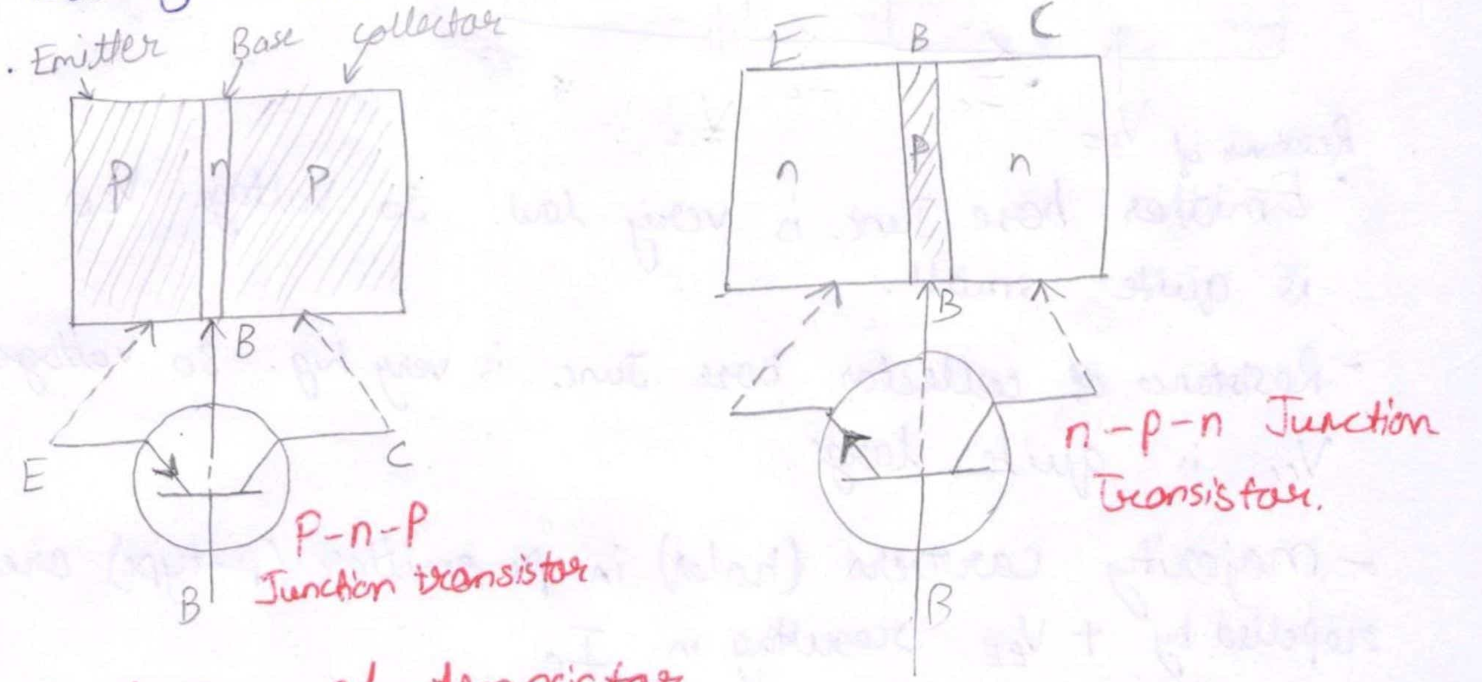
Junction Transistor

Obtained by growing a thin layer of one type Semiconductor in b/w two thick layers of other similar type semiconductor.

- Thus junction transistor is semiconductor device having two junctions & 3 terminals.



→ 3 layers of transistor

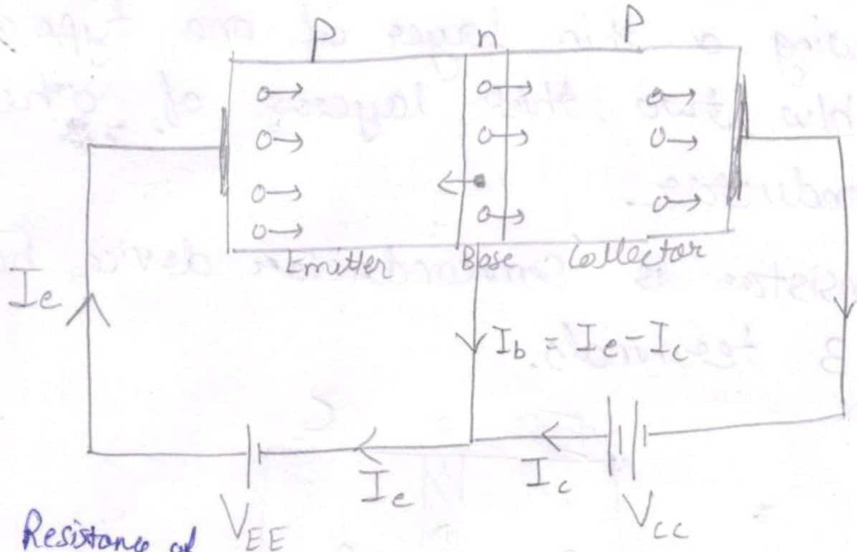
Emitter (E) – Left hand side thick layer, heavily doped

Base (B) – Central thin layer, lightly doped

Collector (C) – Right hand side thick layer, moderately doped.

