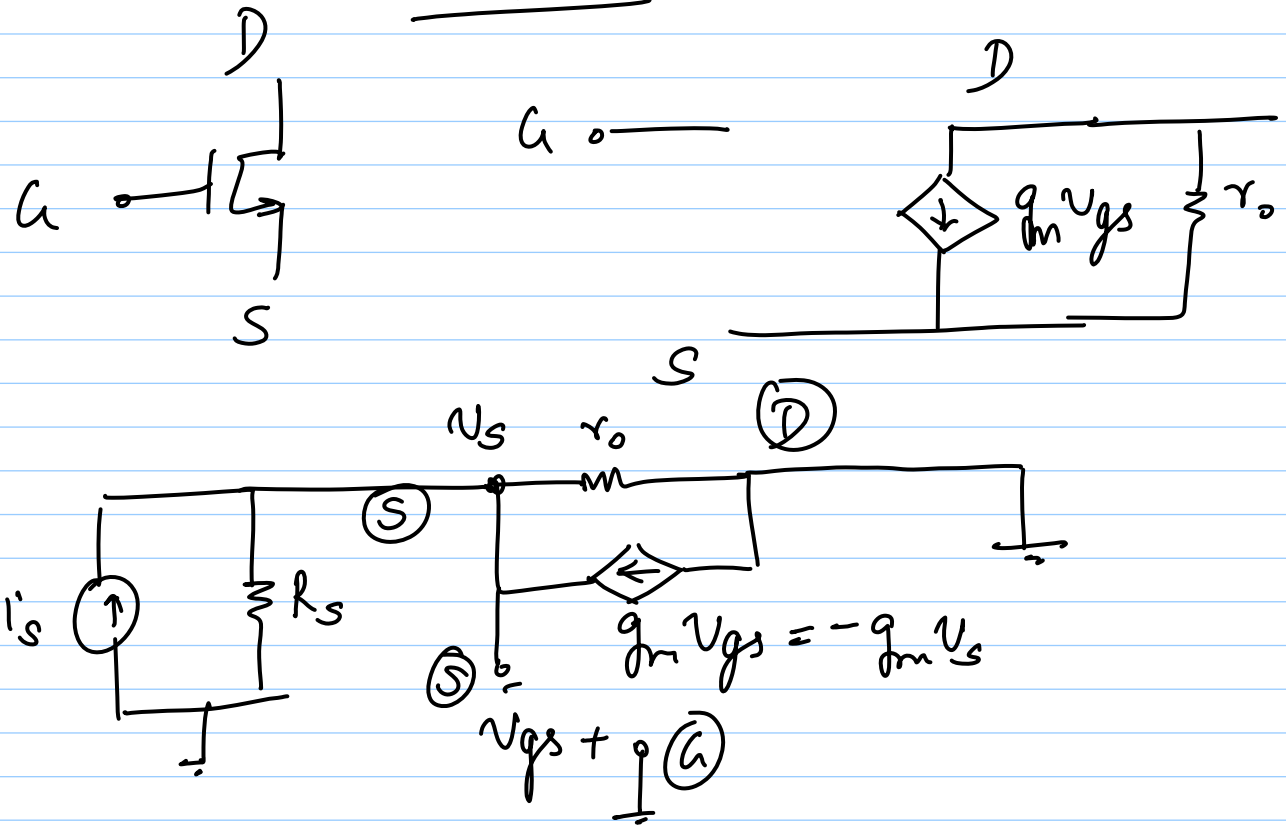
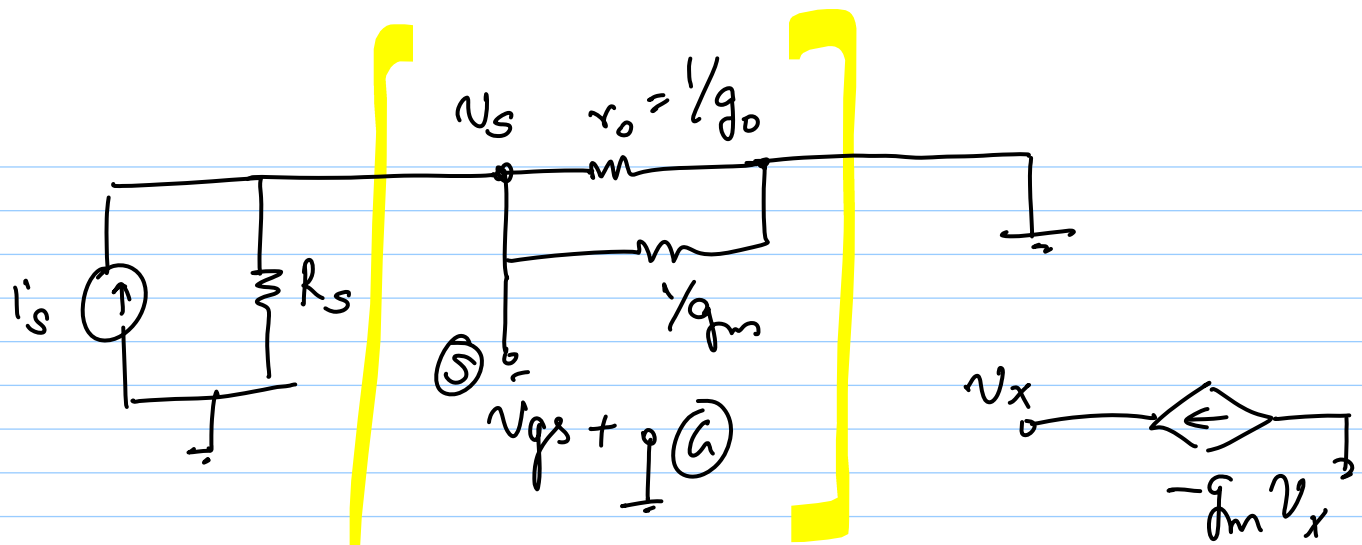
28-9-12

