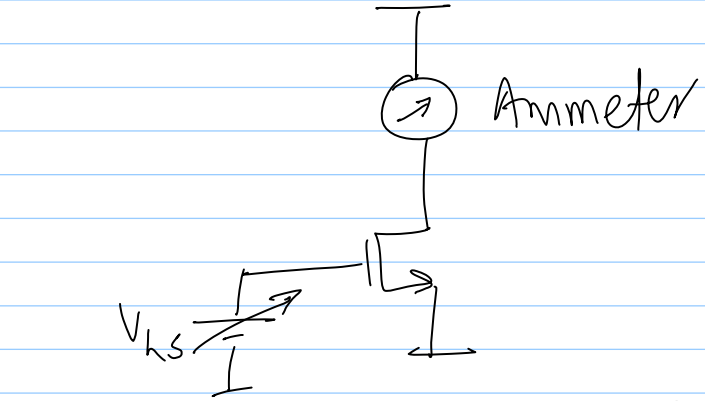
30-8-12

Lec 15



independent of device characteristics

* Apply V_{GS}
* measure I_D
* If $I_D > 100\mu A$, $V_{GS} > V_{GS_1}$ ⇒ reduce V_{GS}
* If $I_D < 100\mu A$, $V_{GS} < V_{GS_1}$ ⇒ increase V_{GS}

⇒ Negative Feedback

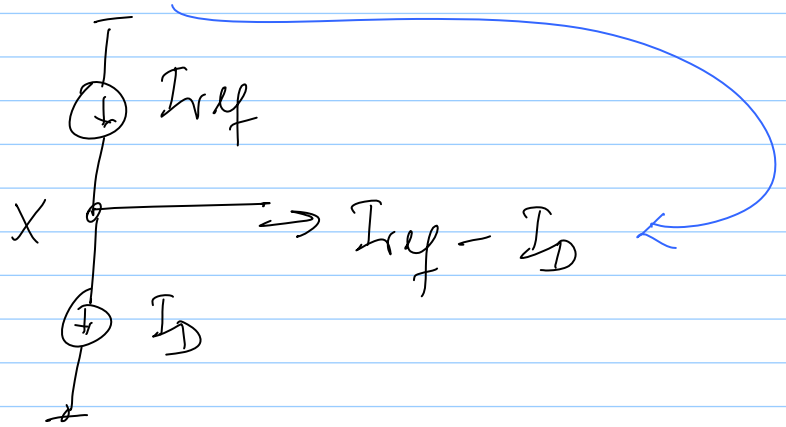
Open loop method:

$V_{GS_1} \rightarrow I_{D_1}$
$V_{GS_2} \rightarrow I_{D_2}$

Solve device equations to get $\mu_n C_{ox}$ & V_T

$100\mu A$ ⇒ reference quantity (I_{ref})
actual I_D ⇒ output quantity
use the error $(I_{ref} - I_D)$ = difference between reference & output to tweak input (V_{GS})

$(I_{ref} - I_D)$ = comparing I_{ref} & I_D



use KCL to achieve $(I_{ref} - I_D)$

If $I_{ref} = I_D$, V_x can be anything, but since no charge is added/removed, V_x does not change!

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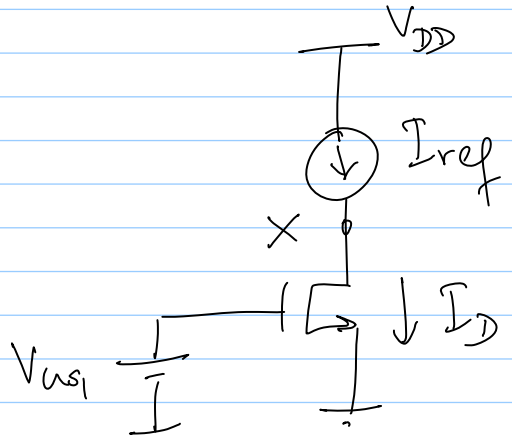
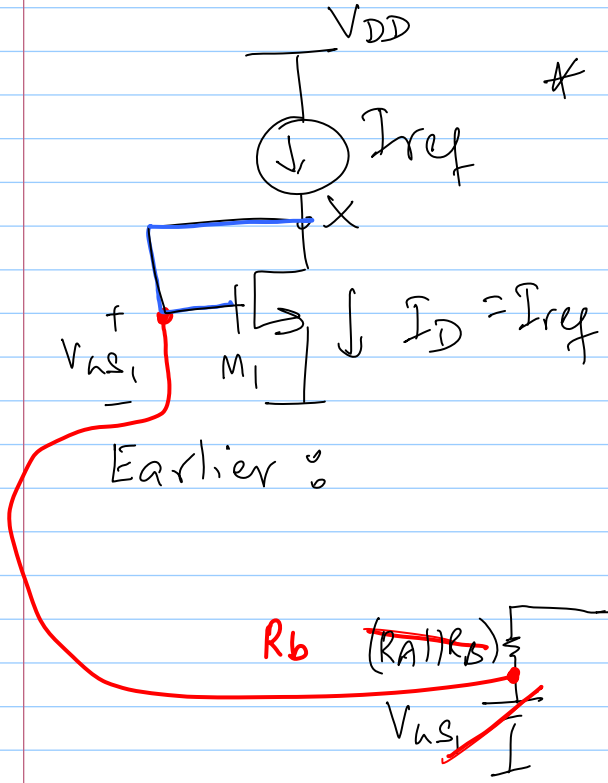
* If $I_{ref} > I_D$, V_x ↑ with time
* If $I_{ref} < I_D$, V_x ↓ with time



