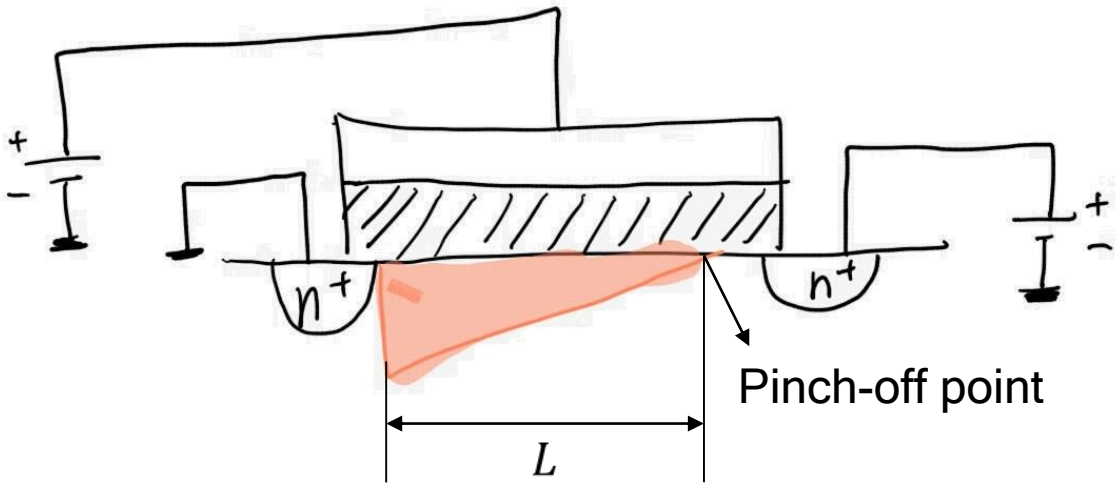
Lesson 27 : MOSFET Channel Length Modulation / Transconductance

Make by 성홍제



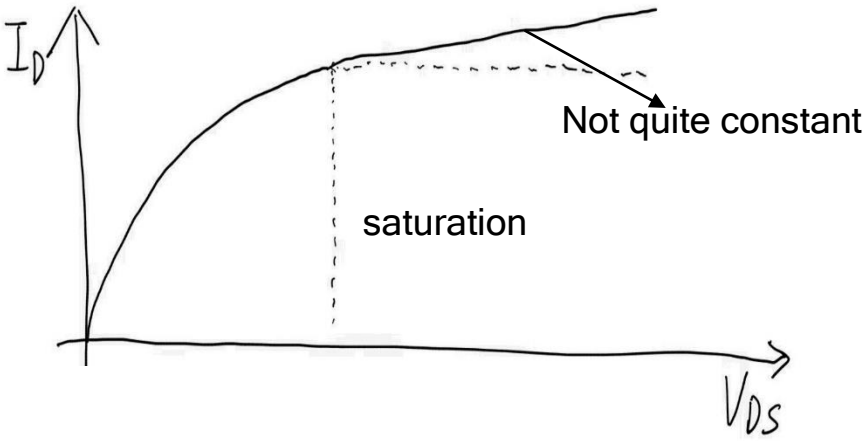
$$I_D = \frac{1}{2}\mu_n C_{ox}\frac{W}{L}(V_{GS} - V_{TH})^2$$

