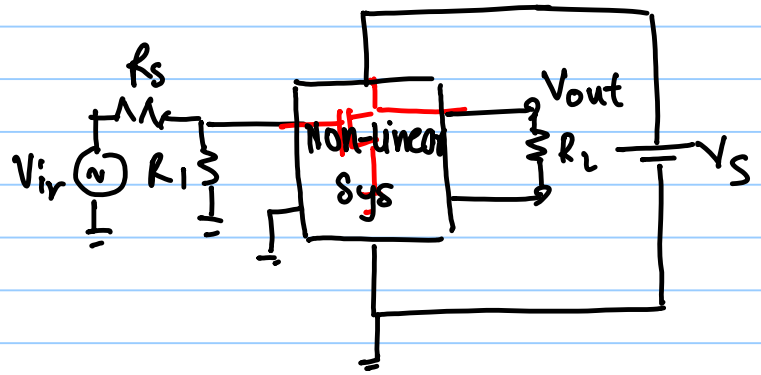
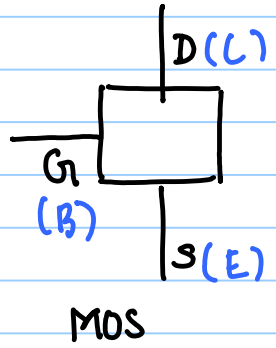
Lecture #4

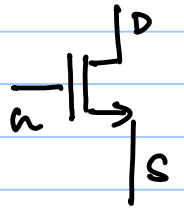
Note Title 22-01-2020



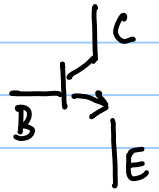
- Non-linear system to deliver large power
- input-to-output as linear control
- MOSFETs (MOS)
  BJTs



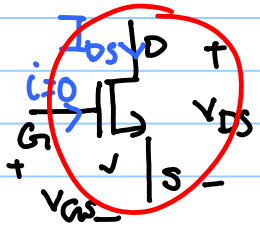
MOS



MOS
(NMOS)



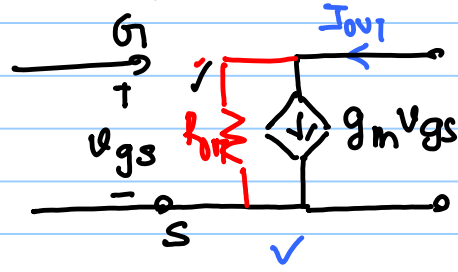
(npn-BJT)



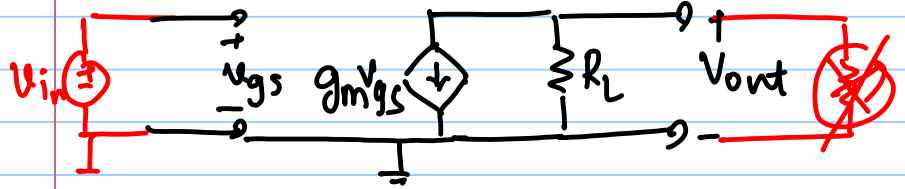
$I_{DS} = f(V_{GS}, V_{DS})$

≡

linear approximate model of MOS

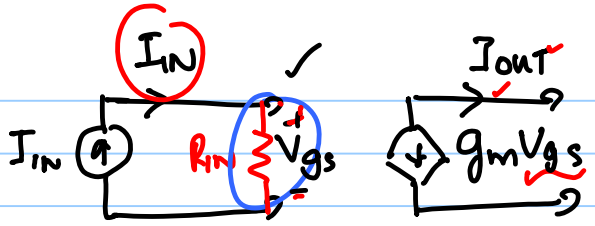


Voltage controlled Current Source (VCCS)