→ Functions: Emitter emits majority carriers.
Collector collect majority carriers.
Base provide proper interaction b/w emitter & collector

Working.



- Emitter base Junc. is forward biased.
- Collector base Junc. is reverse biased.

- Resistance of Emitter base Junc. is very low. So voltage V_{EE} is quite small.
- Resistance of collector base Junc. is very hig. So voltage V_{CC} is quite large.
- majority carriers (holes) in emitter (p-type) are repelled by + V_{EE} resulting in I_e.
- ∵ base is lightly doped so only few holes get neutralised by e^--hole combination, resulting in I_b.
- Remaining holes pass over to collector because of negive V_{cc} resulting in I_c.

[Motion of e^- from book]

→ Current in p-n-p transistor is carried by holes & at same time their conc. is maintained. But in external circuit current is due to flow of e^-. Direction shown by arrow. motion of e^- opp. to arrow.

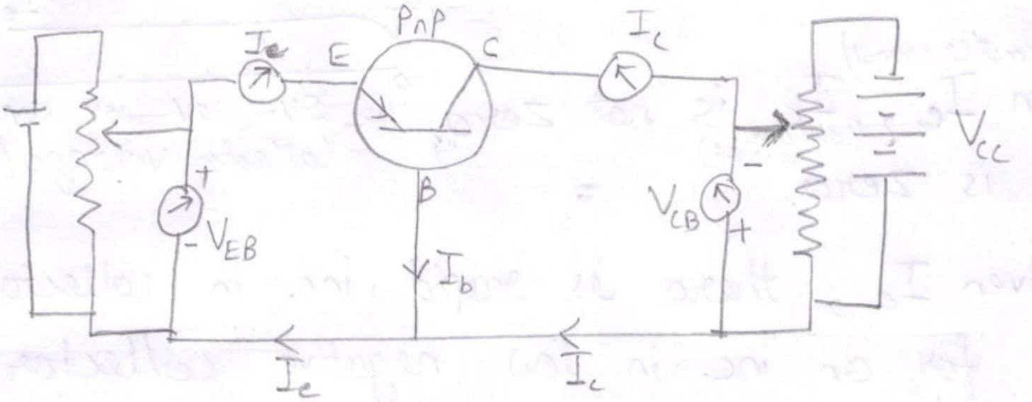
$$I_e = I_b + I_c$$

& I_e & I_c flow in opp. direction.

⇒ Modes of Study of Junction Transistors

a) Common base config.
b) common emitter ,, & c) common collector config.

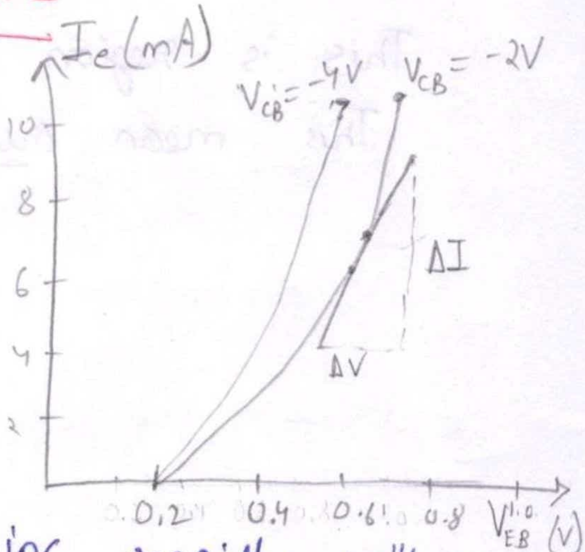
a). Common Base Transistor Characteristics



→ Emitter base circuit is forward biased with V_{EE}
Collector base " " Reversed biased with V_{cc}
current obey condition $I_e = I_b + I_c$

Input or Emitter characteristics

Apply suitable constant voltage on collector & by applying various value of emitter voltage note corresponding value emitter current. Plot graph. ⟶



i) For given collector voltage, I_e inc. rapidly with inc. value of emitter base voltage. i.e. input resistance is small.

