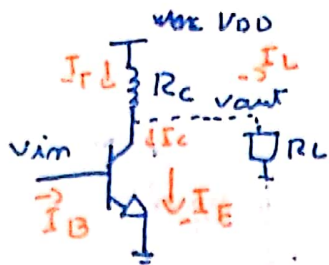


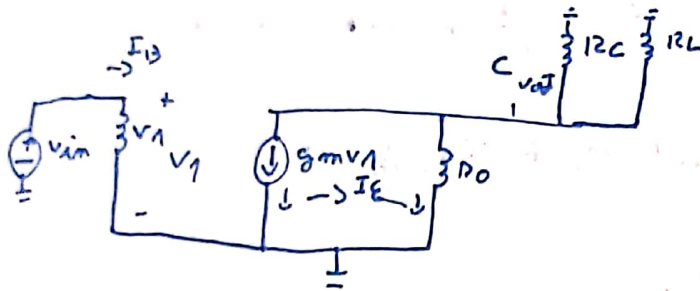
## CE amplifier stage



$$A_V = \frac{\Delta V_{out}}{\Delta v_{in}} \quad \text{In large signal}$$

$$A_V = \frac{v_{out}}{v_{in}} \quad \text{In small signal}$$

Equivalent small signal Model



$$v_1 = v_{in}$$

$$R_{eq} = R_C || R_L || r_o$$

$$-\frac{v_{out}}{R_{eq}} - g_m v_{in} = 0$$

$$-g_m v_{in} = \frac{v_{out}}{R_{eq}}$$

$$\frac{v_{out}}{v_{in}} = -g_m \times R_C || R_L || r_o$$

In BJT PDK you can't increase

The device characteristics of a Bipolar transistor

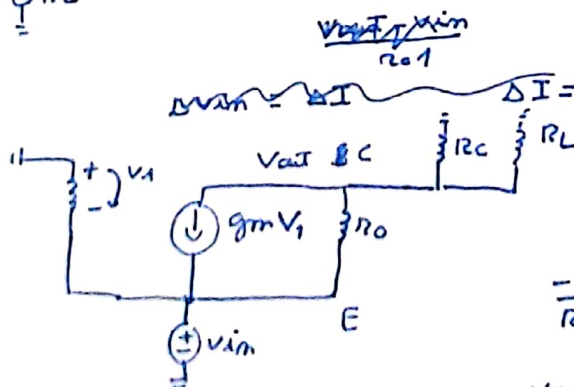
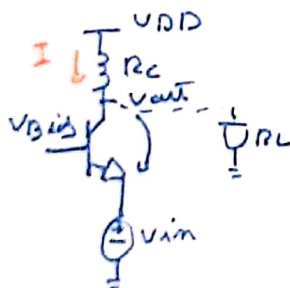
gain of Bipolar > mosfet

But consumption > mosfet

## Common Base stage

assuming only  $R_o$  and  $r_{\pi}$

We calculate the equivalent gain



$$v_1 = -v_{in}$$

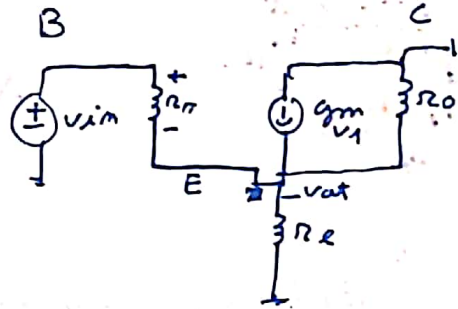
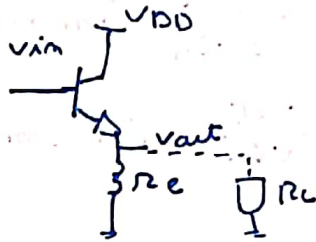
$$-\frac{v_{out}}{R_C || R_L} = -\frac{(v_{out} - v_{in})}{r_o} - g_m v_1$$

$$-v_{out} \left( \frac{1}{R_C || R_L} + \frac{1}{r_o} \right) + v_{in} \left( \frac{1}{r_o} + g_m \right)$$

$$\frac{v_{out}}{v_{in}} = \frac{\left( \frac{1}{r_o} + g_m \right)}{\frac{1}{R_C || R_L} + \frac{1}{r_o} + \frac{1}{r_o}}$$

~~common collector~~

## Emitter follower



$$v_1 = (v_{in} - v_{out})$$

sum of currents

$$-\frac{v_{out}}{R_e} - \frac{(v_{out} - v_{in})}{r_{\pi}} - \frac{v_{out}}{r_o} + g_m(v_{in} - v_{out}) = 0$$

$$-v_{out} \left( \frac{1}{R_e} + \frac{1}{r_{\pi}} + \frac{1}{r_o} + g_m \right) + v_{in} \left( \frac{1}{r_{\pi}} + g_m \right) = 0$$

$$\frac{v_{out}}{v_{in}} = \frac{\left( \frac{1}{r_{\pi}} + g_m \right)}{\left( \frac{1}{R_e} + \frac{1}{r_{\pi}} + \frac{1}{r_o} + g_m \right)}$$

$$A_v < 1$$

→ Just a buffer stage