$$\frac{V_{out}}{V_{in}} = -g_m R_L = K$$

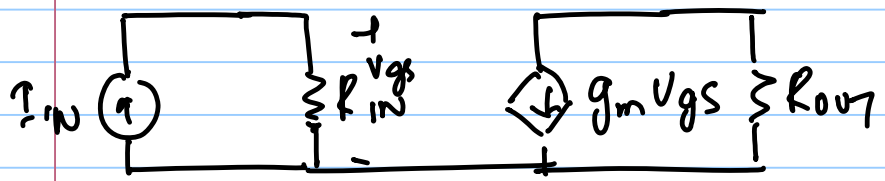
(VCVS)



$$I_{OUT} = g_m R_{IN} I_{IN}$$

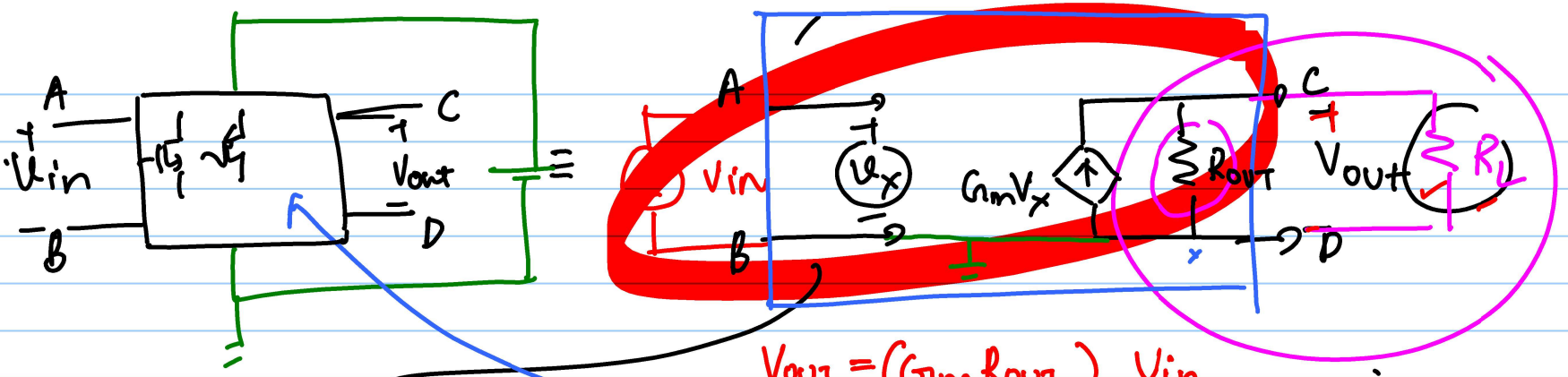
$$\frac{I_{OUT}}{I_{IN}} = -g_m R_{IN}$$

$$V_{gs} = I_{IN} \cdot R_{IN}$$

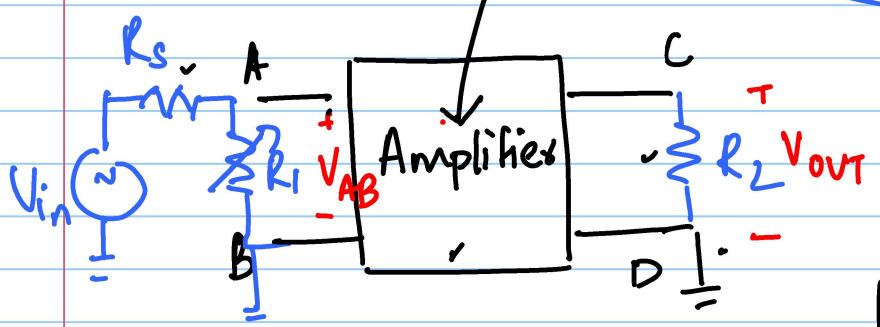


$$V_{OUT} = g_m (R_{IN} \cdot I_{IN}) R_{OUT} \Rightarrow \frac{V_{out}}{I_{IN}} = . (g_m R_{IN}) R_{OUT}$$

