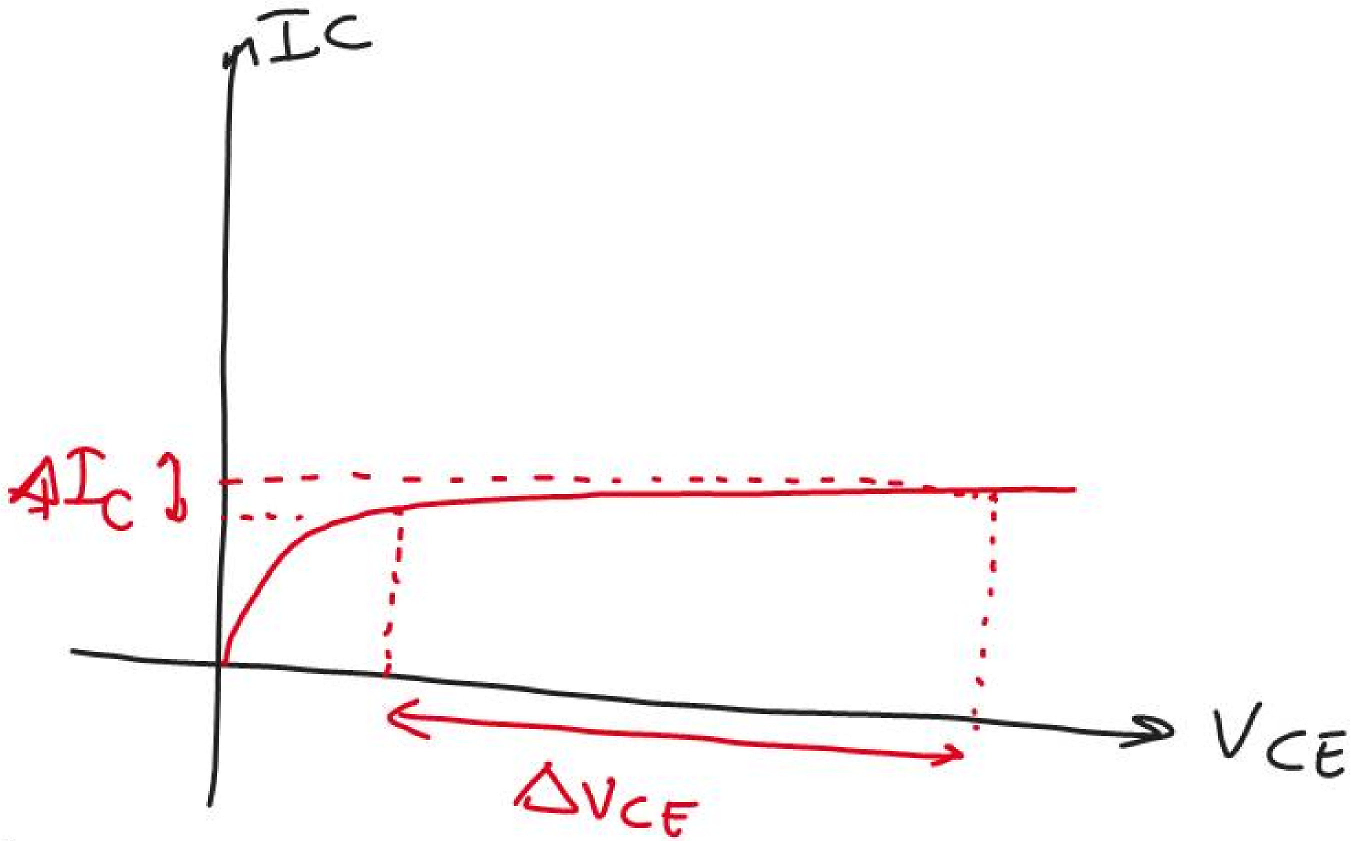
12.04.2011

©



Early's Effect:

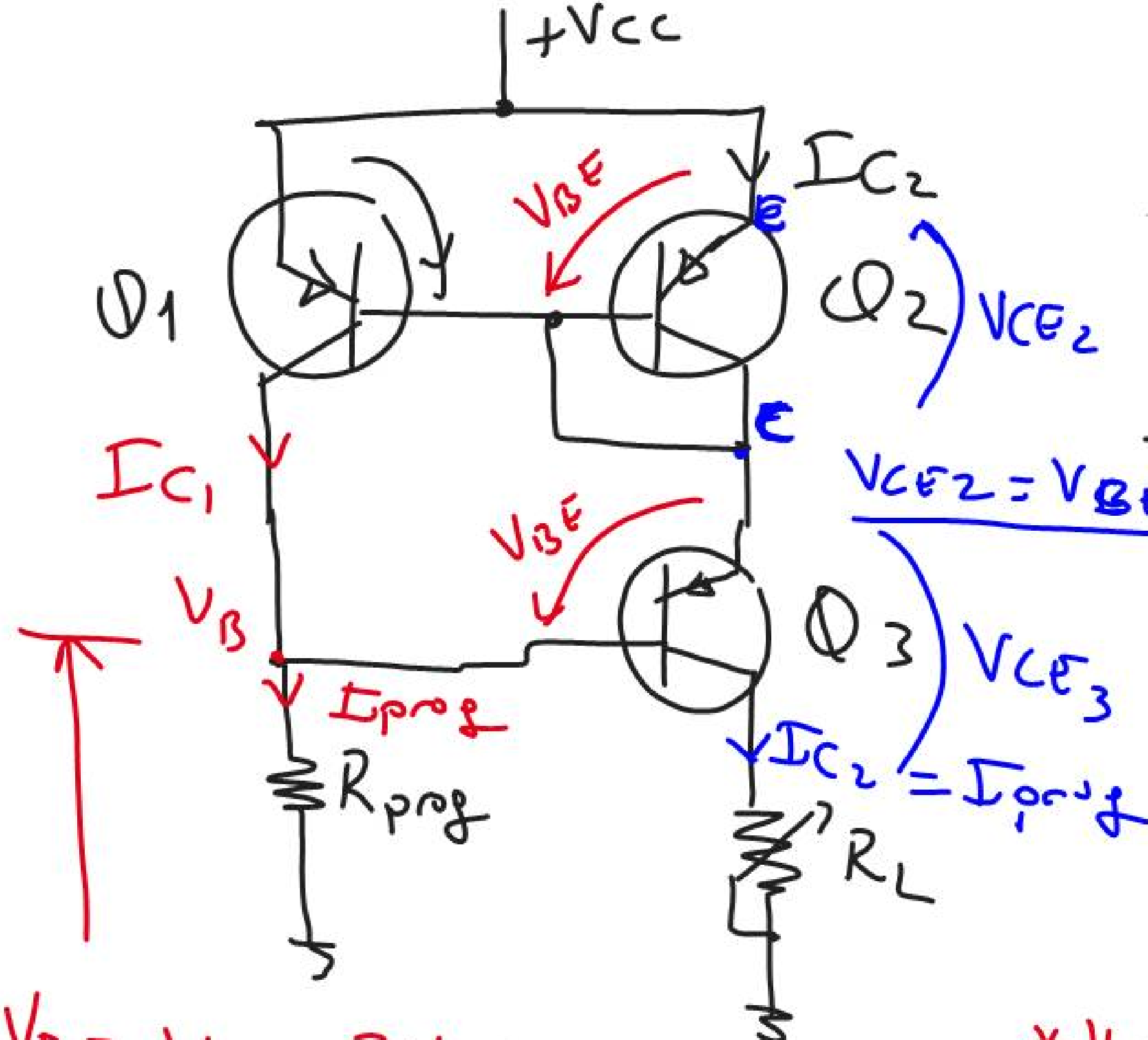
$$\Delta V_{BE} \propto \Delta V_{CE}$$

$\Rightarrow$ when V_{CE} changes, so does V_{BE}

when V_{BE} changes, so does I_B

when I_B changes, so does I_C (βI_B)

Wilson's Current Mirror:



$I_{C_1} \equiv I_{prog}$

$V_{BE_1} = V_{BE_2}$ (matched)

$I_{C_2} \equiv I_{C_1} = I_{prog}$

$V_{CE2} = V_{BE_2}$

* Since V_{CE2} does not change, I_{C_2} is not affected by $\Delta V_{CE_2} \approx 0$ (no Early's effect on I_{C_2})

