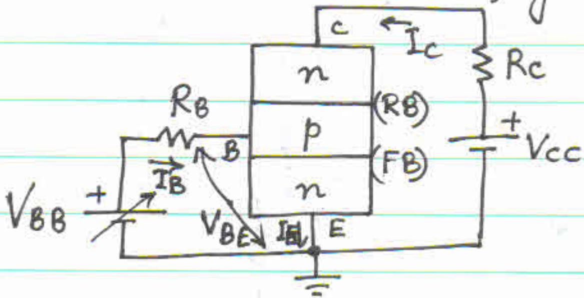
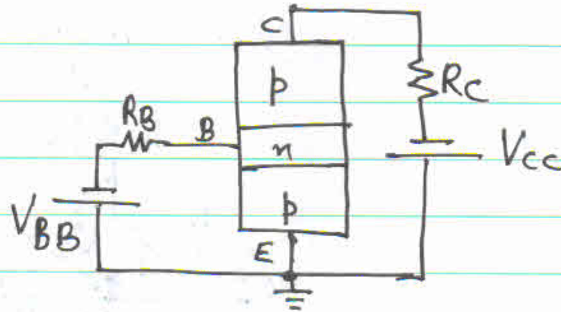
→ Common Emitter Configuration:





Common emitter current gain: $\beta = \frac{i_c}{i_B} \geq 1$

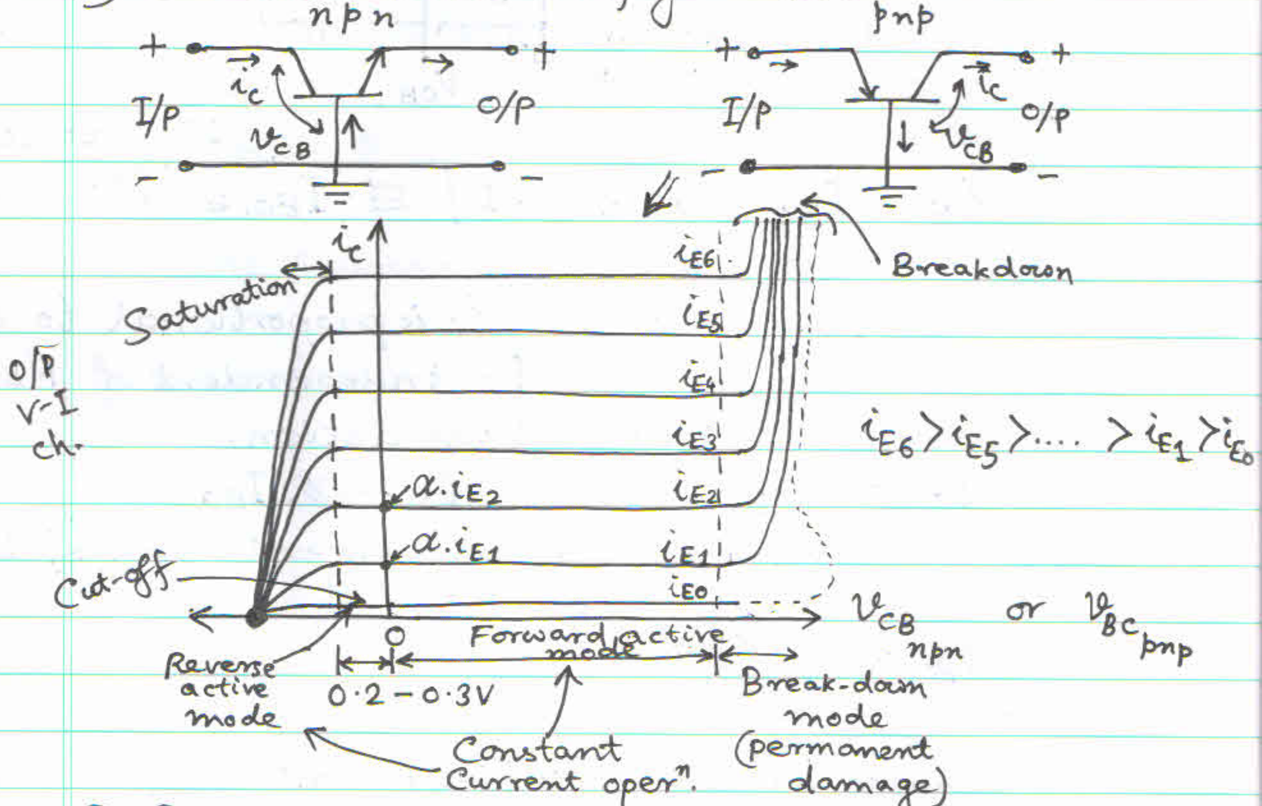
$$i_E = i_c + i_B$$
$$= \beta . i_B + i_B$$
$$= (1+\beta)\, i_B$$

