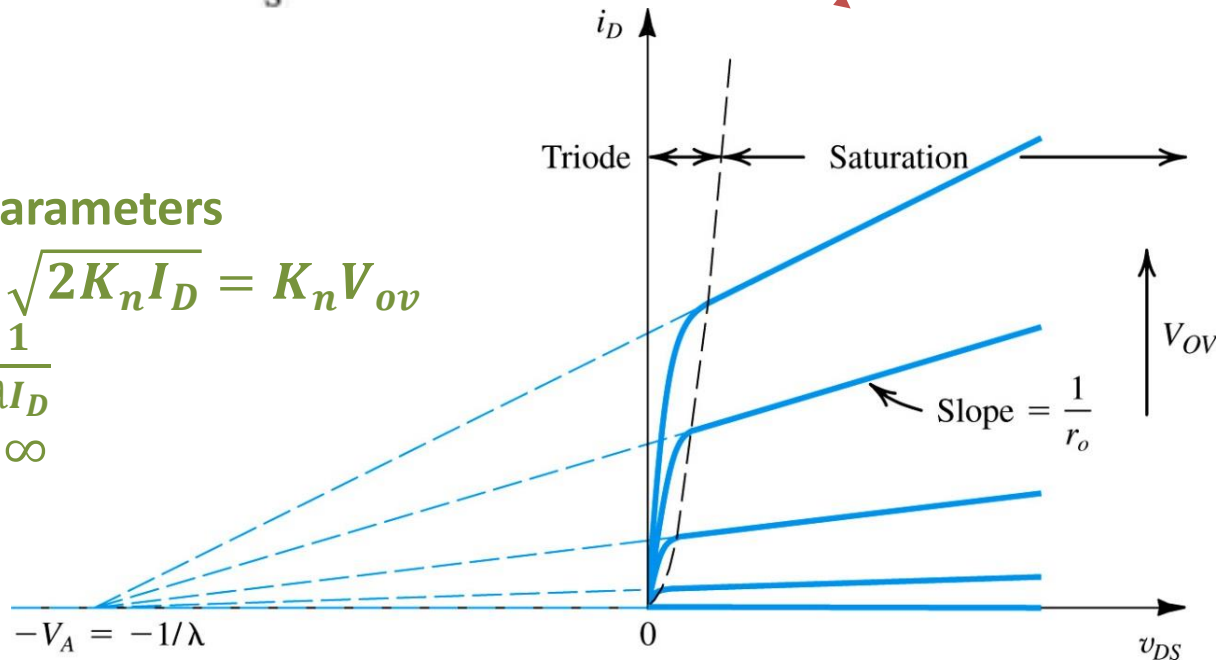
$V_{BS} = 0$



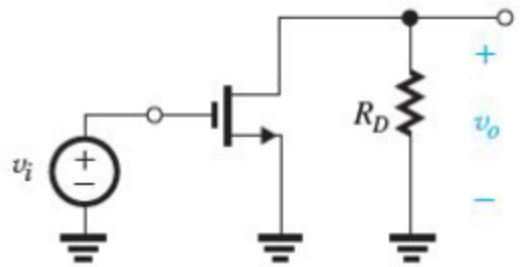


Small Signal Parameters

- $g_m = \sqrt{2K_n I_D} = K_n V_{ov}$
- $r_0 = \frac{1}{\lambda I_D}$
- $r_{in} = \infty$



Basic MOSFETs Amplifier Configuration

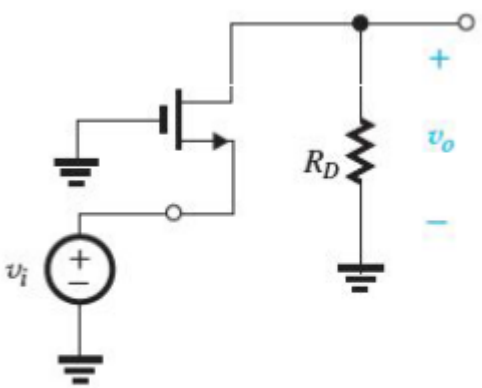


(a) Common Source (CS)

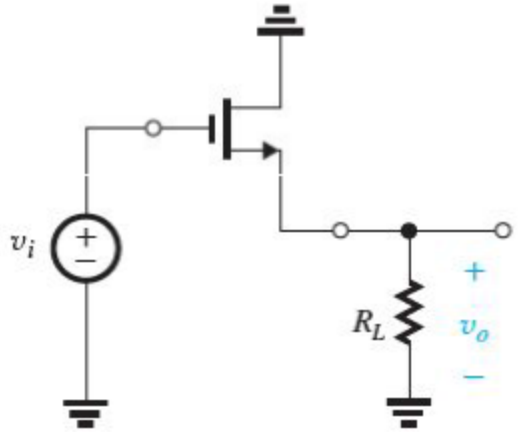
Exercise 5.38

Consider the given common source amplifier with g_m=1mA/V, r_0=150kΩ, R_{sig}=100kΩ, and R_L=15kΩ.