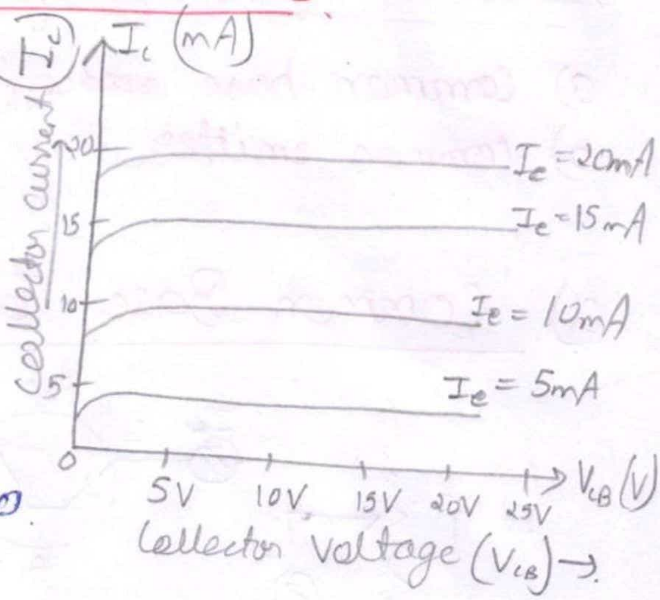
ii) For higher negative collector voltage, I_e rise more rapidly with collector voltage.

- Reciprocal to slope of line line AB will give input resistance (R_i) of transistor.

$$\therefore \quad R_i = \frac{\Delta V}{\Delta I} = \frac{AC}{BC}$$

Output or Collector characteristics.

Fix suitable constant value of emitter current & by applying various values of collector voltages note collector current. Graph →

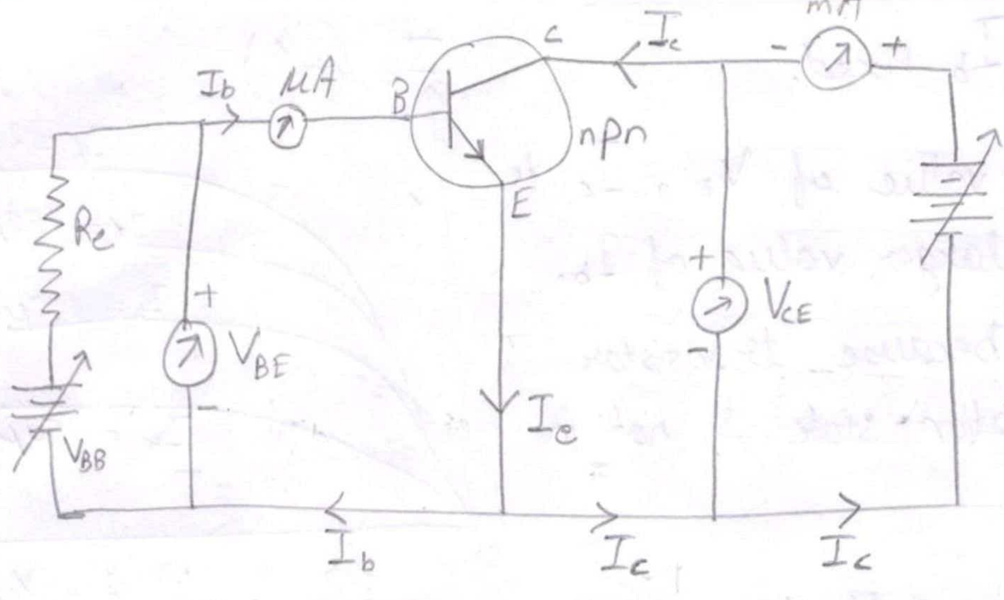


i) For given I_e (emitter current), I_c (collector current) is not zero when V_c is zero.

ii) For given I_e, there is rapid inc. in collector current for an inc. in low negative collector voltage. This is region of low collector resistance. Transistor is never operated in this region.