$$i_c = \left(\frac{\beta}{1+\beta}\right) i_E$$
$$= \alpha . i_E \quad \left(\because \alpha = \frac{\beta}{1+\beta}\right)$$

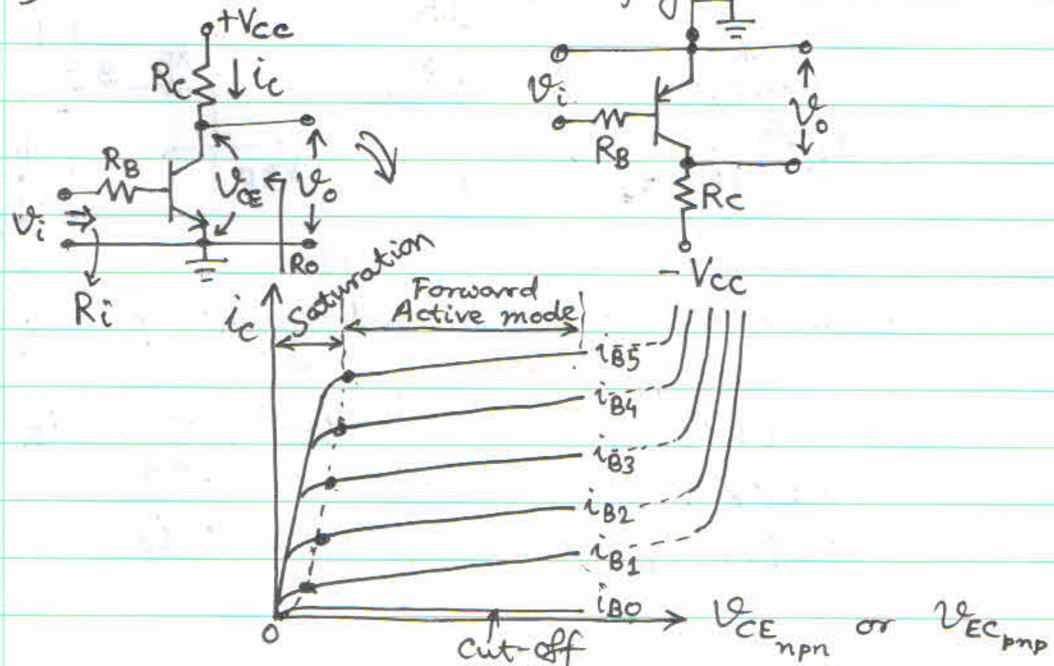
or, $\beta = \dfrac{\alpha}{1-\alpha}$

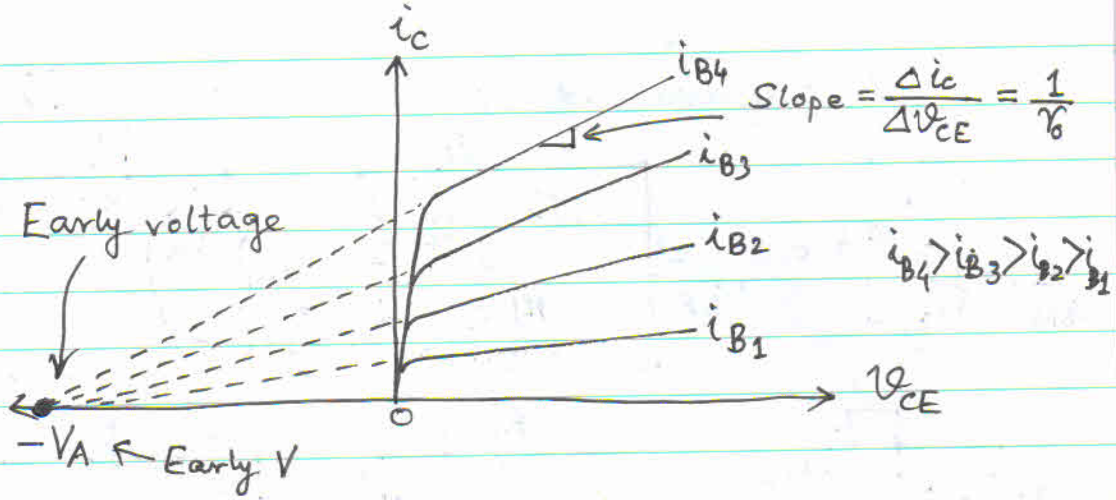
6. V-I characteristics:

a) Common-base configuration:

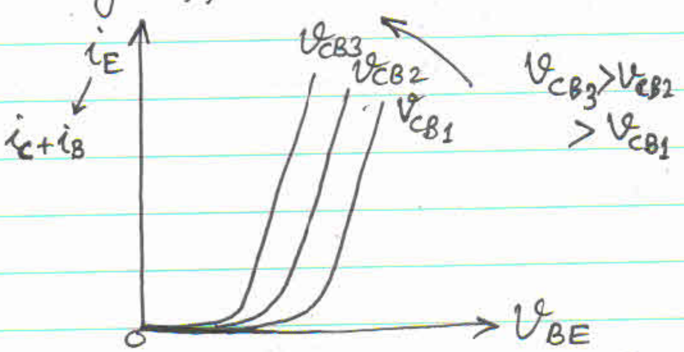


b) Common-emitter configuration:





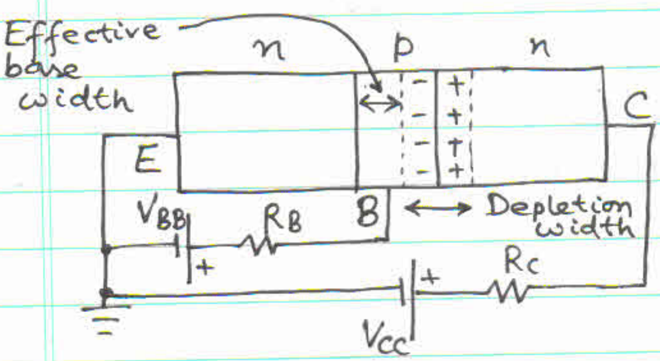
Early effect & base width modulation:



