10/1/07

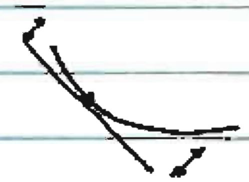
$$dz = \left(\frac{\partial z}{\partial x}\right)dx + \left(\frac{\partial z}{\partial y}\right)dy$$

$$i_D = \left(\frac{\partial i_D}{\partial v_{GS}}\right)dv_{GS} + \left(\frac{\partial i_D}{\partial v_{DS}}\right)dv_{DS}$$

Want a linear world!!

linear ≡ plane, tangent to surface

2D



linear → small signal model ←

non-linear → large signal model

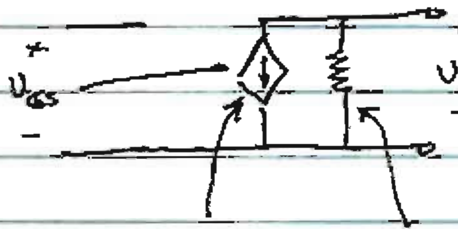


Fig 4.37(b)

$$\left(\frac{\partial i_D}{\partial v_{GS}}\right)dv_{GS} \equiv g_m \qquad Z = \frac{1}{\left(\frac{\partial i_D}{\partial v_{DS}}\right)} \equiv r_o = r_D$$

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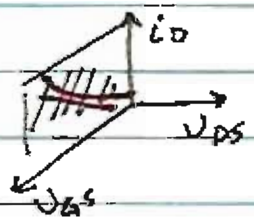
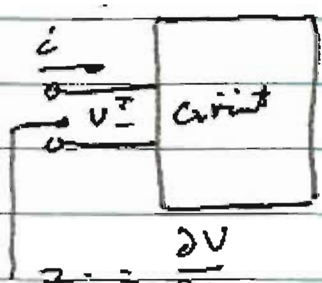


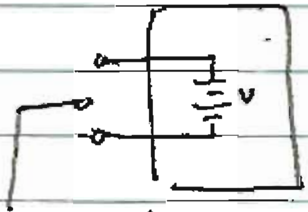
$$z = \frac{V}{I}$$

$$= \left.\frac{\partial V}{\partial i}\right|_{\text{constant}} \longrightarrow \frac{V}{I}$$

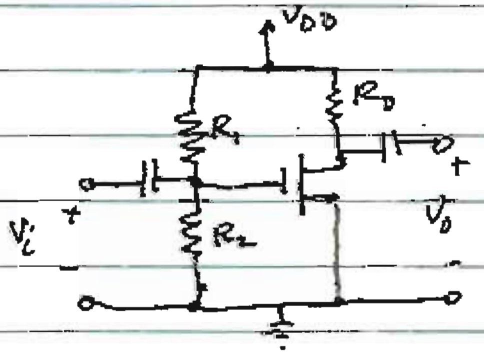
linear, sinusoidal



$$Z_{in} = \frac{\partial V}{\partial i}$$

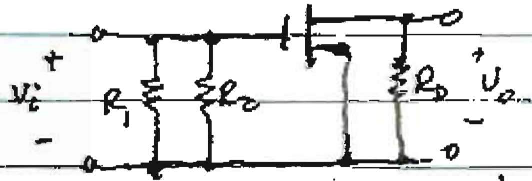


$$Z_{in} = \frac{\partial V}{\partial i} = \frac{0}{?} = 0$$



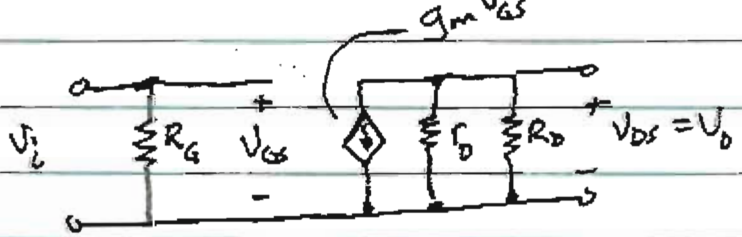
Small-signal analysis

Δ Variable is small and the only consideration.