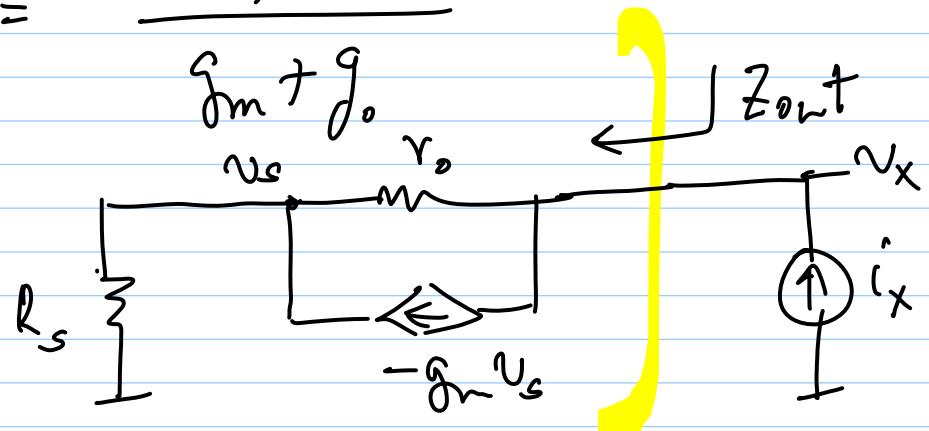
# Lec 27



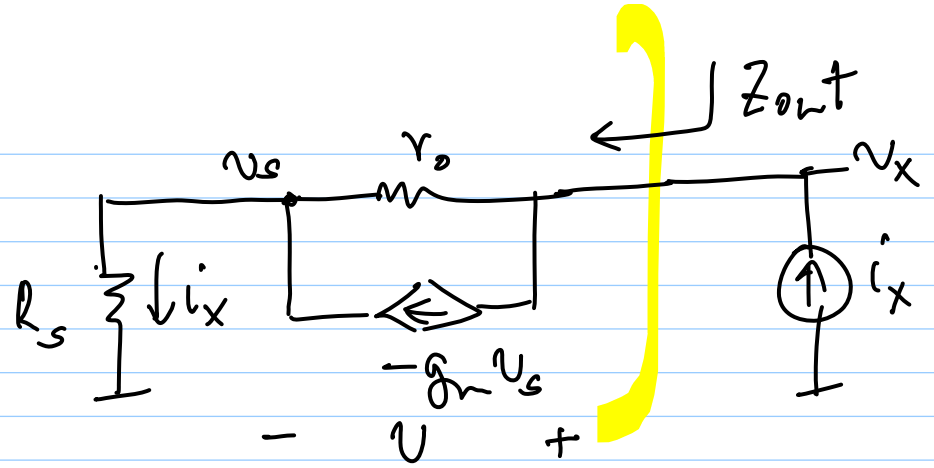




$$Z_{in} = \frac{1}{g_m + g_o}$$

$Z_{out}$



$Z_{out}$




$$v_s = R_s i_x$$

$$v = \left(i_x + g_m v_s\right) r_o$$

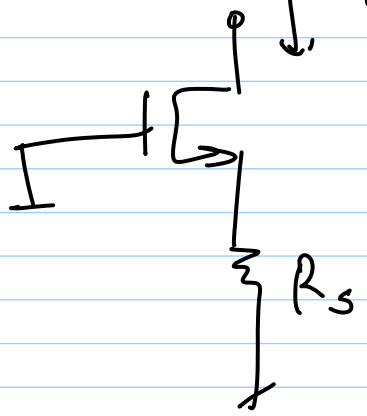
$$= i_x \left(1 + g_m R_s\right) r_o$$

$$v_x = v + v_s = i_x \left[\left(1 + g_m R_s\right) r_o + R_s\right]$$

$$Z_{out} = \frac{v_x}{i_x} = R_s \left(1 + g_m r_o\right) + r_o$$

$$Z_{out} = R_s \left(1 + g_m r_o\right) + r_o$$

$$\approx g_m r_o \cdot R_s$$