$J1_{CB}$: RB

$J2_{BE}$: FB

Larger V_{CB} causes wider depletion width, causes reduction in effective base width

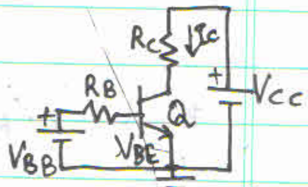


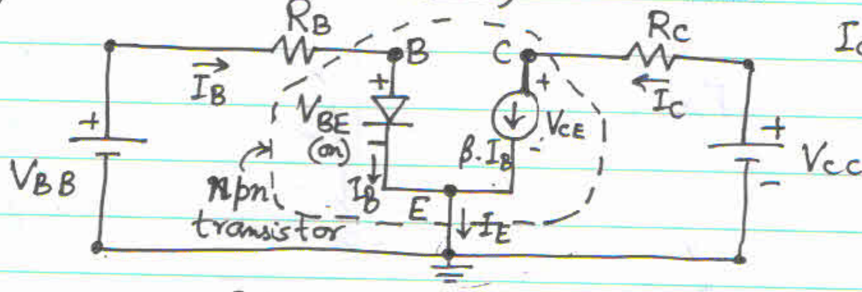
$$\frac{1}{r_o} = \left.\frac{\partial i_C}{\partial v_{CE}}\right|_{v_{BE} = \text{constant}}$$

$$r_o \cong \frac{V_A}{I_C}$$

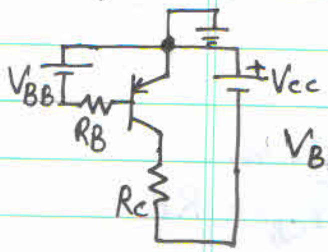
$$i_C = I_S\left(e^{\frac{v_{BE}}{V_T}}\right)\left(1 + \frac{v_{CE}}{V_A}\right)$$

