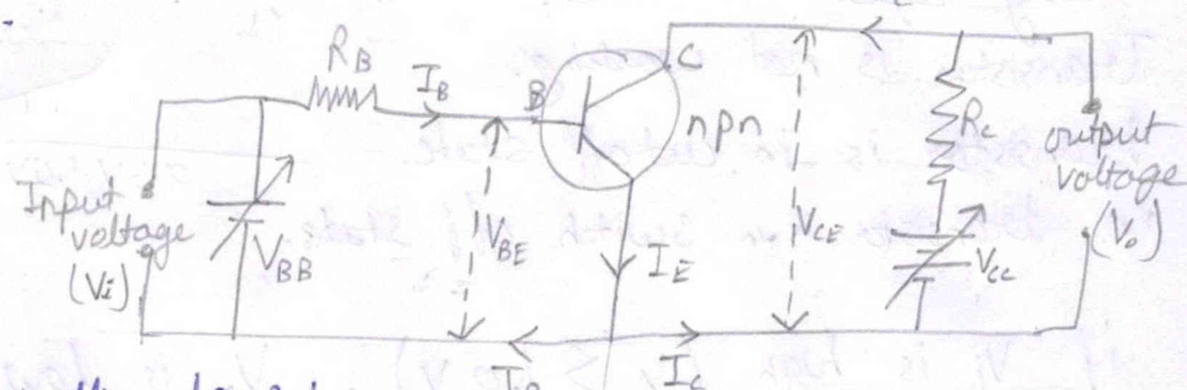
Transistor As a Switch — for on/off of current in circuit

Here, we use npn transistor with common Emitter transistor.



using Kirchoff's law :

i) for input circuit : $-V_{BB} + I_B R_B + V_{BE} = 0$

$$\Rightarrow \quad V_{BB} = I_B R_B + V_{BE} \quad \text{——— (1)}$$

for Si transistor $V_{BE} = 0.6\,V$

ii) For output circuit : $-V_{CC} + I_C R_C + V_{CE} = 0$

$$\Rightarrow \quad V_{CE} = V_{CC} - I_C R_C \quad \text{——— (2)}$$

let V_{BB} be d.c. input voltage (V_i) & V_{CE} as output voltage (V_o)

$$\therefore \quad V_i = I_B R_B + V_{BE} \quad \& \quad V_o = V_{CC} - I_C R_C$$

→ Case 1 : for Si transistor $V_i < 0.6\,V$: $I_C = 0$. Cut off state

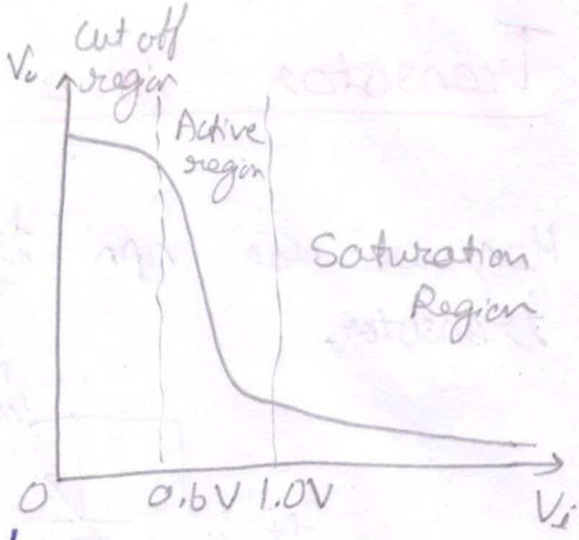
Case 2 : $V_i > 0.6V$ but less than $1.0\,V$: Some I_C.

if I_C increase, V_o decrease. but if V_i inc. beyond 0.6 V, I_C increase almost linearly, so V_o decrease linearly till V_i becomes nearly 1 V. This is active state of transistor.

Case 3 : $V_i > 1.0\,V$. ~~V~~

with inc in V_i, V_o decrease towards zero but never becomes zero.