CCVS



$$V_{OUT} = (G_m R_{OUT})\, V_{in}$$



$$\frac{V_{OUT}}{V_{in}} = G_m R_{OUT}$$

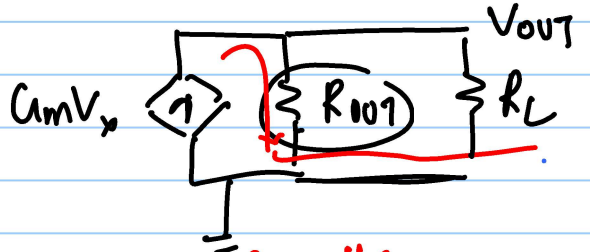
$G_m = 10\,mA/V \pm 10\%$

$R_{OUT} = 10\,k\Omega \pm 20\%$

$$V_{OUT} = G_m (R_L \| R_{OUT})\, V_{AB}$$

$$V_{AB} = \frac{R_1}{R_1 + R_S}\, V_{IN}$$

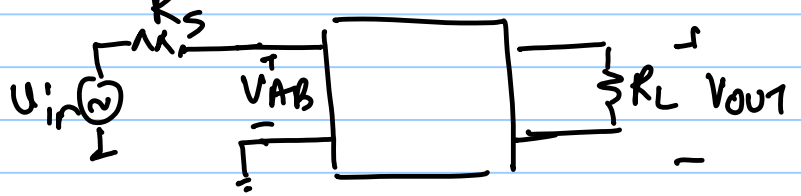
$$V_{OUT} = \frac{G_m}{\frac{1}{R_L} + \frac{1}{R_{OUT}}} \times \frac{R_1}{R_1 + R_S}\, V_{in}$$



$R_{OUT} \| R_L$

PVT variations.

Process, voltage, temperature



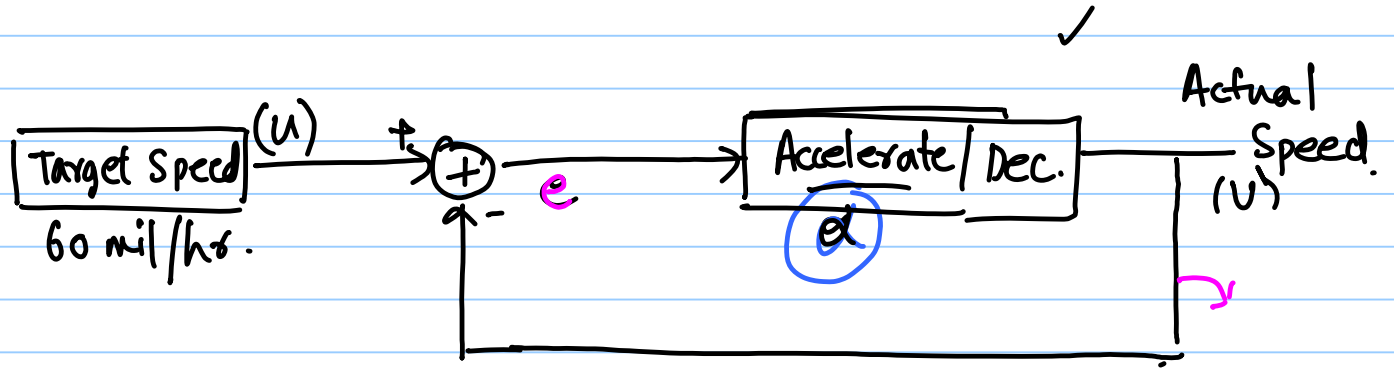
$V_{out} = 100\, V_{in} = G_m (R_L \| R_{OUT})\, V_{IN}$

$= 1\omega$

$V_{out} = 100\, V_{in}$

$0 \rightarrow 60$ miles/hr.

Example.



- $v(0) = 0$, $v(t) = \alpha \cdot t$
- α varies with time.
  α is proportional to $(U-V)$