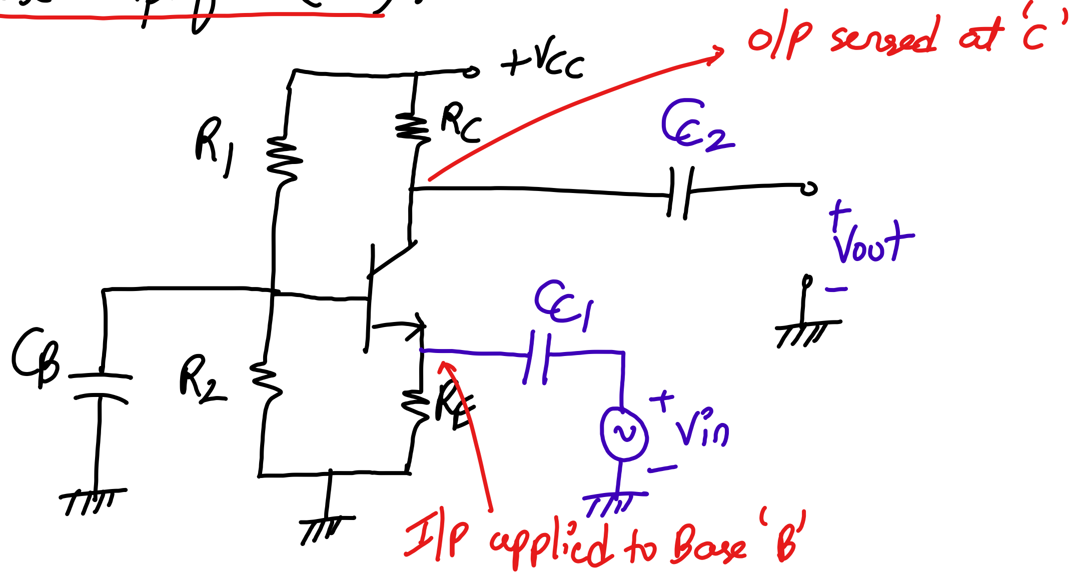
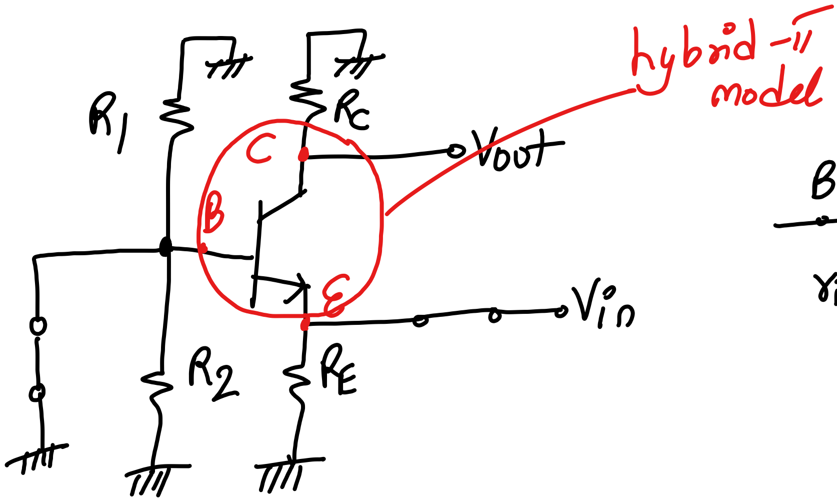
AEC lec 12 (online) 12/8/23

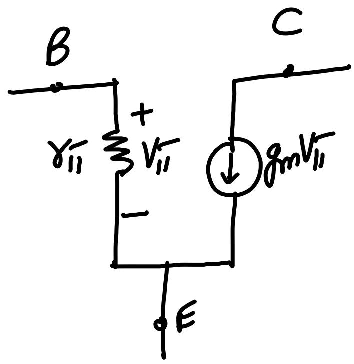
Common Base amplifier (CB):