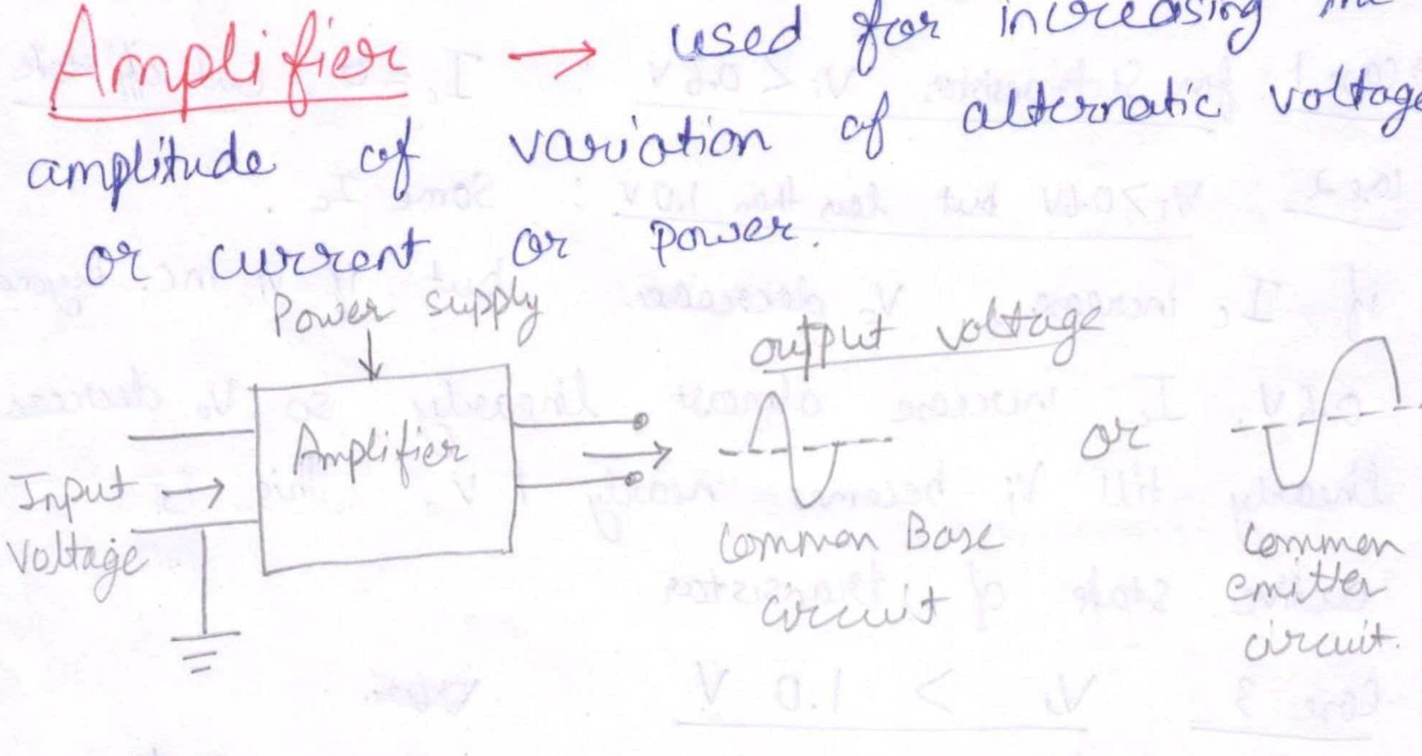
So. if V_i is (i.e. $V_i < 0.6$ V)
V_o is high ($= V_{cc}$) & I_c is nearly equal to zero.
Transistor is not working.
transistor is in cutoff state.
i.e. transistor is in switch off state.



if V_i is high ($V_i > 1.0$ V), V_o is low $\simeq 0$
I_c is maximum or saturated.
Now transistor is fully conducting. i.e. switch on state

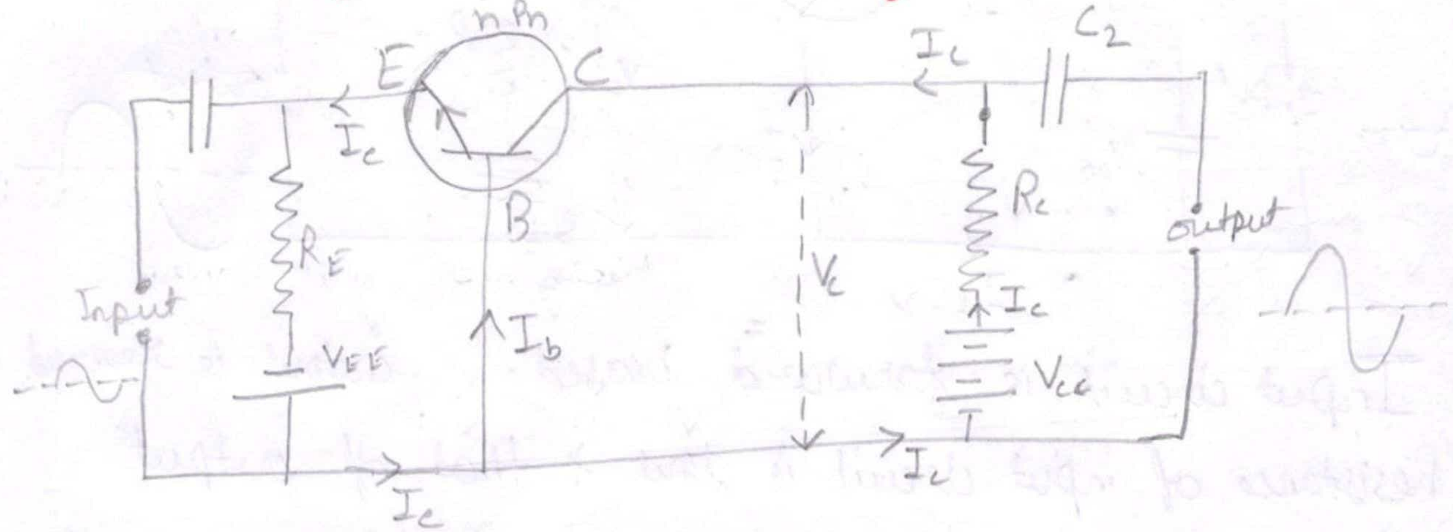
→ Switching circuits are made in such a way that transistor does not remain in active state.