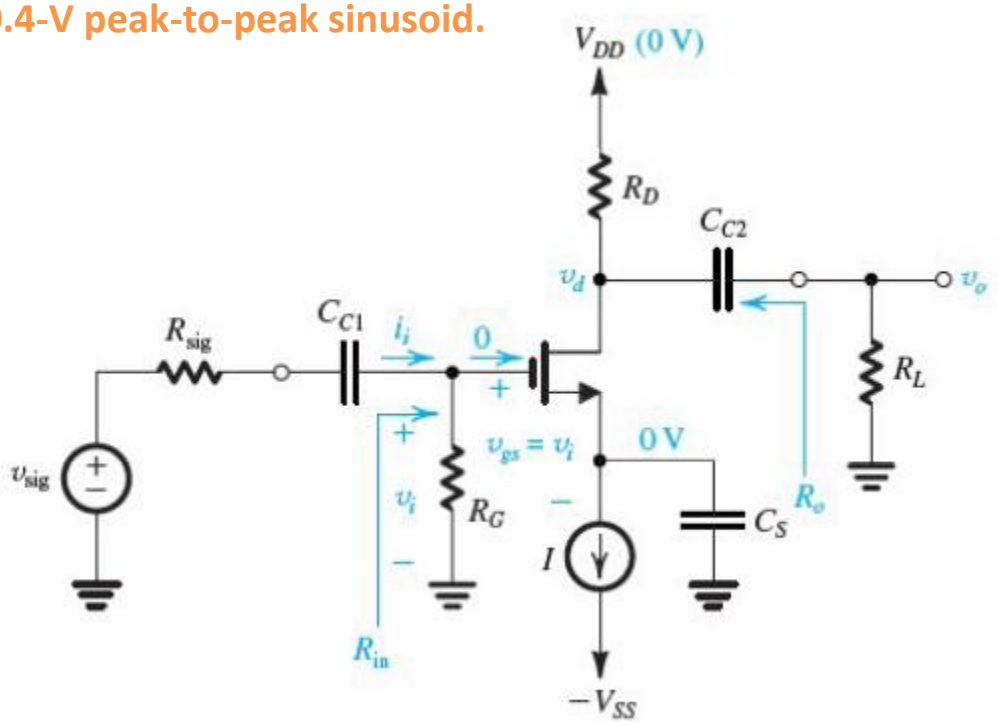
a) Calculate R_{in}, $A_{v\_cs}=V_0/V_i$, and R_0, both without and with r_0 taken into account
b) Calculate the overall voltage gain $G_v=v_0/v_{sig}$, with r_0 taken into account
c) Determine output signal v_0 if v_{sig} is a 0.4-V peak-to-peak sinusoid.



(b) Common Gate (CG)



(c) Common Drain (CD)



Problem

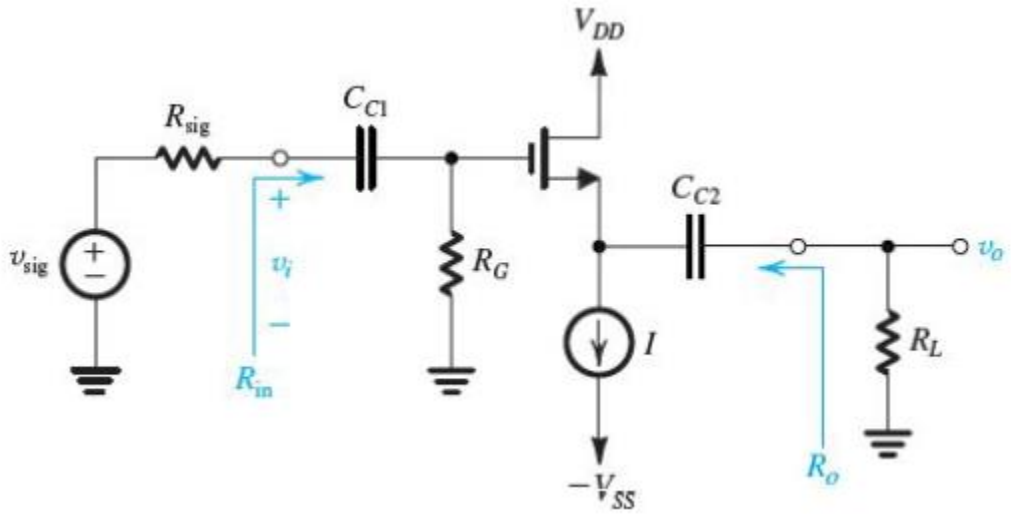
An common source NMOS amplifier is to be designed to provide a 0.5V peak output signal across a 50kΩ load that can be used as a drain resistor. If a gain of at least -5V/V is needed, what g_m is required? Using a dc supply of 1.8V, what values of I_d and V_{ov} would you choose? What W/L ratio is required if $k_n'=200\mu A/V^2$? If $V_t=0.4V$, find V_{gs}.

Exercise 5.41

Consider the given common collector amplifier with g_m=1mA/V and r_0=150kΩ. Let R_{sig}=1MΩ, R_G=1MΩ, and R_L=15k Ω,

a) **Find R_{in}, $A_v=V_0/V_i$, and R_0 without and with r_0 taken into account.**

b) **Find the overall voltage gain $G_v=v_0/v_{sig}$ with r_0 taken into account,**



Problem

Design the given circuit so that the transistor operates in saturation with V_{DS} biased 1V form the edge of the triode region, with I_D=1mA and V_D=3V, for each of the following two devices (use a 10µA current in the voltage divider):

a) $|V_t|$=1V and K_p=0.5mA/V^2

b) $|V_t|$=2V and K_p=1.25mA/V^2

For each case, specify the values of V_G, V_D, V_S, R_1, R_2, R_S, and R_D.