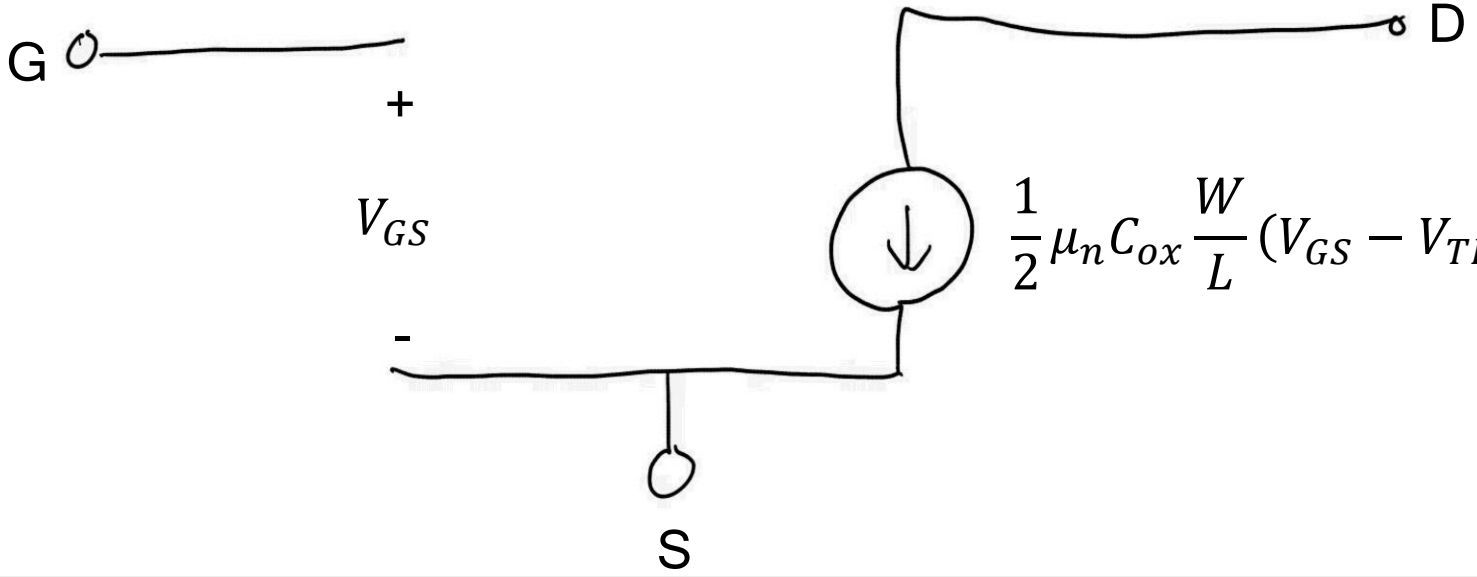
$$V_{DS} \uparrow \Rightarrow pinch - off\ point\ move\ left \Rightarrow L \downarrow \Rightarrow I_D \uparrow$$

Lesson 27 : MOSFET Channel Length Modulation

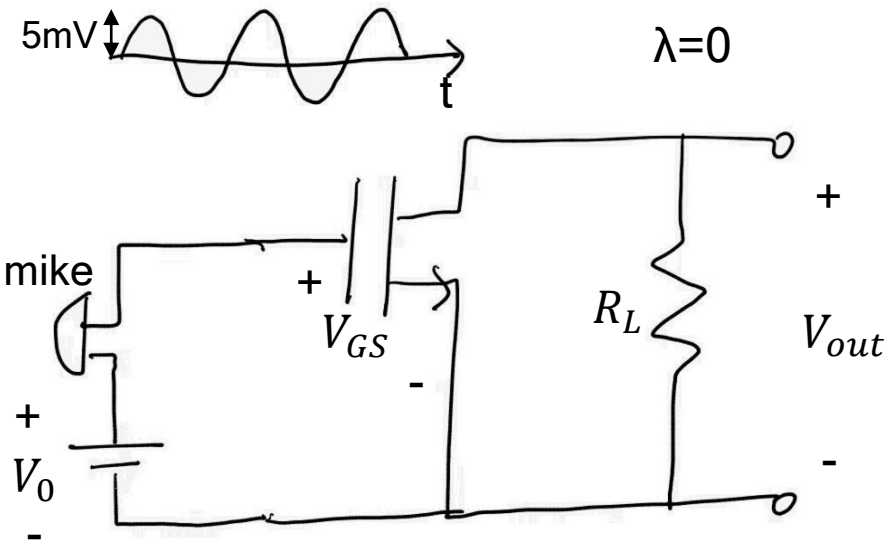
$$I_D = \frac{1}{2}\mu_n C_{ox}\frac{W}{L}(V_{GS} - V_{TH})^2(1 + \lambda V_{DS})$$

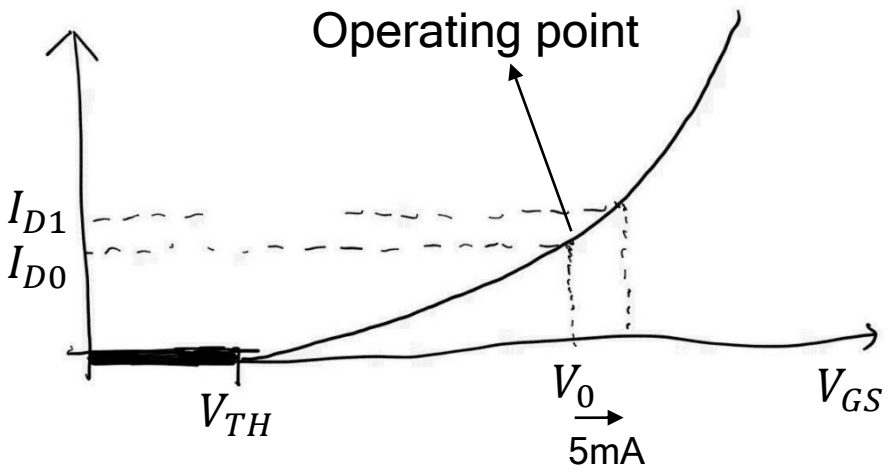
λ : $\left[\frac{1}{V}\right]$ channel-length modulation coefficient





$$\frac{1}{2}\mu_n C_{ox}\frac{W}{L}(V_{GS} - V_{TH})^2(1 + \lambda V_{DS})$$





If $V_{TH} = 0.5V, \mu_n C_{ox} = 100\mu\,{}^{A}/_{V^2}, \frac{W}{L} = 10$ and choose $V_0 = 0.9V$