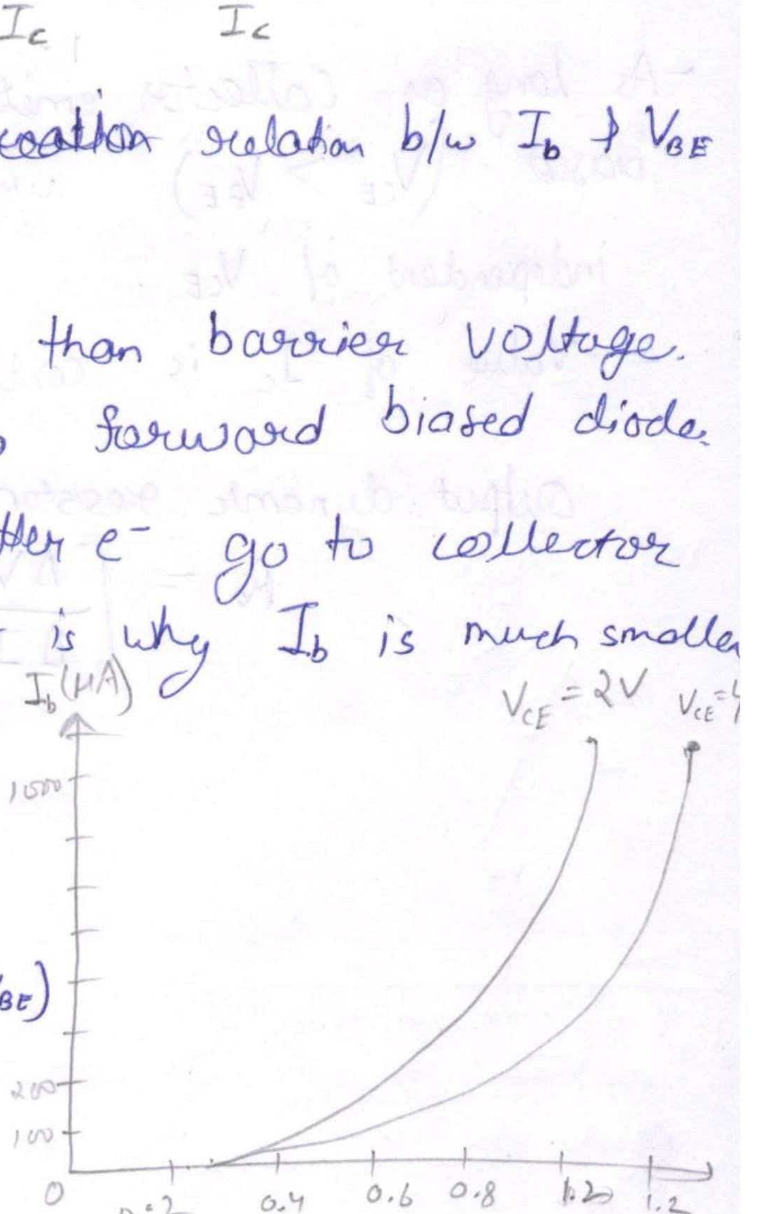
iii) for given I_e, I_c become saturated for a certain collector voltage shown by horizontal line. This is region of high collector resistance. This mean output resistance is very high.

b) Common Emitter Transistor characteristics



Input characteristics : ~~reation~~ relation b/w I_b & V_{BE} Keeping V_{CE} Fixed.

- When V_{BE} is greater than barrier voltage. curve look similar to forward biased diode. More then 95% of emitter e^- go to collector to form I_c. That is why I_b is much smaller



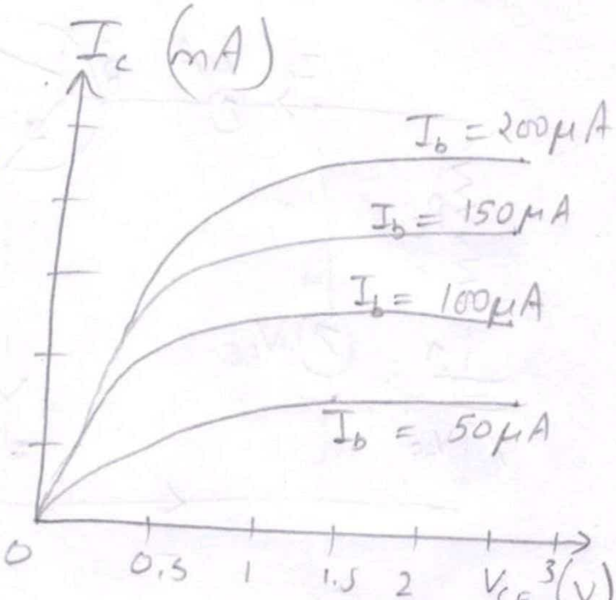
Input dynamic resistance of transistor (R_i) =

$$\frac{\text{change in base-emitter voltage } (\Delta V_{BE})}{\text{change in base current } (\Delta I_b)}$$

at constant V_{CE}

$$R_i = \left(\frac{\Delta V_{BE}}{\Delta I_b} \right)_{V_{CE} \text{ Constant}}$$

The output characteristics variation of I_c with V_{CE} keeping I_b fixed.



- For given value of V_{CE}, I_c is larger for larger value of I_b. This happen because transistor is in saturation state & not in active state.

- As long as collector emitter junction is reverse biased ($V_{CE} > V_{BE}$) we get I_c which is independent of V_{CE}.

- Value of I_c is controlled by I_b

Output dynamic resistance of transistor

$$R_o = \left[\frac{\Delta V_{CE}}{\Delta I_c}\right]_{I_b \text{ is constant.}}$$