Swing limits = HW

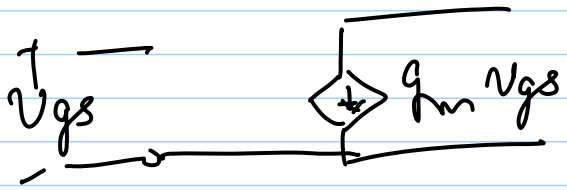
VCVS — Common drain amp.

VCCS — Trans-admittance amp.

CCCS — Common-gate ampl.

CCVS — Transimpedance amp.

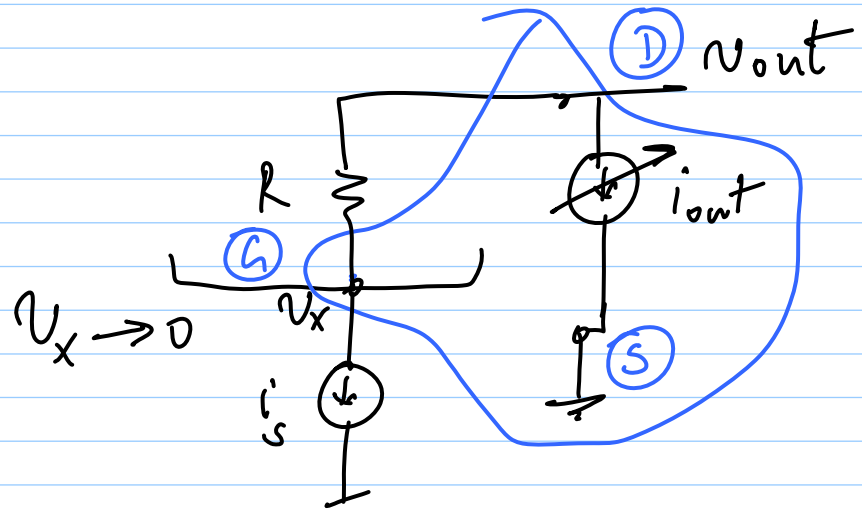
$v_{out} = R i_s$




$g_m \to \infty$

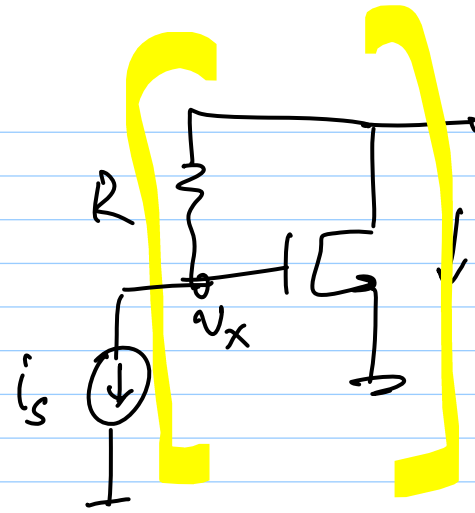
$v_{out} = R i_s$

$v_{out} - R i_s = 0$ ✓




* $v_x > 0 \Rightarrow \downarrow v_{out}$
$\Rightarrow \uparrow i_{out}$

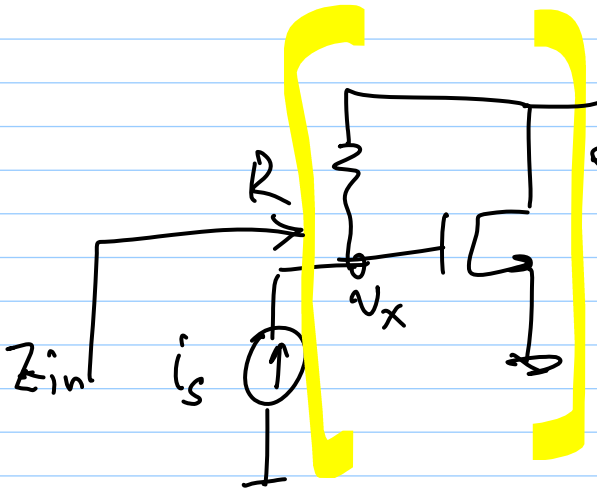
* $v_x < 0 \Rightarrow \uparrow v_{out}$
$\Rightarrow \downarrow i_{out}$




