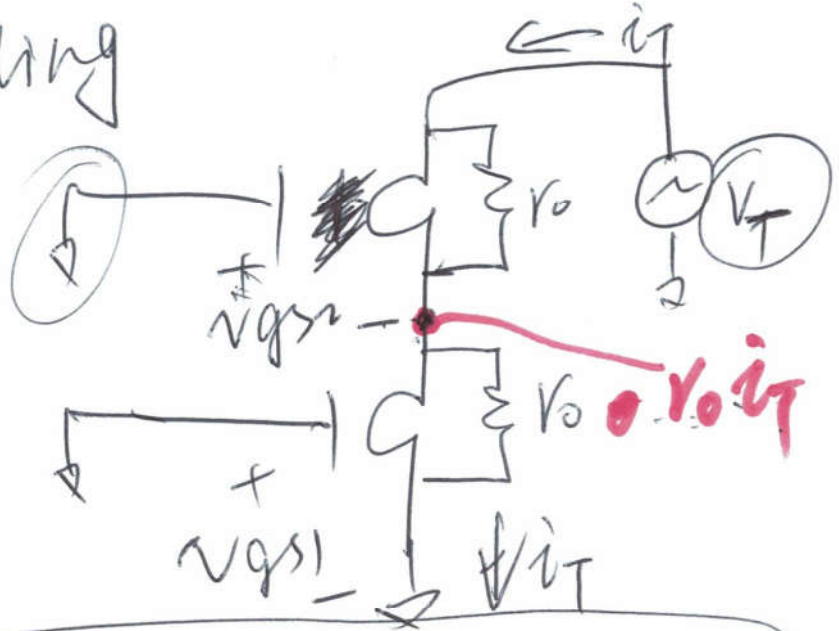
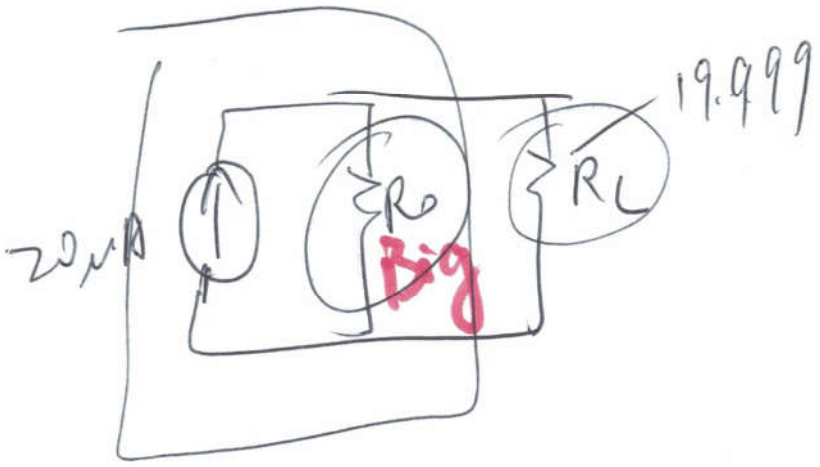
cascoding