Amplifier → used for increasing the amplitude of variation of alternatic voltage, or current or power.



Transistor as Common Base Amplifier

a) Amplifier circuit using an n-p-n transistor



- The input (emitter base) circuit is forward biased.
- V_{EE} is small so so resistance of input circuit is small.
- The ouput (collector base) circuit is reverse biased V_{cc} is high voltage battery. ∴ output resistance is large.

- let 5% of I_e appear as I_b due to e⁻-hole combination in base & 95% of emitter current flows as I_c. Due to I_c,

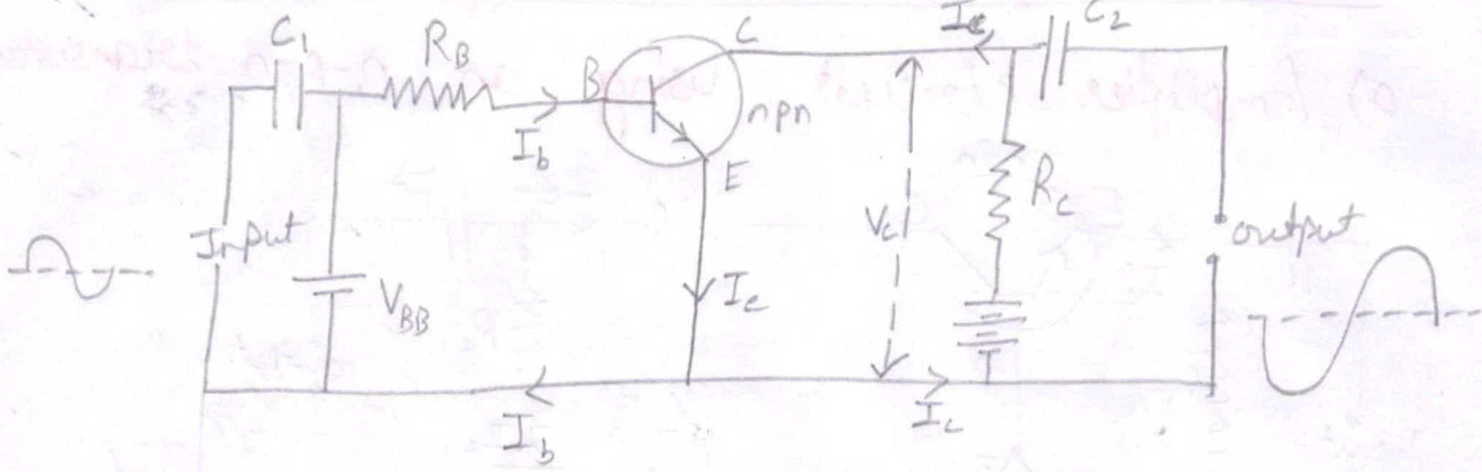
voltage drop across $R_c = I_c R_c$

If V_c is collector voltage (pot. diff. b/w collector & base) then $V_{CB} = V_c + I_c R_c$ or $V_c = V_{CB} - I_c R_c$

working

→ so when input signal voltage is fed to emitter base circuit, it will change emitter voltage & hence I_e, which inturn will change I_c. Due to this, V_c will vary. This variation in collector voltage appear as amplified output.

Transistor as common emitter Amplifier



Input circuit is forward biased & output is reversed.
Resistance of input circuit is low & that of output circuit is high.

- When input signal voltage is feed to Emitter base circuit, it will change emitter voltage & hence I_e, which inturn will change I_c.
  Due to it collector voltage V_c will vary in accordance with relation. These ~~relation~~ variation in voltage appear as amplified output.

* Phase relation: During +ive half cycle of input a.c. signal voltage, the output signal voltage at collector varies through a negative half cycle & vice-versa.