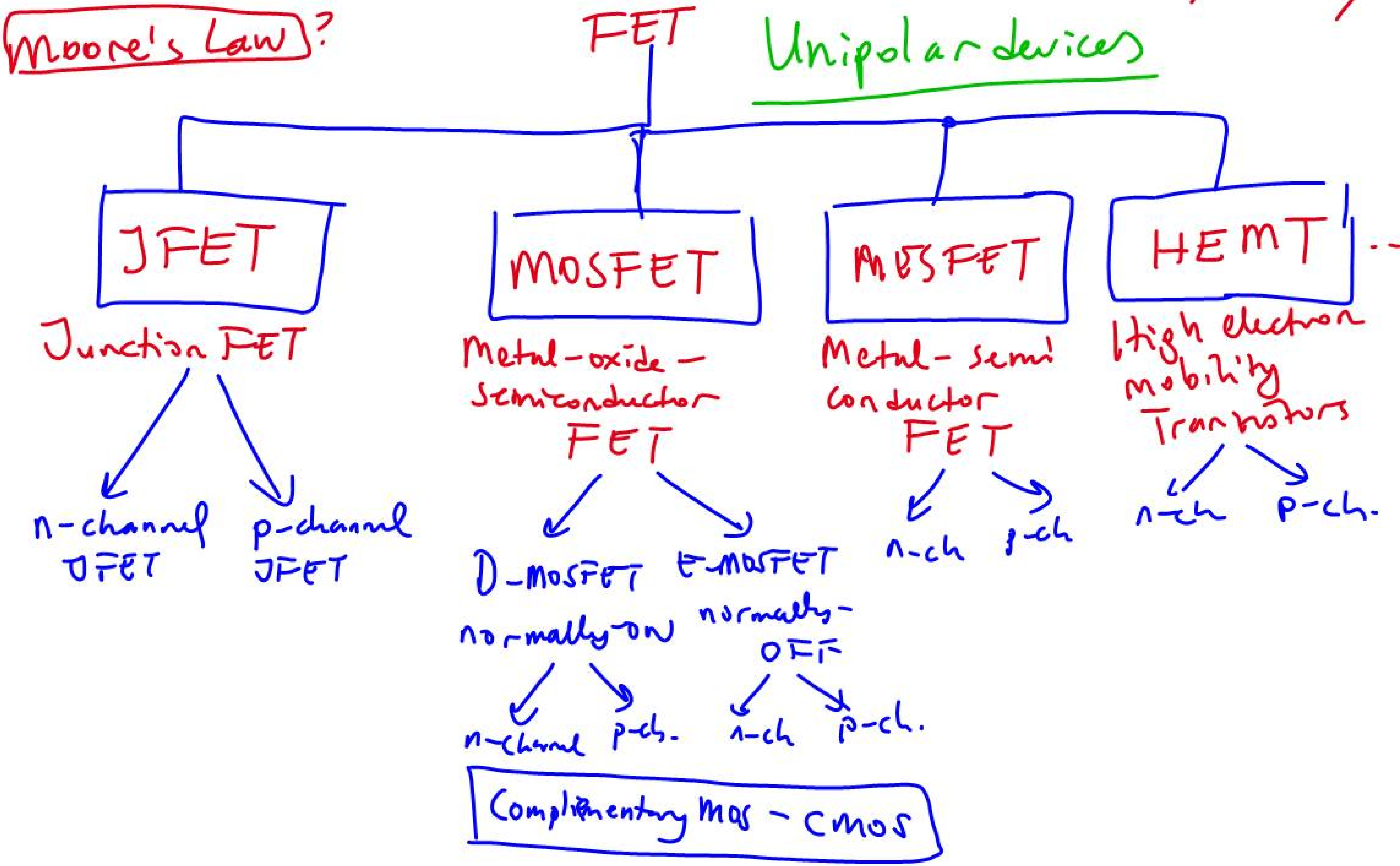
* V_{CE_3} is changing to provide the constant current I_{prog}.

However since I_{C3} is not determining the I_{prog} This will not be a problem for the mirror.

$$V_B = V_{CC} - 2V_{BE}$$

$$I_{prog} = \frac{V_{CC} - 2V_{BE}}{R_{prog}}$$

Field Effect Tranzistors (FETs)