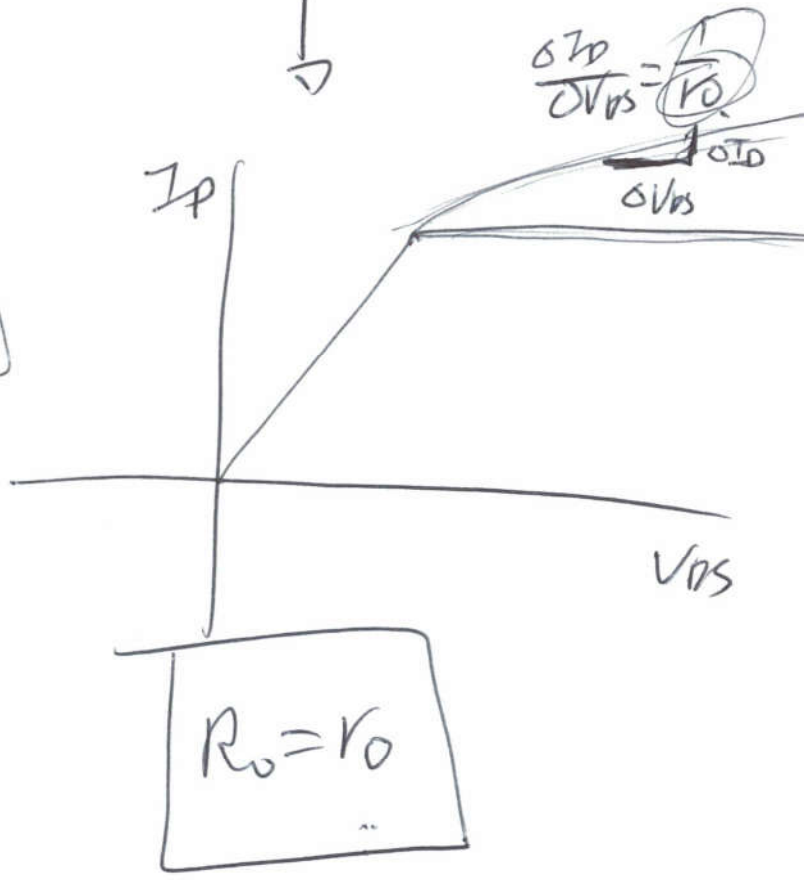
P036 - P052



$$v_{gs2} = -i_T r_o$$

$$i_T = g_m v_{gs2} + \frac{V_T - i_T r_o}{r_o}$$





$R_o = r_o$

$$R_O = \frac{V_T}{i_T}$$

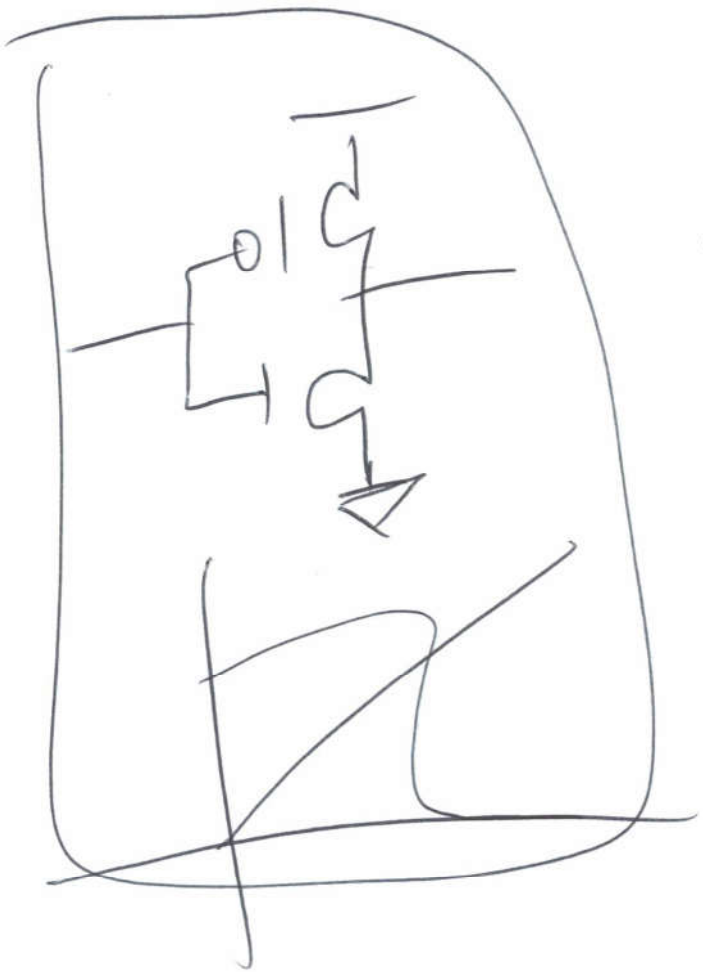
$$i_T = -g_m i_T r_O + \frac{V_T - i_T r_O}{r_O}$$