* $I_D > I_{ref} \Rightarrow V_x$ ↓ $\Rightarrow$ reduce V_{as1}
* $I_D < I_{ref} \Rightarrow V_x$ ↑ $\Rightarrow$ increase V_{as1}

$\Rightarrow$ V_x & V_{as} move in same direction

$\Rightarrow$ connect G to X !



* Verify that device is still in saturation

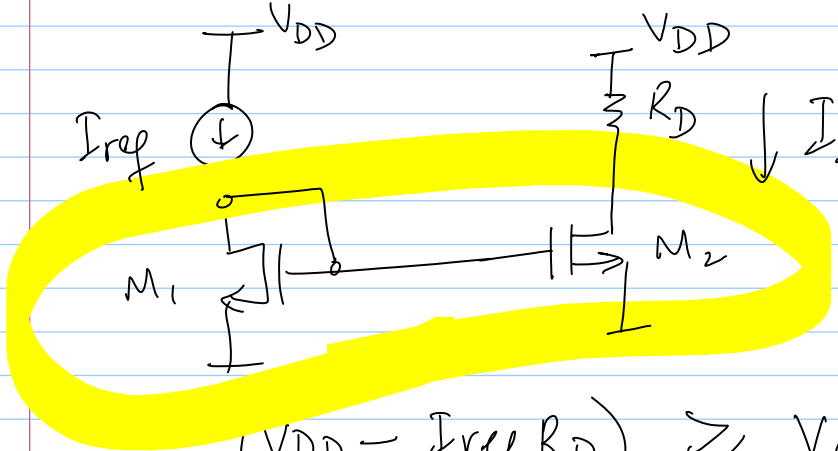
$V_D = V_G \Rightarrow V_D > V_G - V_T$

M_1 & M_2 have same $\mu_n C_{ox}$ & V_T on an IC

* No current through new connection

$\Rightarrow$ no dc drop across R_b

$\rightarrow$ V_X remains @ V_{GS1}



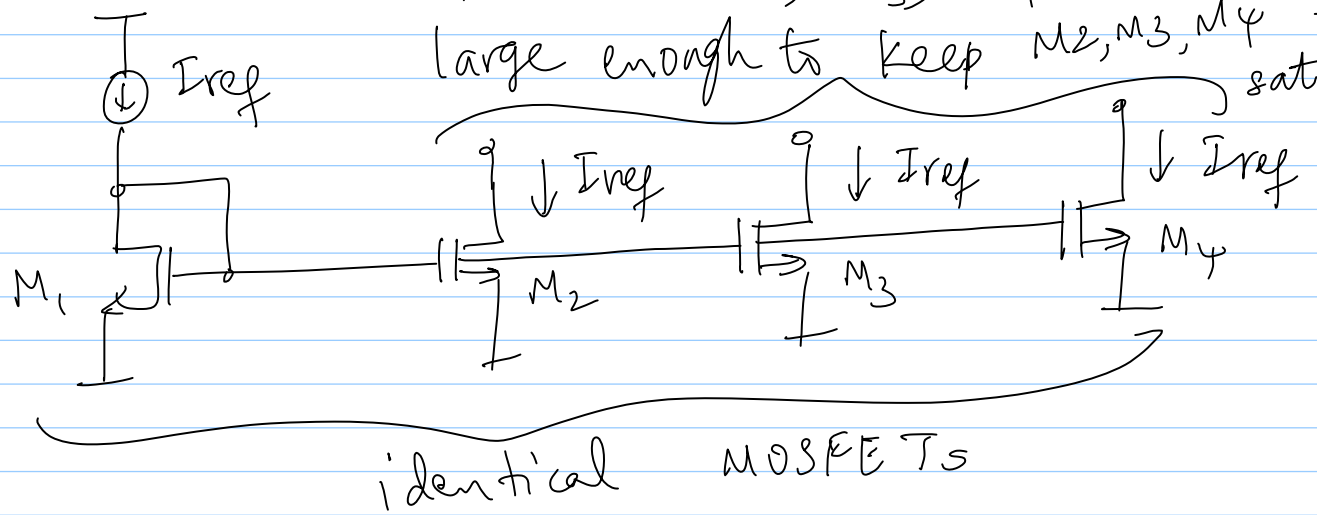
provided R_D is such that M_2 is still in sat.

$(V_{DD} - I_{ref} R_D) \geq V_{GS1} - V_T$ for M_2 to be in sat.

$\rightarrow$ CURRENT MIRROR

e.g.

Assume V_{D2}, V_{D3}, V_{D4} are large enough to keep M2, M3, M4 in sat.



identical MOSFETs