$R_G = R_1 \| R_2$

$V_i = V_{GS}$



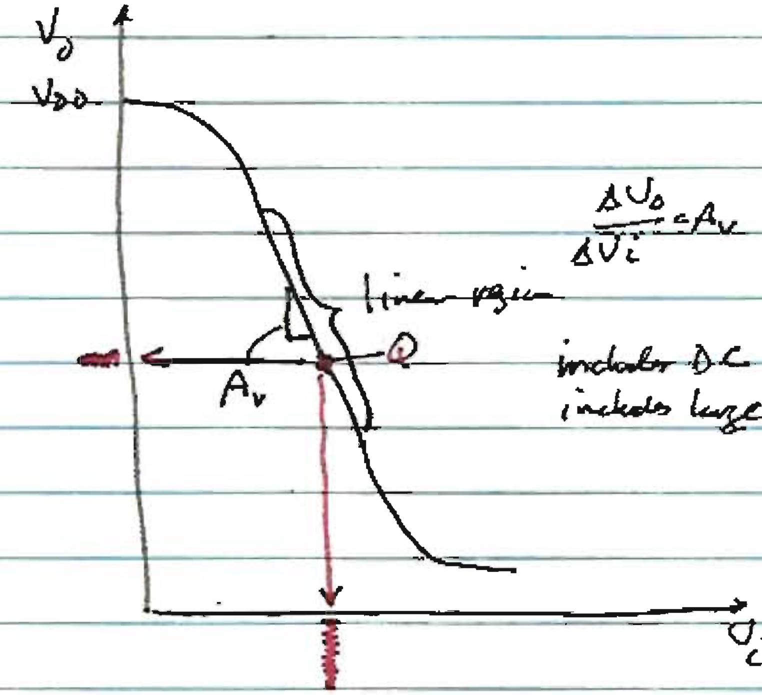
Voltage gain = $A_v = \frac{v_o}{v_i}$

$$v_o = -g_m \underline{v_{GS}}(r_o \| R_D)$$

$$= -g_m v_i (r_o \| R_D)$$

$$\frac{v_o}{v_i} = A_v = -g_m (r_o \| R_D)$$

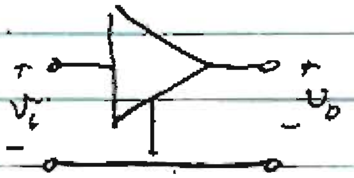
alternative method = transfer characteristic



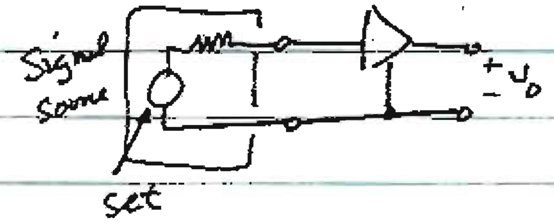
$\frac{\Delta v_o}{\Delta v_i} = A_v$

includes DC effect
includes large signals

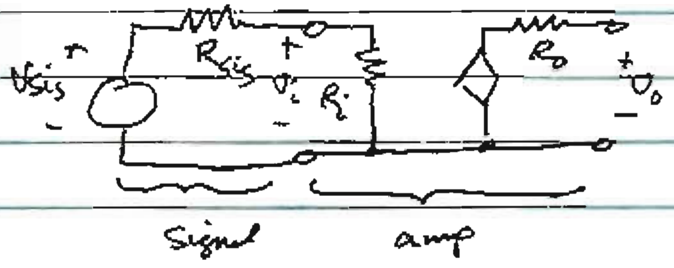
Know info Table 8.3, pp 302-303



Spec:
$\frac{v_o}{v_i} = 100$



?



$V_i = \left(\frac{R_i}{R_{sig}+R_i}\right) V_{sig}$ V_{sig}, R_{sig} unknown

$V_o = 100\, V_i$

G overall gain

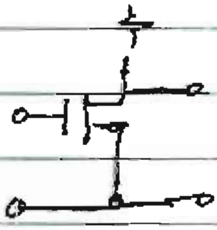
A actual gain

Common Source, Common Gate, Common Drain

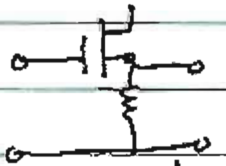
1st lead input

2nd lead output

3rd lead common



input gate
output drain } CS
common source



input gate
output source } CD or source follower
common drain

input source
output drain } CG
common gate