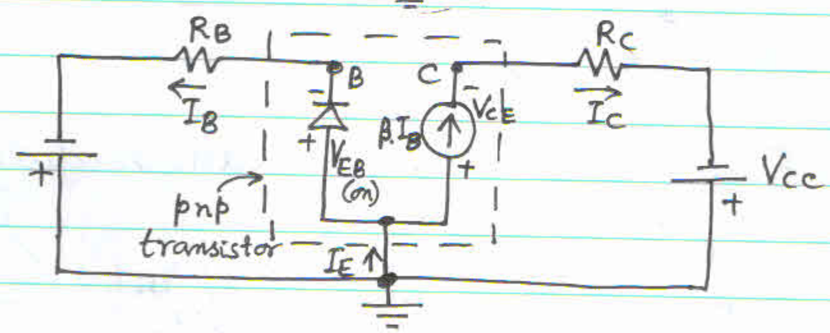
7. DC Equivalent circuit (CE): → DC, AC



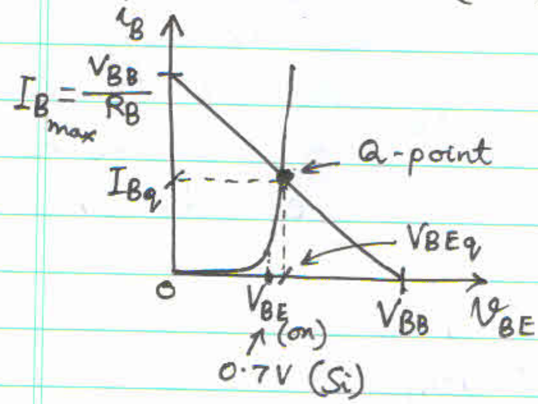


$I_C = \beta I_B$

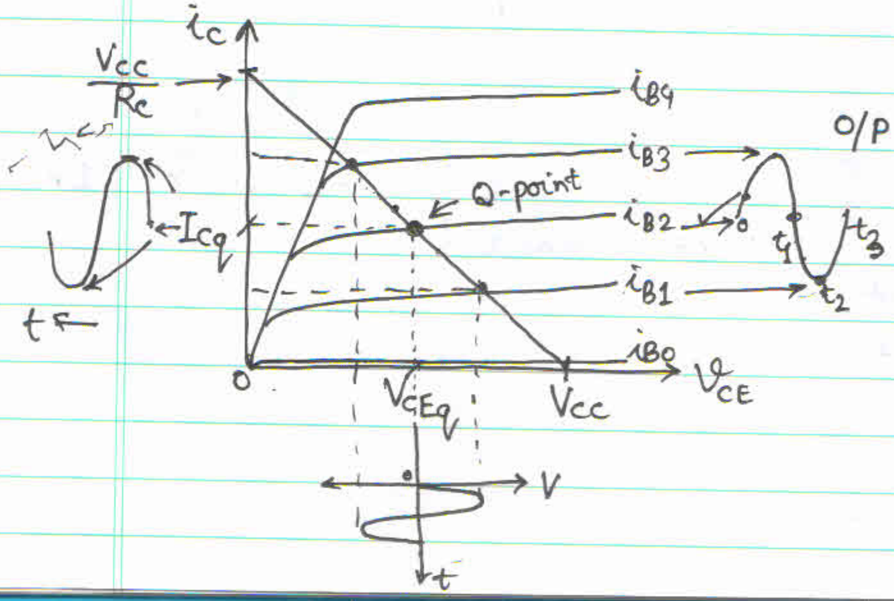


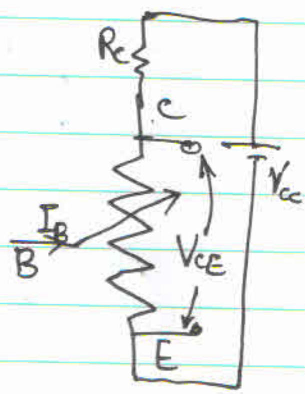


8. DC Load Line (CE)



I/P

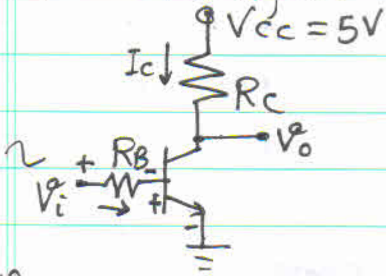


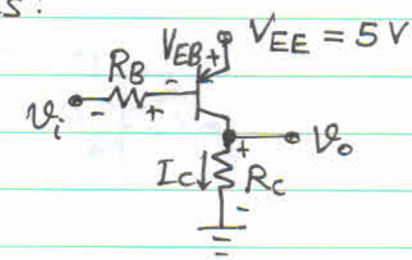


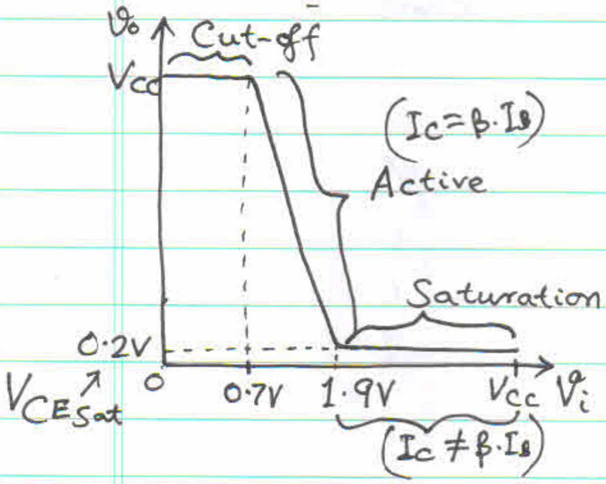