$v_{out} - R i_s = 0$ $(v_x)$

$i_{out} = g_m v_x$, $g_m \to \infty$

$\Rightarrow v_x \to 0$

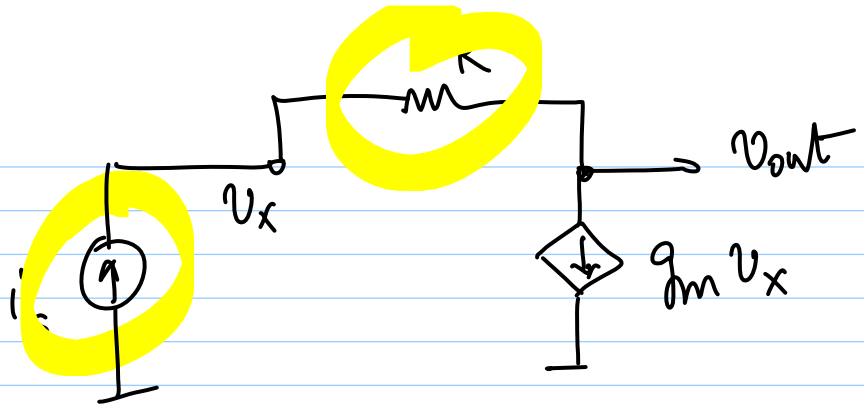



$v_{out} = -R i_s$

$g_m \to \infty \Rightarrow v_x = 0$

$Z_{in} = 0$

$Z_{out} = 0$

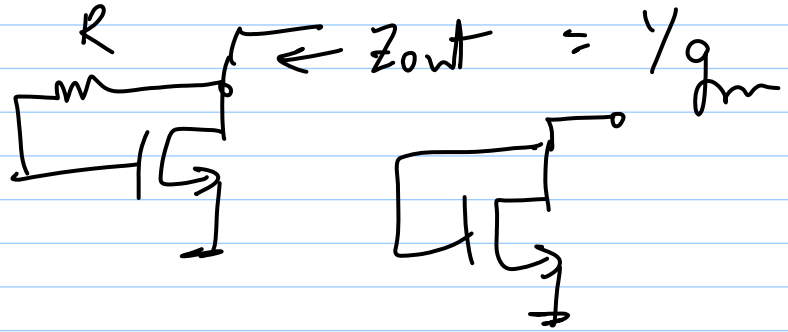


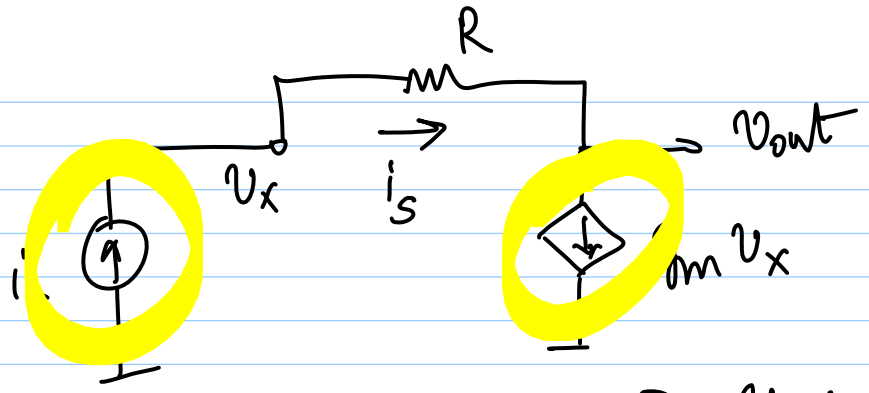

$i_s = g_m v_x$

$Z_{in} = 1/g_m$

$Z_{out} = 1/g_m$

$Z_{out}$






$$\left.\begin{aligned} v_{out} &= v_x - i_s \cdot R \\ i_s &= g_m v_x \end{aligned}\right\} \quad v_{out} = i_s\left[\frac{1}{g_m} - R\right]$$

$$\frac{v_{out}}{i_s} = \frac{1}{g_m} - R$$

$$\frac{v_{out}}{i_s} = -R\left(1 - \frac{1}{g_m R}\right)$$

$g_m R \to \infty \Rightarrow \frac{v_{out}}{i_s} \to -R$

$g_m R \gg 1 \Rightarrow \boxed{g_m \gg \frac{1}{R}}$