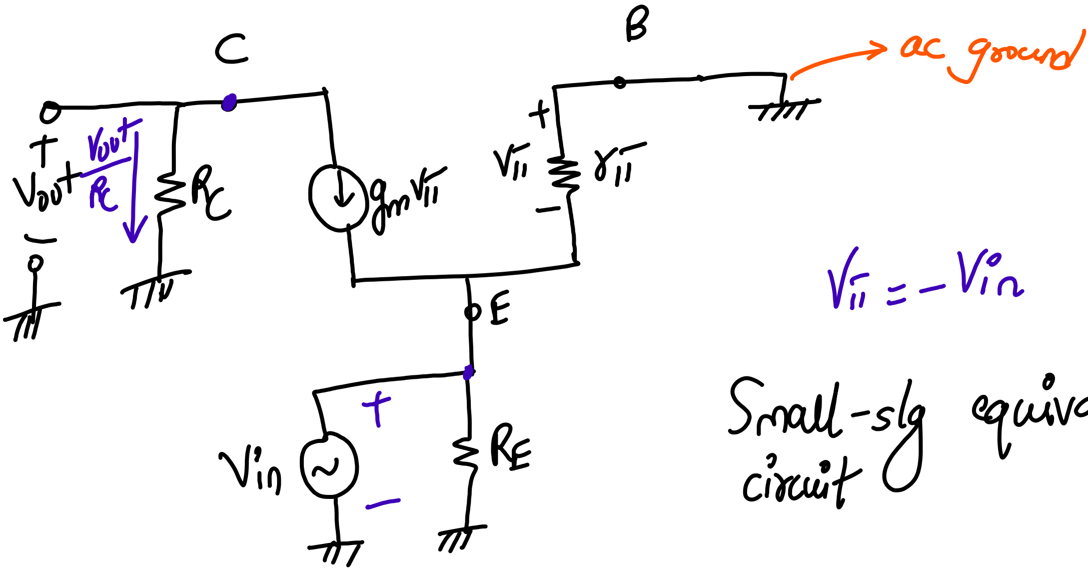


I] AC analysis: (s.c all Cap's & independent sources)

Assume:
$V_A = \infty$
$r_o = \infty$







$V_\pi = -V_{in}$

Small-slg equivalent circuit

1. A_v
2. R_{in}
3. R_{out}

① Small-slg voltage gain (A_v):

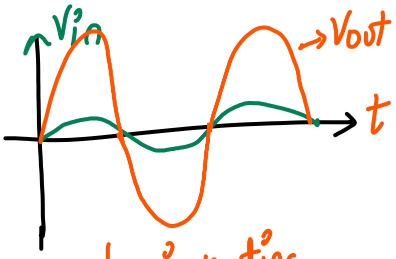
$$V_\pi = -V_{in}$$

KCL at node 'C',

$$g_m V_\pi + \frac{V_{out}}{R_C} = 0$$

$$-g_m V_{in} + \frac{V_{out}}{R_C} = 0$$

$$\frac{V_{out}}{V_{in}} = g_m R_C$$



Non-inverting

$$\boxed{A_v = +g_m R_C}$$ → voltage gain for CB amplr

$$\boxed{R_{in} = \frac{1}{g_m} \parallel R_E}$$ "Low" → CB amplr

$$R_{out} = R_C$$ → CB amplr

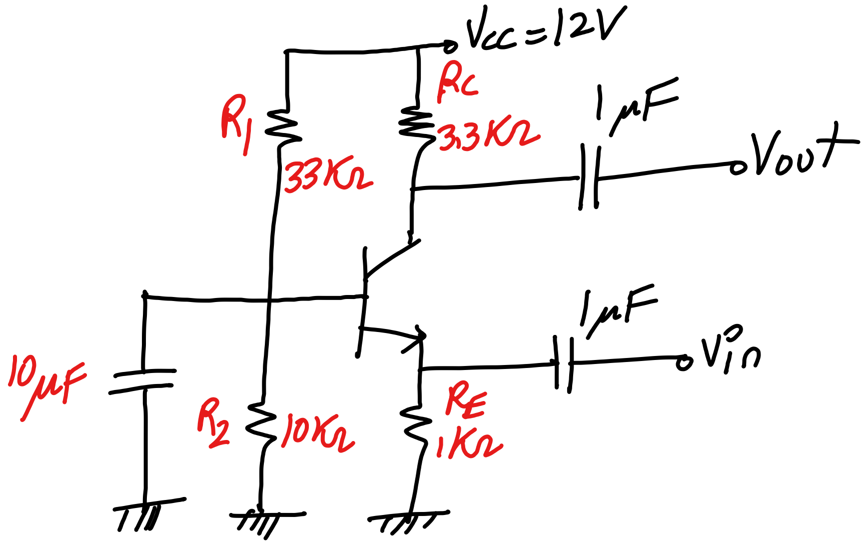
For Rin and Rout derivation, refer AEC Lec 12 markings pdf

Numerical 13: Find a) Small-slg voltage gain

b) I/P resistance & c) O/P resistance

for ckt shown below:

CB amplr



Given

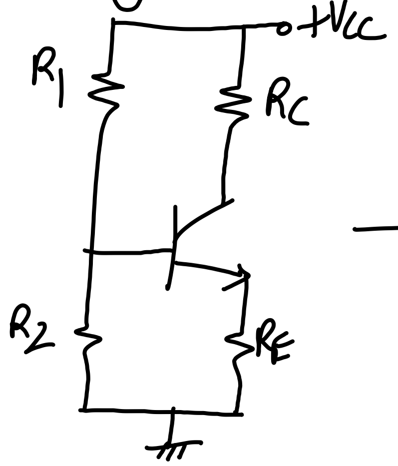
$\beta = 99$

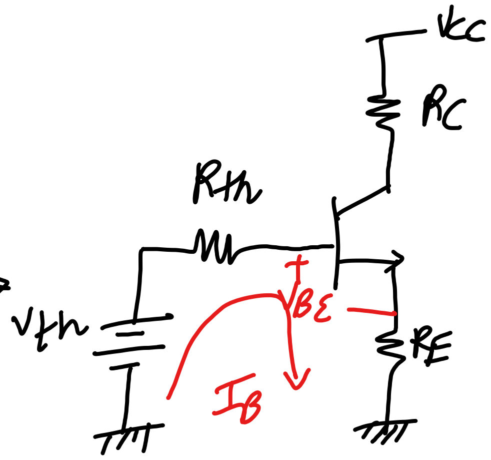
$V_{BE(on)} = 0.7V$

$V_A = \infty$

Aim $\rightarrow$ I_{CQ} $\rightarrow$ g_m, r_π $\rightarrow$ A_v, R_{in}, R_{out}

1) DC analysis:





$I_E = (1+\beta) I_B$

a) $V_{th} = \frac{R_2}{R_1+R_2} \times V_{CC} = \frac{10K}{10K + 33K} \times 12 = \underline{2.79}\ V$

b) $R_{th} = R_1 \,||\, R_2 = 33K \,||\, 10K\Omega = \underline{7.67}\ K\Omega$

c) $I_{BQ} = \frac{V_{th} - V_{BE}}{R_{th} + (1+\beta) R_E} = \frac{2.79 - 0.7}{7.67K + 100 \times 1K\Omega}$

$I_{BQ} = \underline{19.41 \mu A}$

d) $I_{CQ} = \beta I_{BQ} = 99 \times 19.41 \times 10^{-6}$

$I_{CQ} = \underline{1.92\,mA}$

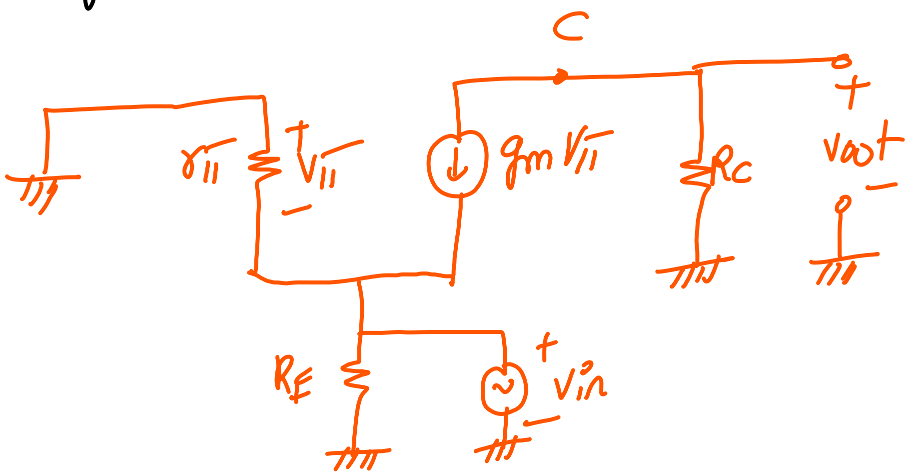
2) Small-slg parameters:-

$V_T = 26\,mV$ at $27^\circ C$ (Assume)

$$g_m = \frac{I_{CQ}}{V_T} = \frac{1.92\times10^{-3}}{26\times10^{-3}} = 73.85\,\frac{mA}{V}$$

$$r_\pi = \frac{\beta}{g_m} = \frac{99}{73.85\times10^{-3}} = 1.34\,K\Omega$$

3) Small-slg equivalent ckt:



$$A_v = g_m R_C = 73.85\times\cancel{10^{-3}} \times 3.3\times\cancel{10^{3}}$$

$$\boxed{A_v = 243.69}$$

$$\frac{1}{g_m} = \frac{10^3}{73.85} = 13.54\,\Omega$$

$$R_{in} = \frac{1}{g_m} \,||\, R_E = 13.54\,\Omega \,||\, 1\,K\Omega \approx 13.36\,\Omega$$

(low)

$$\boxed{R_{out} = R_C = 3.3\,K\Omega}$$

—x—