$$\boxed{V_{BE} > V_{CE} \rightarrow 0.2 \text{ to } 0.3}$$

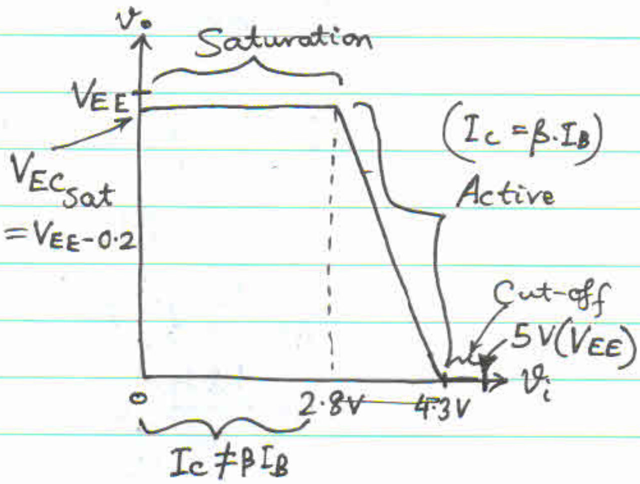
$$I_B = \frac{V_{BB}}{R_B} - \frac{V_{BE}}{R_B} \rightarrow V_{BB} - I_B . R_B \quad \Big| \quad V_{CE} = V_{CC} - I_C . R_C$$

9. V - transfer characteristics:



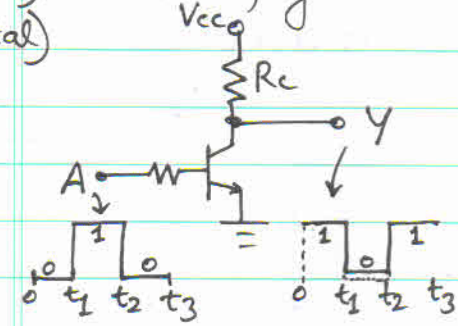




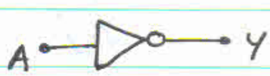


10. a) CE configuration as an inverter (NOT gate) ↳ Sat. & Cut-off

(Digital)