$I = qn \cdot v\, A$

$\downarrow$

$C \cdot \frac{1}{cm^3} \cdot \frac{cm}{s} \cdot cm^2$

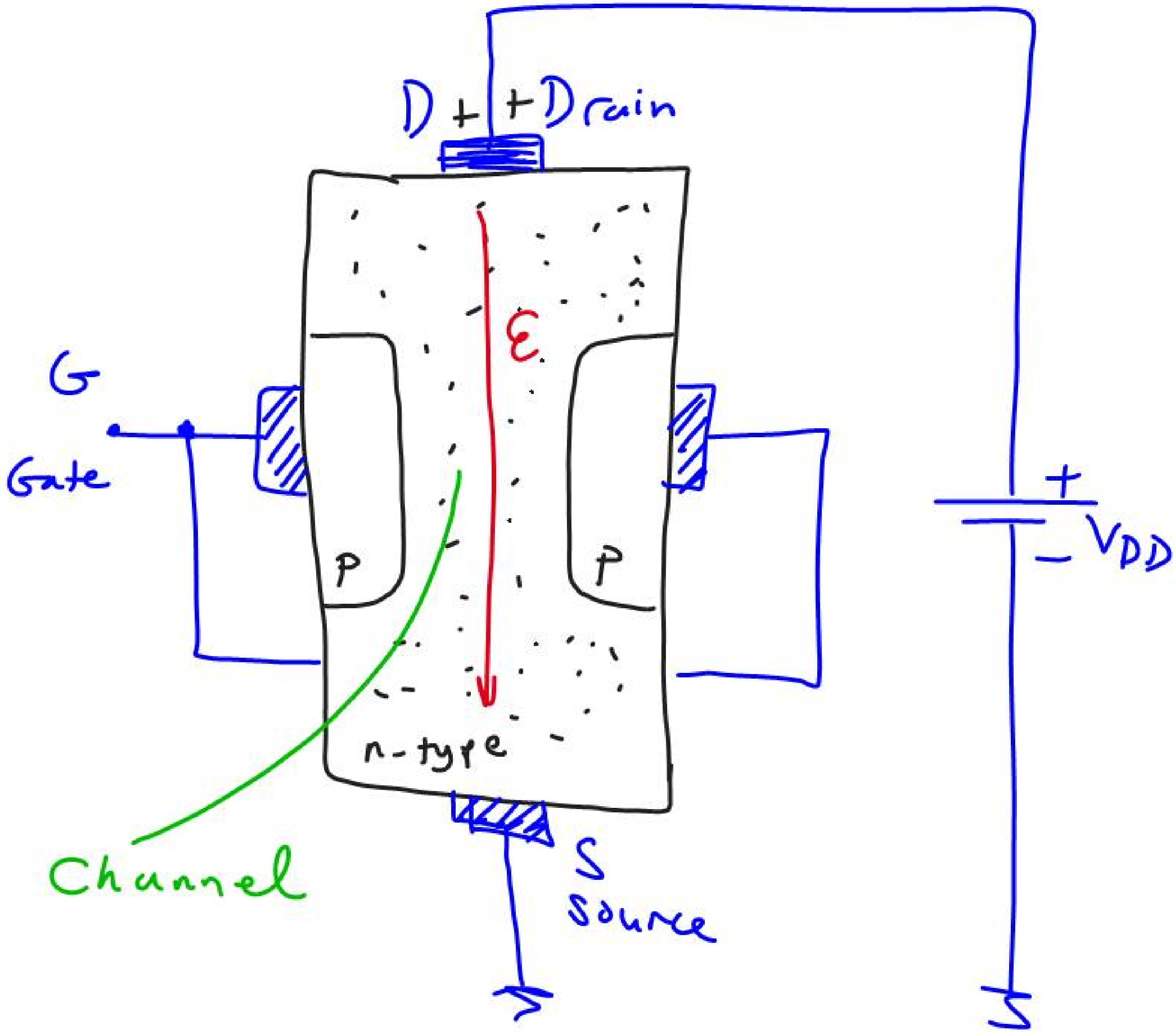
$= \frac{C}{s} = \text{Ampere}$

by controlling

- the cross-sectional area (A) JFET, MOSFET
- or the number of carriers (n) MOSFET, HEMT, MESFET
- or the velocity of carriers (v) HEMT, JFET, MOSFET

The current can be controlled.