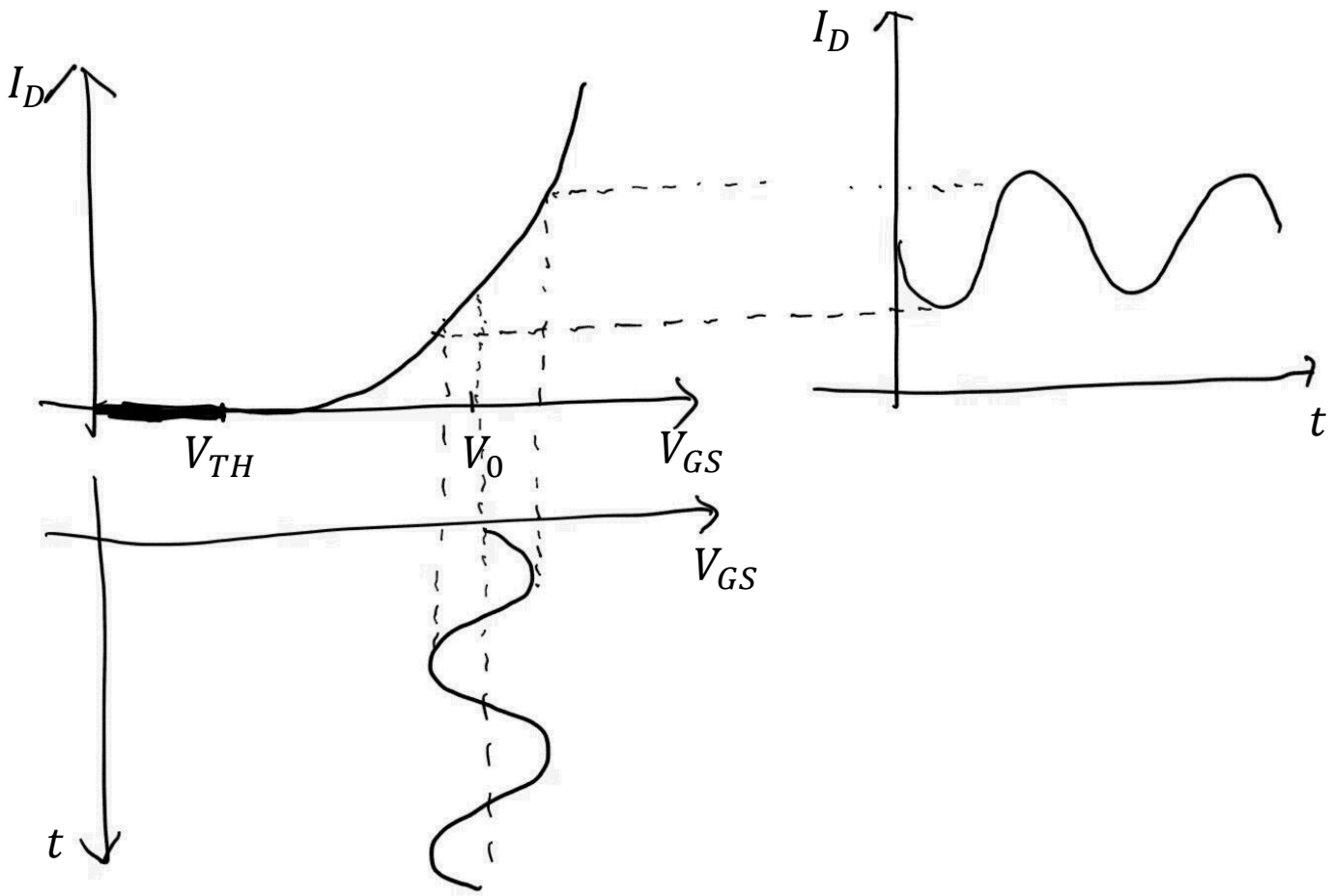
We want get 10 times amplitude

$$I_{D0} = \frac{1}{2}\mu_n C_{ox}\frac{W}{L}(0.9V - 0.5V)^2 = 80\mu A$$

$$I_{D1} = \frac{1}{2}\mu_n C_{ox}\frac{W}{L}(0.905V - 0.5V)^2 = 82\mu A$$

$$\Rightarrow \quad R_L = \frac{50mV}{2\mu A} = 25\text{K}\Omega$$

$$V_{GS} = V_{mike} + V_0$$



Lesson 27 : Concept of Transconductance

$$g_m = \frac{dI_D}{dV_{GS}} \qquad \lambda=0$$

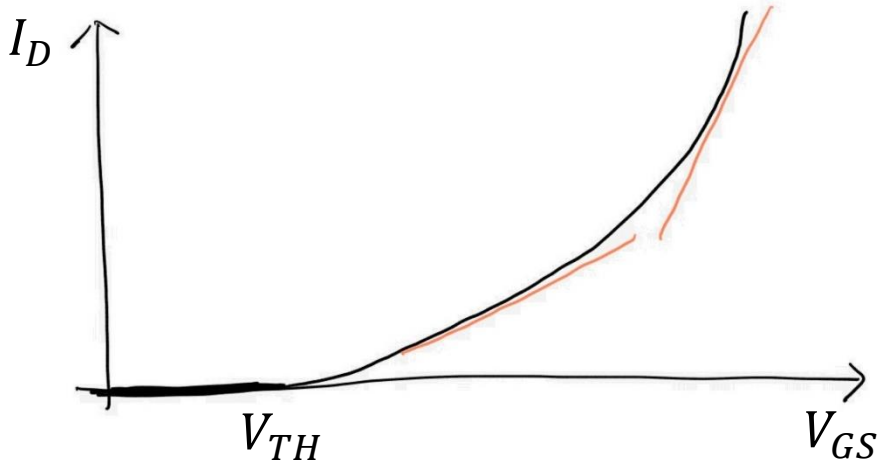
unit : $\left[\frac{1}{V}\right]$, Siemens $[S]$

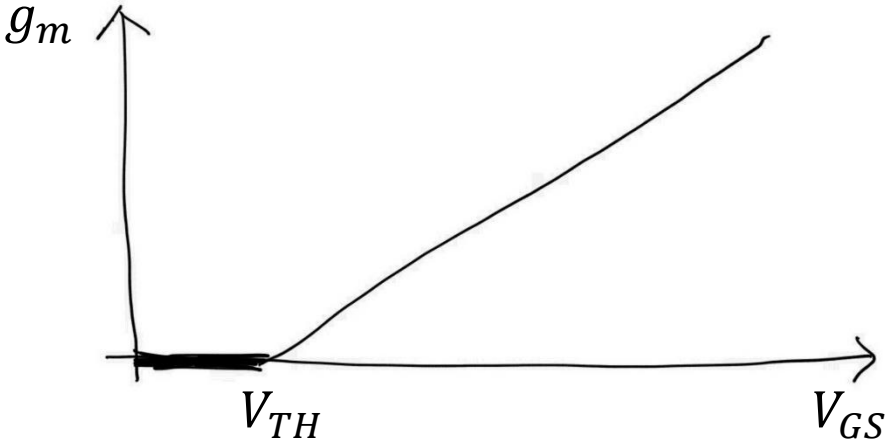
$$I_D = \frac{1}{2}\mu_n C_{ox}\frac{W}{L}(V_{GS}-V_{TH})^2$$

$$g_m = \mu_n C_{ox}\frac{W}{L}(V_{GS}-V_{TH})$$

$$g_m = \frac{2I_D}{V_{GS}-V_{TH}}$$

$$g_m = \sqrt{2I_D\mu_n C_{ox}\frac{W}{L}}$$





Thank you for watching!