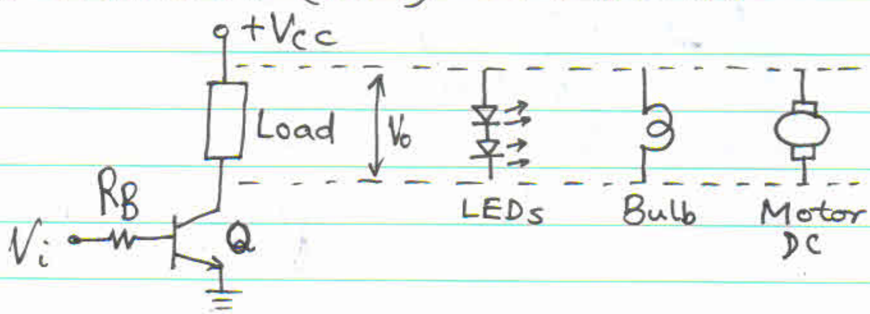


≈

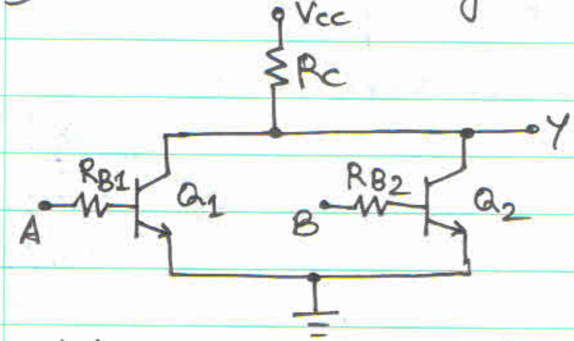


A	Y
0 (0V)	1 (Vcc)
1 (Vcc)	0 (0.2V)

b) Transistor (BJT) as a switch:



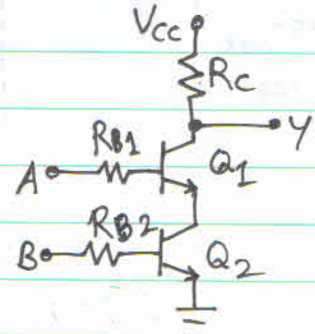
c) BJT as a NOR gate



A	B	Y	
0(0V)	0	1	(Vcc)
0	1	0	
1(Vcc)	0	0	
1	1	0	(0.2V)

'0' means 0.2V ; '1' means Vcc (for O/P Y)