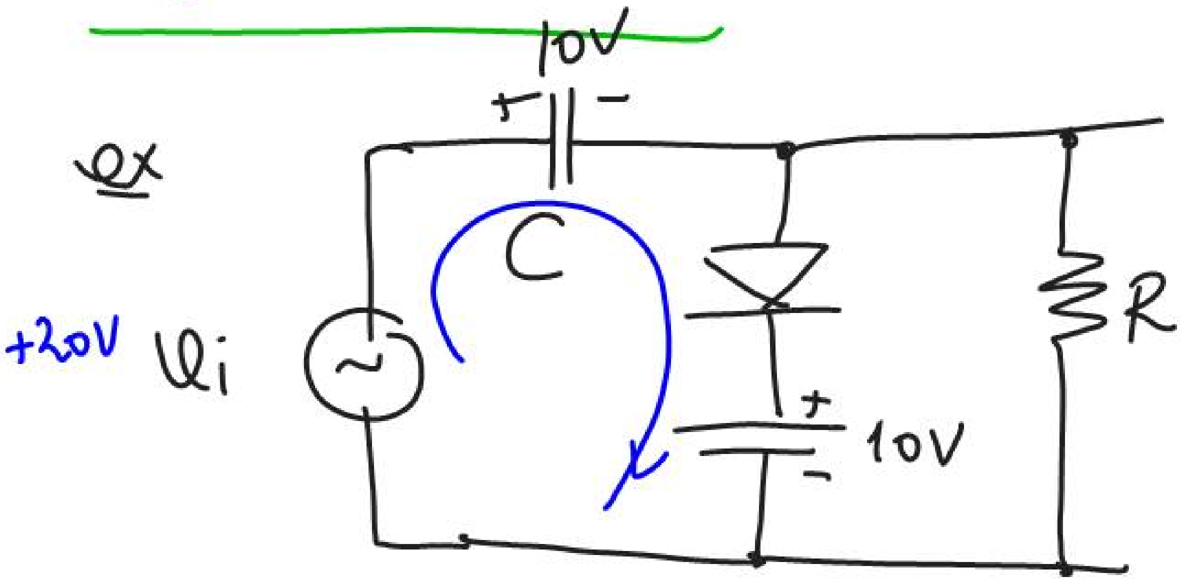
An n-Channel JFET

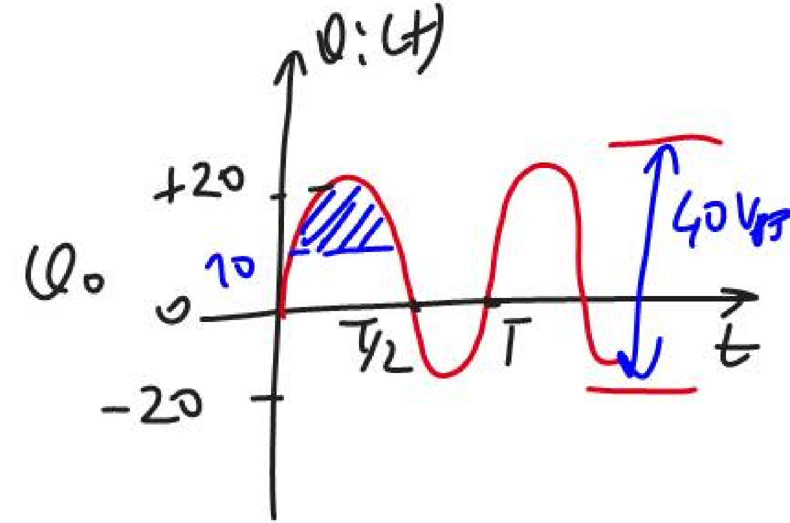


* Gate-to-source Junction is always REVERSE-BIASED.

RECITATION:

ex





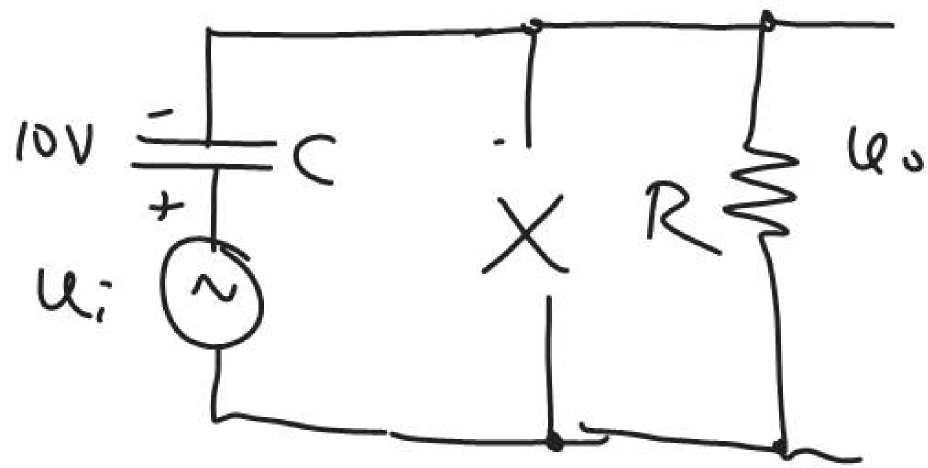
A clamper:

$$v_i - v_C - 10V = 0$$

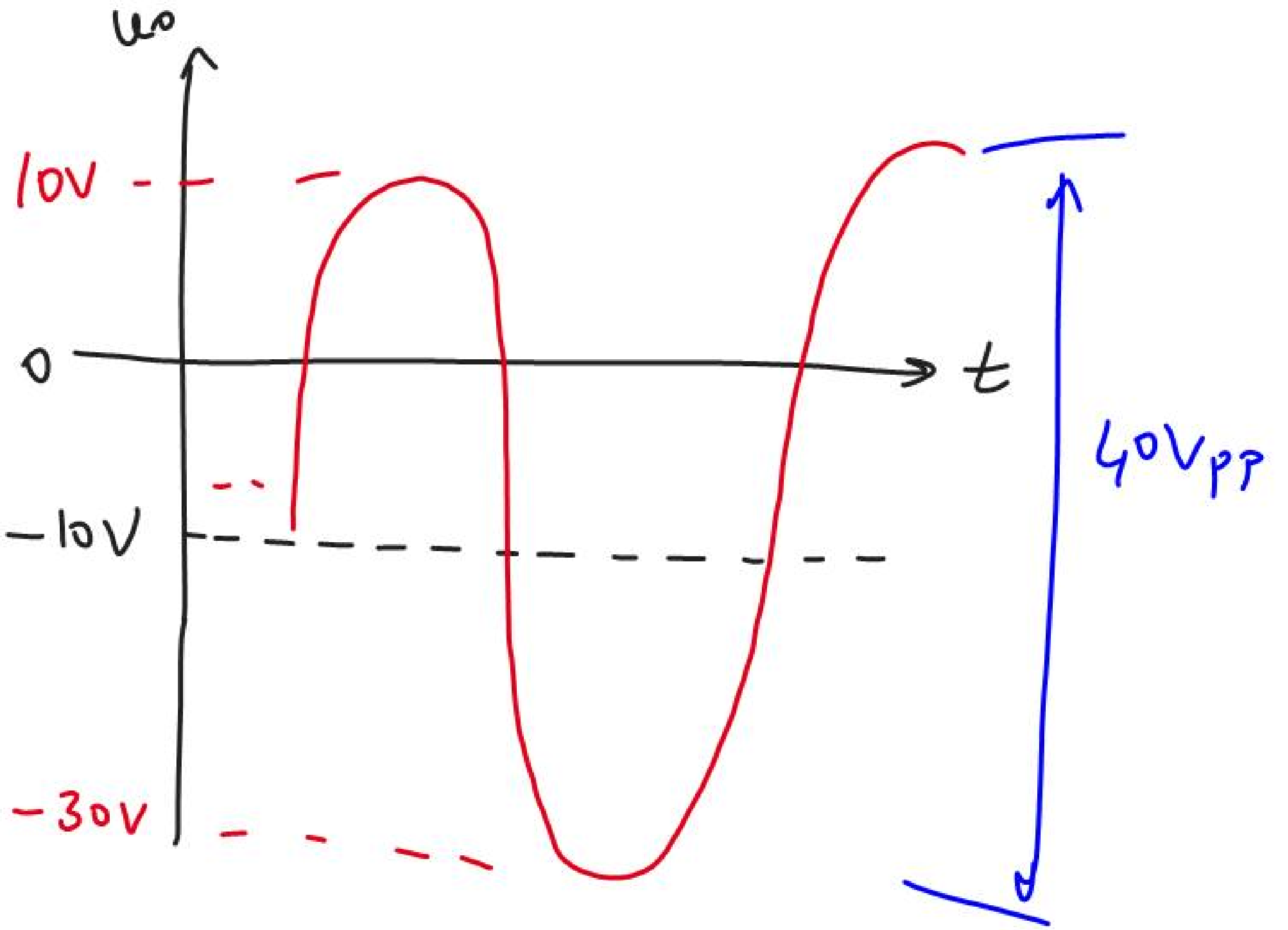
$$20 - v_C - 10 = 0$$

$$v_C = 10V$$

After the capacitor is charged
The diode will reverse forward biased.

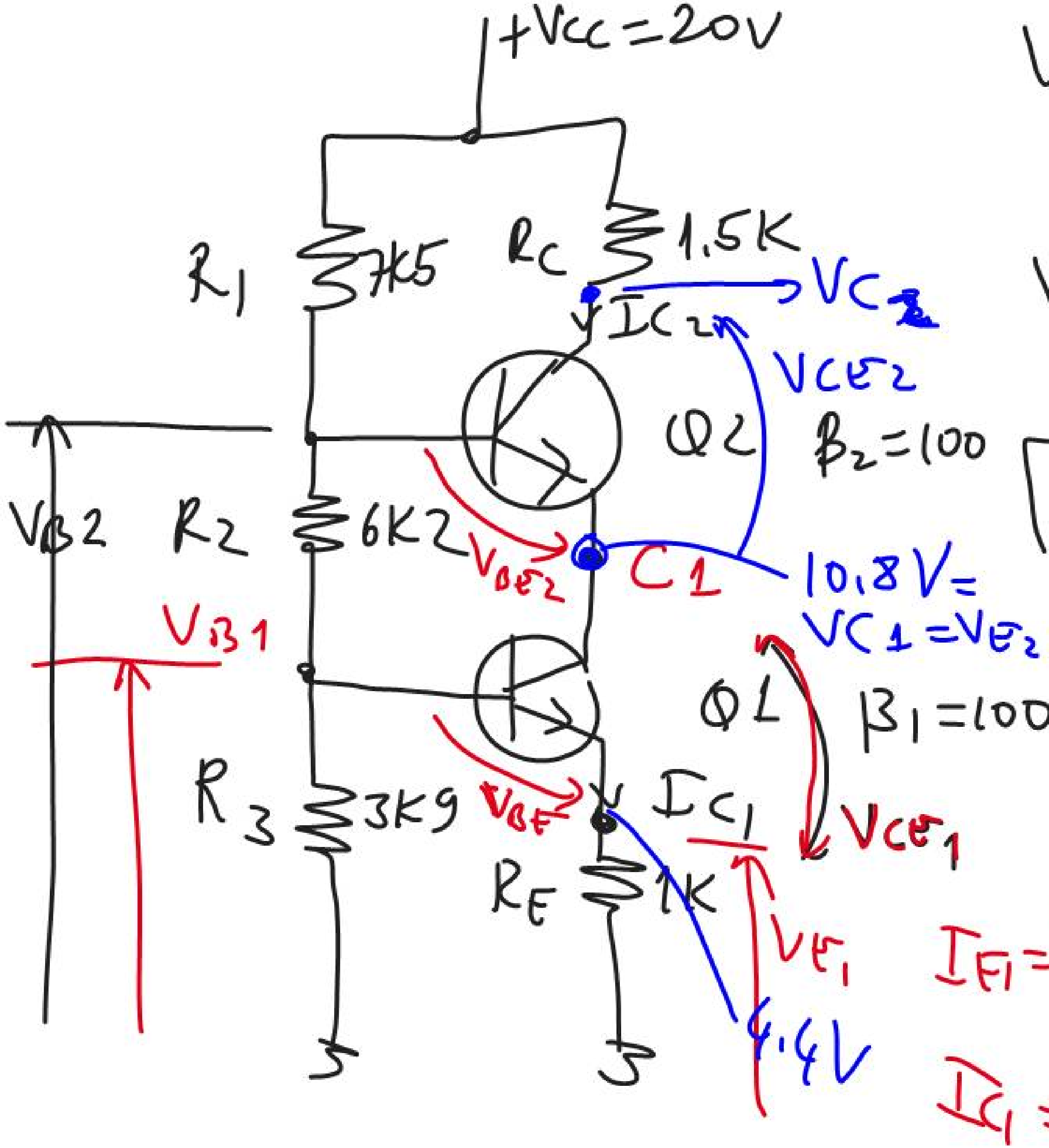


$$v_o = v_i - 10V$$



uo
10V
0
t
-10V
-30V
40Vpp

ex Cascode



$I_{E1} = \frac{V_{E1}}{R_E}$

$I_{C1} \cong I_{E1}$

$$V_{B1} \cong \frac{V_{cc}}{R_1+R_2+R_3} \cdot R_3$$

$$V_{B1} = \frac{20}{(7.5+6.2+3.9)\times 10^3} \times 3.9 \times 10^3$$

$$\boxed{V_{B1} \cong 4.4V}$$

$$V_E = V_{B1} - V_{BE1}$$
$$= 4.4 - 0.7$$

$$V_E = 3.7V$$

$$I_{E1} = \frac{V_E}{R_E}$$

$$I_E = \frac{3.7}{1K} = 3.7mA$$

$$\boxed{I_{C1} \cong 3,7mA}$$

$$V_{B2} \cong \frac{V_{CC}}{(7.5+6.2+3.9)\times 10^{3}} \times (6.2+3.9)\times 10^{3}$$

$$V_{B2} \cong 11.5\,V.$$

$$V_{E2} = V_{C1} = V_{B2} - V_{BE2}$$

$$= 11.5 - 0.7$$

$$V_{C1} = V_{E2} = 10.8\,V$$

$$V_{CE1} = V_{C1} - V_{E1}$$

$$= 10.8 - 4.4$$

$$\boxed{V_{CE1} = 6.4\,V}$$

$$I_{C2} \approx I_{Z1} = 3.7\,mA$$

$$V_{C2} = V_{CC} - I_{C2} \cdot R_C$$

$$V_{C2} = 20 - 3.7\times 10^{-3} \times 1.5 \times 10^{3}$$

$$V_{C2} = 20 - 5.6$$

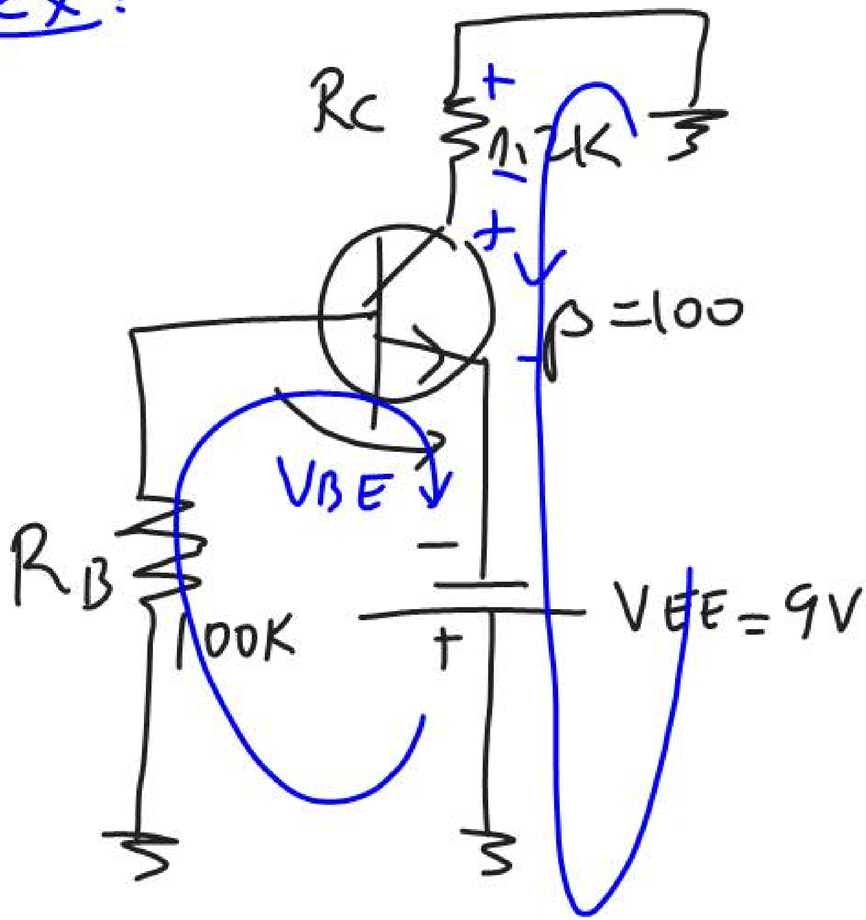
$$\boxed{V_{C2} = 14.4\,V}$$

$$V_{CE2} = V_{C2} - V_{E2}$$

$$= 14.4 - 10.8$$

$$\boxed{V_{CE2} = 3.6\,V}$$

ex:



KVL input:

$$V_{EE} - R_B I_B - V_{BE} = 0$$

$$I_B = \frac{V_{EE} - V_{BE}}{R_B}$$

$$I_B = \frac{9 - 0.7}{10^5} = \frac{8.3}{10^5}$$

$$= 83 \times 10^{-6}$$

$$I_B = 83 \mu A$$

$$I_C = \beta I_B$$

$$I_C = 83 \times 10^{-6} \times 10^2 = 8.3 \times 10^{-3} = 8.3 \text{ mA}$$

Output KVL $\quad 0 - I_C R_C - V_{CE} + V_{EE} = 0$

$$V_{CE} = V_{EE} - I_C R_C$$

$$= 9 - 8.3 \times 10^{-3} \times 1.2 \times 10^3$$

$$V_{CE} < 0$$

Not working!