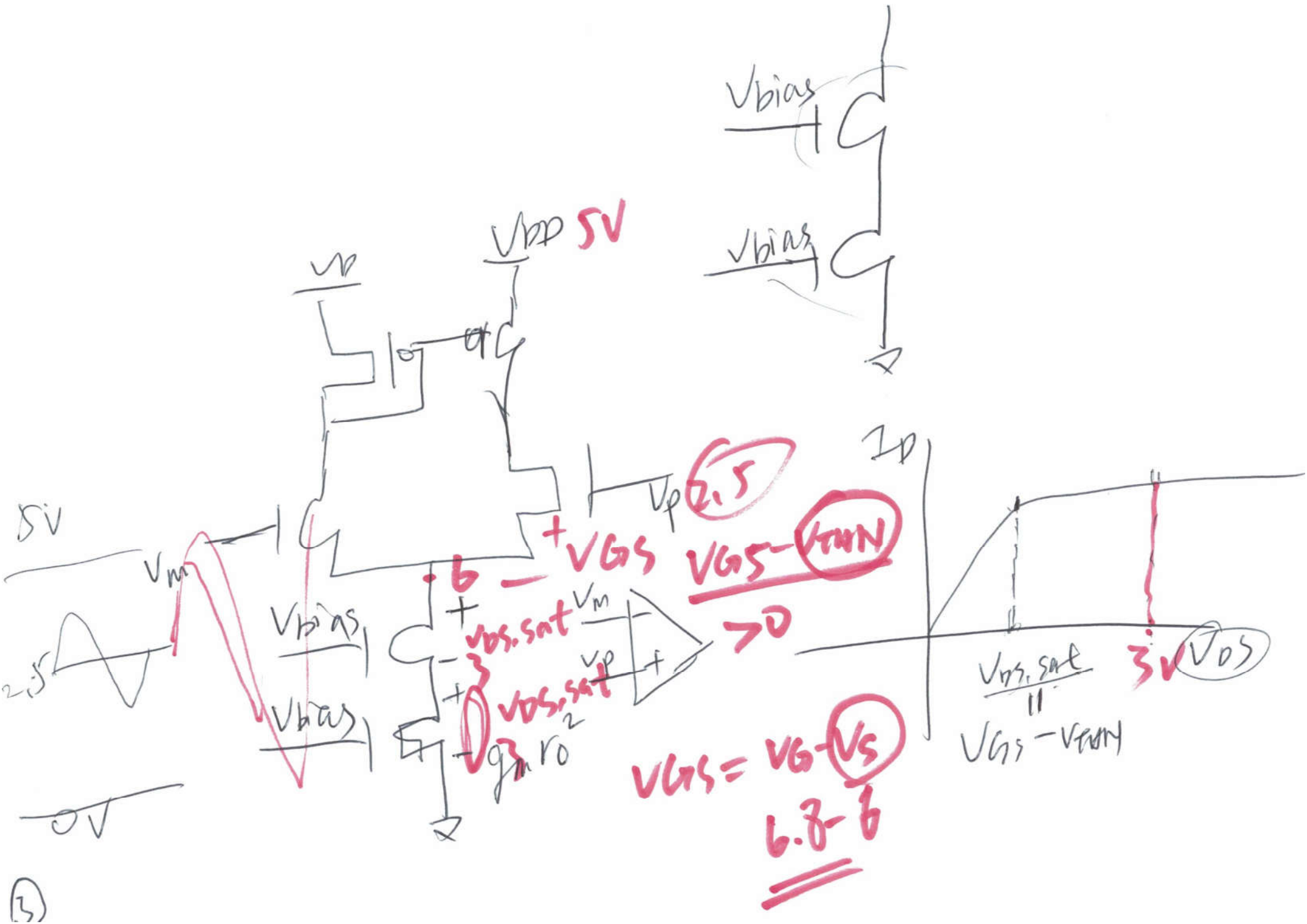
$$i_T r_O = -g_m i_T r_O^2 + V_T - i_T r_O$$

$$r_O = -g_m r_O^2 + \boxed{\frac{V_T}{i_T}} - r_O$$

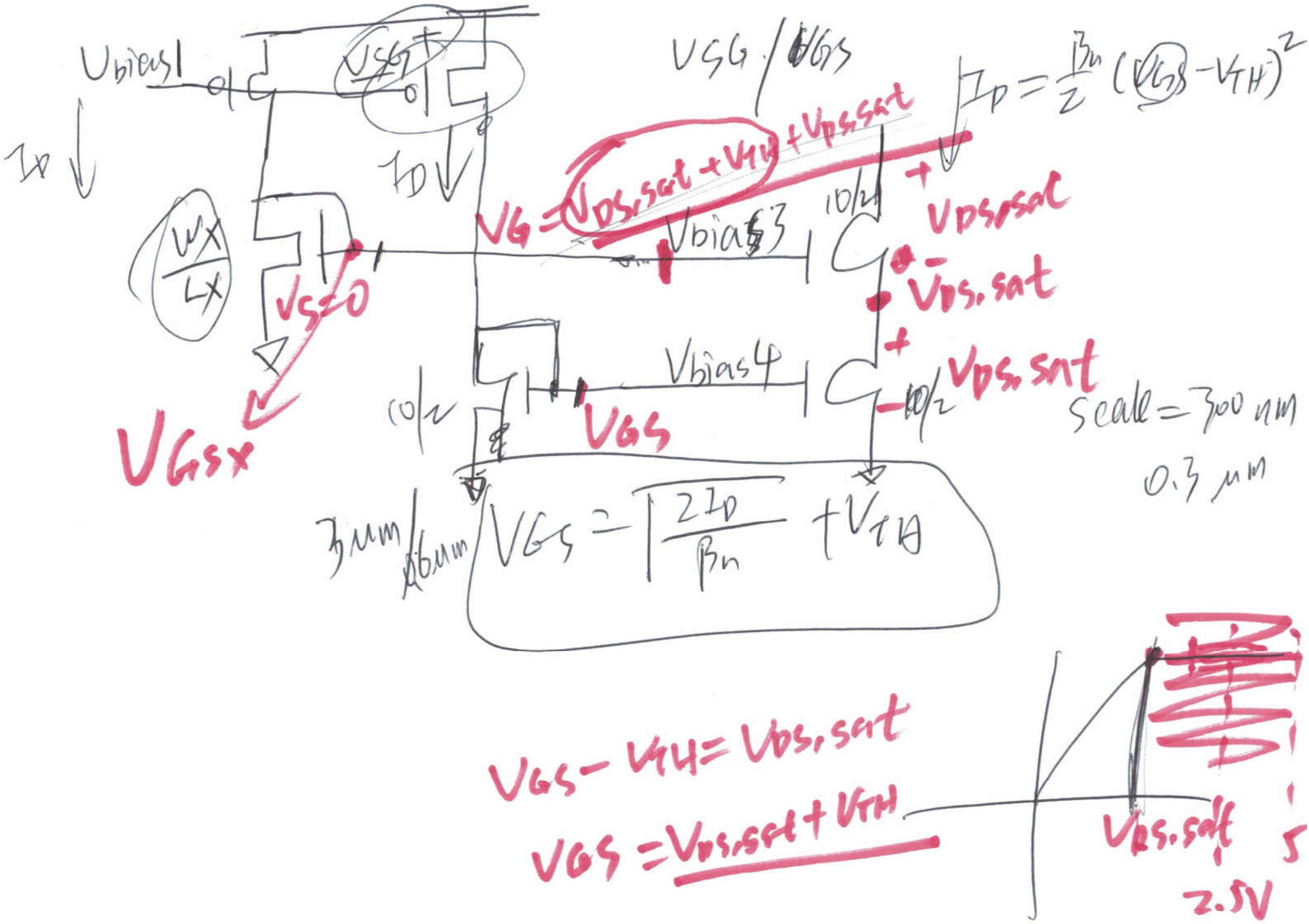
$$\frac{V_T}{i_T} = 2r_O + g_m r_O^2$$

$$= (2 + g_m r_O) r_O \approx g_m r_O^2 \qquad r_O$$




Vbias
Vbias
VDD 5V
VP
5V
Vm
Vbias
Vbias
2.5
0V
Vp 2.5
+ VGS
VGS - VTHN
VDS,sat
Vm
Vp
>0
3
VDS,sat
2
gm ro
VGS = VG - VS
6.8 - 6
ID
VDS,sat
II
VGS - VTHN
3V
VDS

(3)


Vbias1
VSG / VGS
$I_D = \frac{\beta_n}{2}(V_{GS} - V_{TH})^2$
I_D
I_D
$V_G = V_{DS,sat} + V_{TH} + V_{DS,sat}$
$V_{DS,sat}$
$V_{DS,sat}$
$V_{DS,sat}$
Vbias3
10/1
$\frac{W}{L}X$
$V_{GS}=0$
V_{GSX}
Vbias4
10/1
V_{GS}
10/1
3um/0.6um
$V_{GS} = \sqrt{\frac{2I_D}{\beta_n}} + V_{TH}$
scale = 300 nm
0.3 μm
$V_{GS} - V_{TH} = V_{DS,sat}$
$V_{GS} = V_{DS,sat} + V_{TH}$
$V_{DS,sat}$
2.5V

(4)

$$I_D = \frac{\beta_n}{2}\frac{W_X}{L_X}\left(\frac{2V_{DS,sat}+V_{THN}-V_{THN}}{V_{GS}}\right)^2$$

$$= \frac{\beta_n}{2}\frac{W_X}{L_X}\left(V_{DS,sat}+V_{THN}+V_{DS,sat}-V_{THN}\right)^2$$

$$= \frac{\beta_n}{2}\frac{W_X}{L_X}\left(2V_{DS,sat}\right)^2$$

$$= \frac{\beta_n}{2}\boxed{\frac{W_X}{L_X}\cdot 4}\left(V_{GS}-V_{THN}\right)^2$$

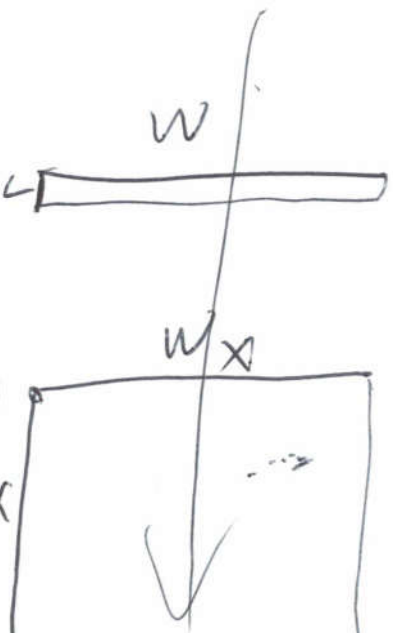
$$= \frac{\beta_n}{2}\boxed{\frac{W}{L}}\left(V_{GS}-V_{THN}\right)^2$$

$$\frac{W_X}{L_X}\cdot 4 = \frac{W}{L} = \frac{10}{2}$$

$$\frac{W}{L} = \frac{10}{2}$$

$$\frac{W_X}{L_X} = (10/2)/4$$

$$\frac{W_X}{L_X} = \frac{10}{8}$$



(5)