d) BJT as a NAND gate



A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

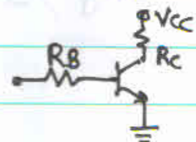
Vcc

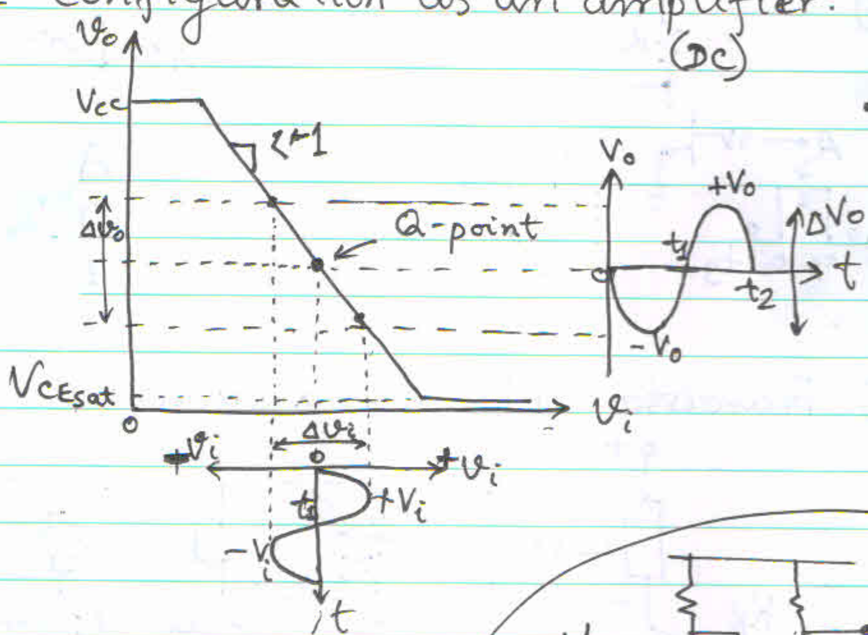
0.4V

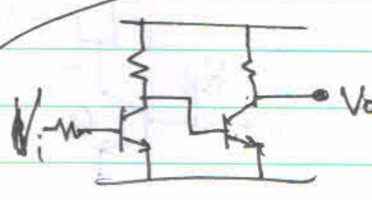
11. CE configuration as an amplifier: (DC)

180° ϕ inversion

Phase







for 360° ϕ

$$I_{Bq} = \frac{V_{cc} - V_{BE(on)}}{R_B} \quad \Big| \quad R_C = \frac{V_{cc} - V_{CEq}}{I_{cq}}$$

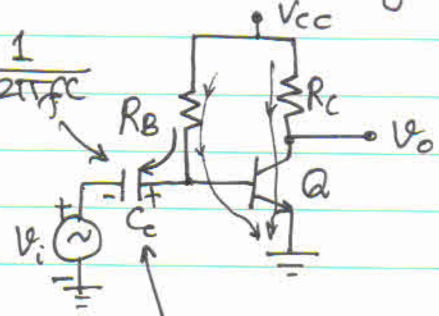
$$V_{CEq} = V_{cc} - I_{cq} \cdot R_c \quad \Big| \quad I_{Bq} = \frac{I_{cq}}{\beta}$$

12. BJT Biasing:

a) Fixed R biasing

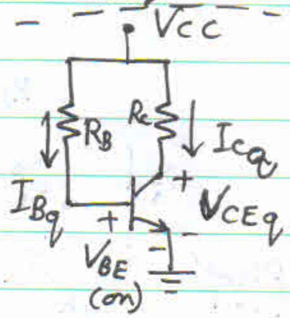
$$\Big| \quad R_B = \frac{V_{cc} - V_{BE(on)}}{I_{Bq}}$$

$$X_C = \frac{1}{2\pi f C}$$



Coupling cap. (clamper)

$\approx$

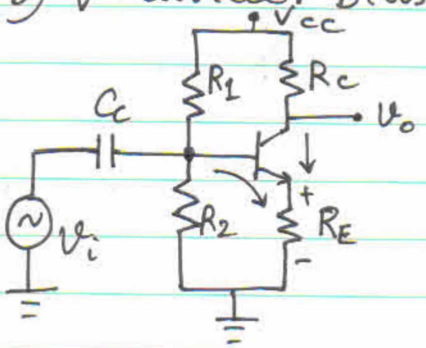


$\Uparrow$

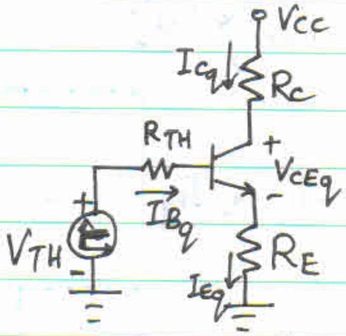
(At DC)

$\Downarrow$

b) V-divider biasing



$\approx$



$$R_{TH} = R_1 // R_2 \quad \Big| \quad V_{TH} = \frac{R_2}{R_1 + R_2} \cdot V_{cc}$$

$$I_{Eq} = (1+\beta) I_{Bq}$$

$$I_{Bq} = \frac{V_{TH} - V_{BE(on)}}{R_{TH} + (1+\beta) R_E}$$

$$I_{cq} = \beta \cdot I_{Bq}$$

13. Multi-stage amplifier: