

I] BJT as a Electronics Switch :

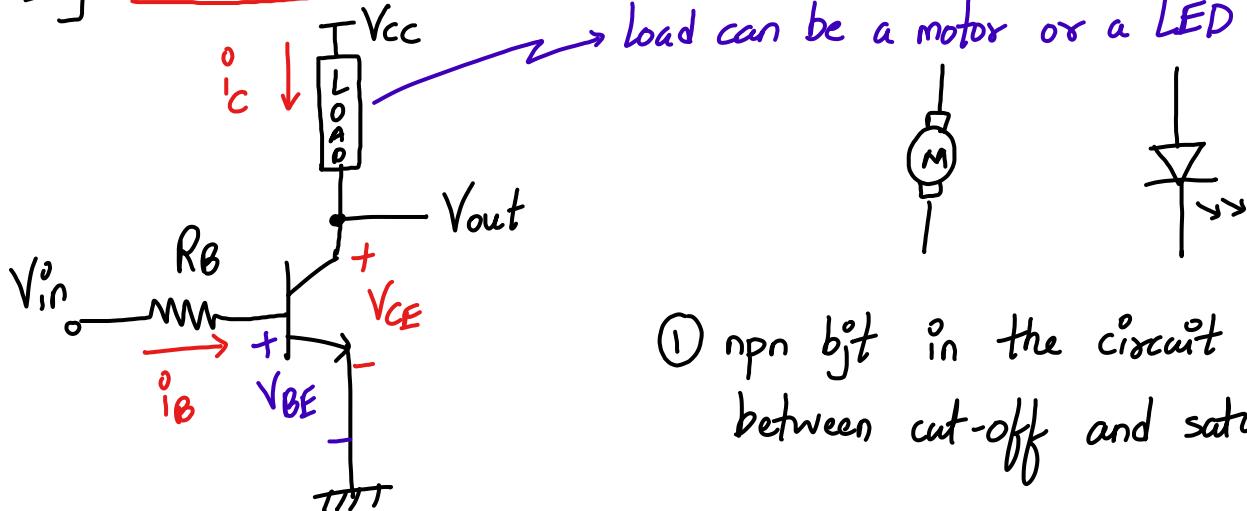


fig1: npn bjt used as a switch

① npn bjt in the circuit is switched between cut-off and saturation region

② bjt can be used to switch currents, voltages & power

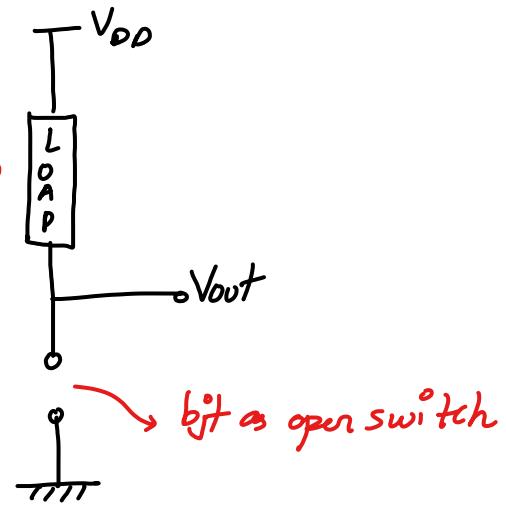
③ If $V_{in} < V_{BE(on)}$ $\rightarrow i_B = i_C = 0$

- a) npn bjt is in cut-off mode
- b) $V_{out} = V_{cc}$
- c) Power dissipation $P_D \approx 0$
- d) If load is a motor \rightarrow motor would be off with zero current

e) If load is a LED \rightarrow Light output will be zero with zero current

④ If $V_{in} = V_{cc}$ \rightarrow npn bjt is usually driven into saturation region

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

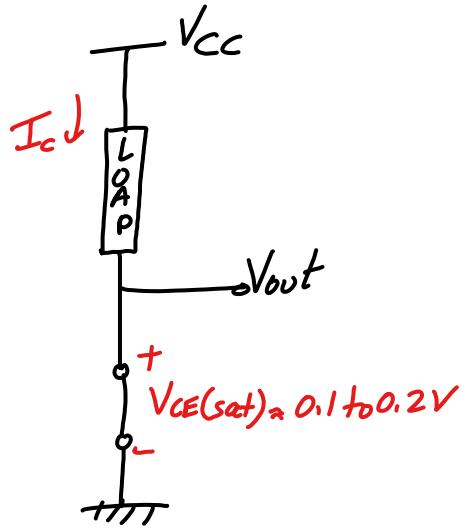


$$\text{From fig 1, } i_B = \frac{V_{in} - V_{BE(on)}}{R_B}$$

$$i_C = I_{C(sat)} = \frac{V_{CC} - V_{CE(sat)}}{R_C}$$

$$V_{out} = V_{CE(sat)}$$

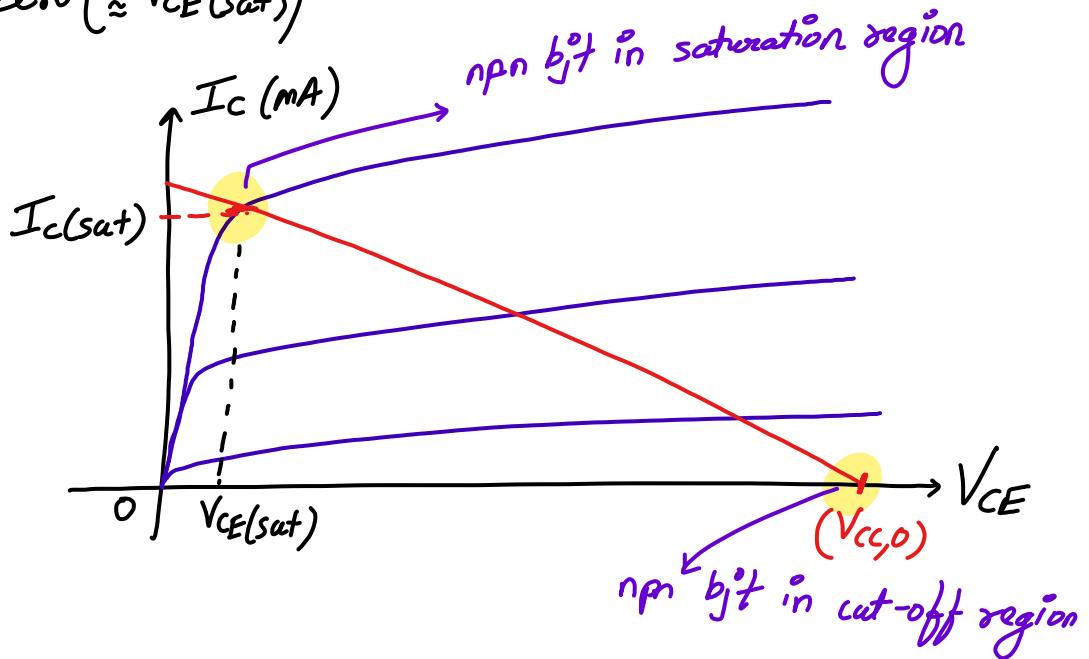
very low value
(0.1 to 0.2V)



⑤ I_c is induced that would turn 'ON' the motor or LED — depending upon the type of load

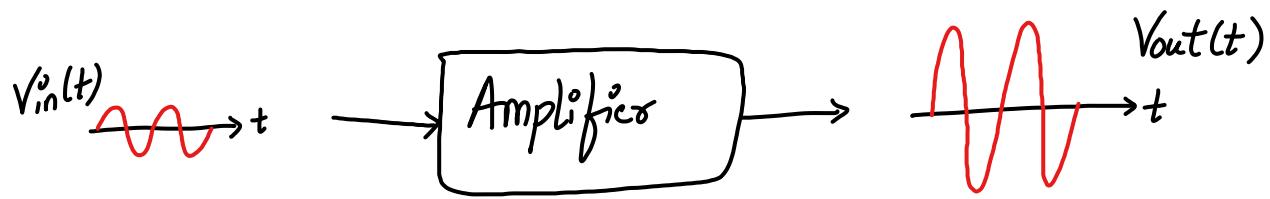
⑥ Assumption: $V_{BE(on)} \approx 0.7 \text{ V}$

⑦ Note: a) V_{CE} when npn bjt is in cut-off region is V_{CC}
b) V_{CE} when npn bjt is in saturation region is almost zero ($\approx V_{CE(sat)}$)



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* BJT as a amplifier :



$$\text{Voltage gain} = \frac{\text{O/p swing}}{\text{I/p swing}} = A_V$$

① For npn bjt to operate as an amplifier following conditions is to be met :

a) Create proper biasing condition for transistor

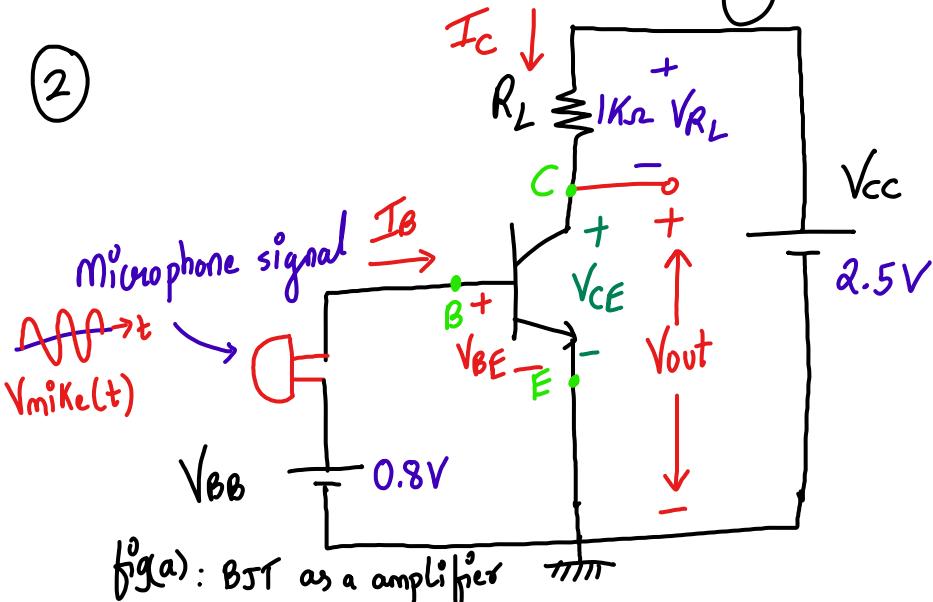
i.e npn bjt operating in active region

i.e B-E J^n : F.B

& B-C J^n : R.B

b) Apply small time-varying input signal

②



fig(a) : BJT as a amplifier

$$I_C = \beta I_B$$

say $\beta = 100 \rightarrow$ "Current gain"

$$I_B = 0.01 \text{ mA}$$

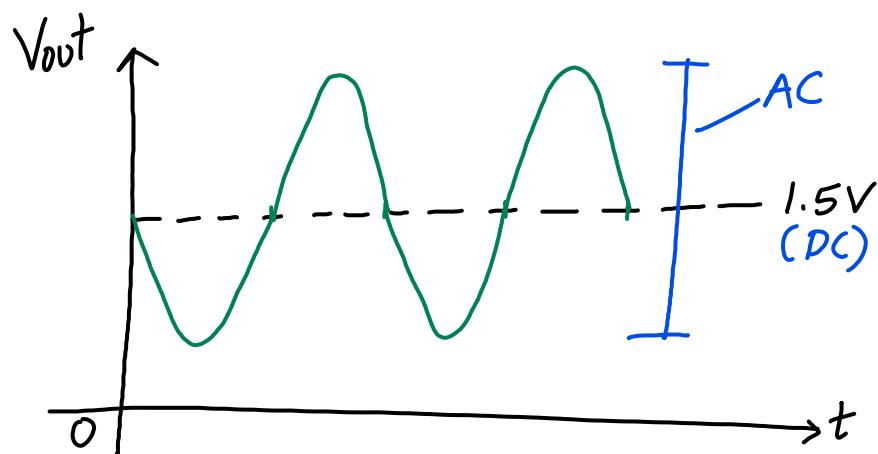
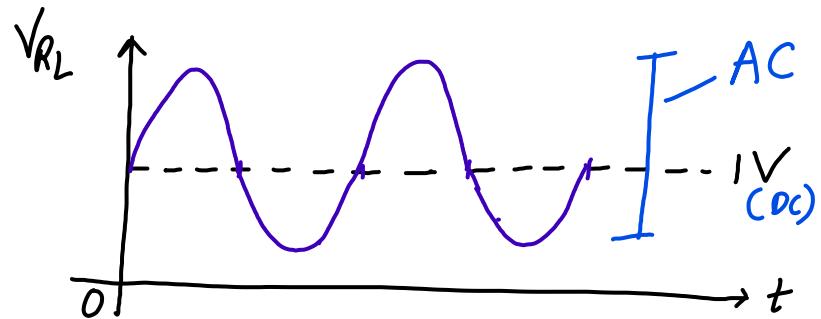
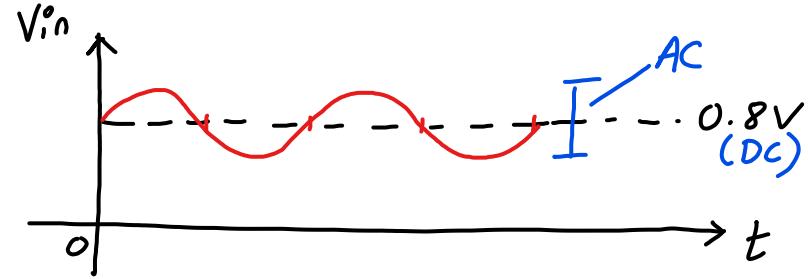
$$I_C = 0.01 \text{ mA} \times 100$$

$$I_C = 1 \text{ mA}$$

$$V_{RL} = R_L I_C = 1K \times 1 \text{ mA} = 1V$$

$$V_{CE} = V_{out} = V_{CC} - R_L I_C = 2.5V - 1V = 1.5V$$

$$V_{in} = V_{BB} + V_{mike}$$



③ By observing V_{out} waveforms, output is amplified version of input

④ In this way, npn bjt behaves as an amplifier

⑤ From fig(a), $V_{CC} = V_{RL} + V_{CE}$

$$\begin{aligned} V_{CE} &= V_{CC} - V_{RL} \\ &= 2.5 - 1 \end{aligned}$$

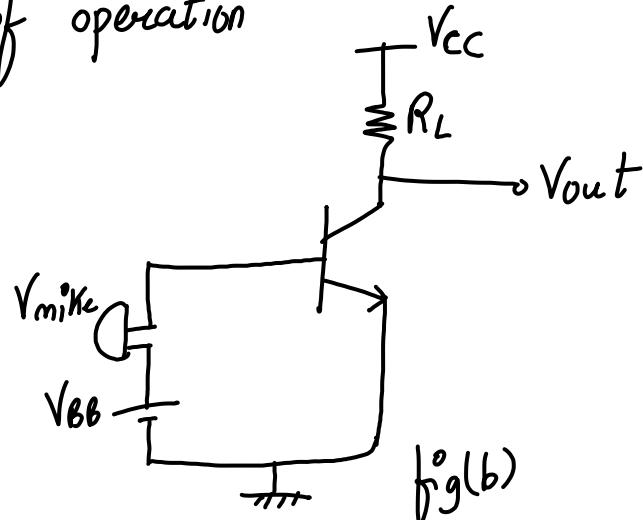
$$V_{CE} = 1.5V$$

⑥ Thus, $V_{BB} = 1V$ & $V_{CE} = 1.5V$

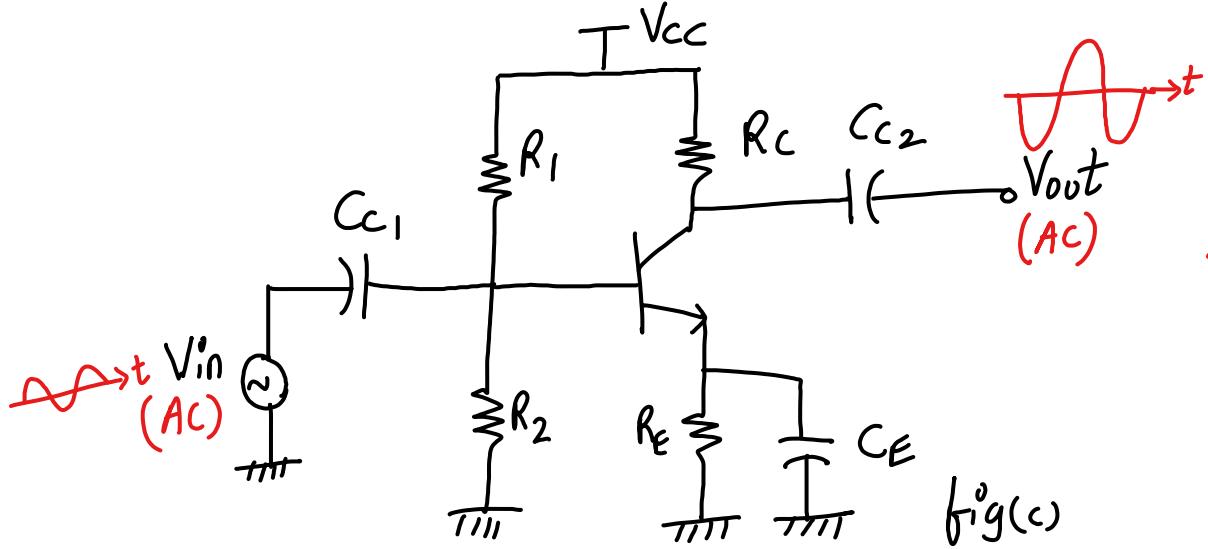
ensure that BE Jⁿ is F.B
and BC Jⁿ is R.B

i.e. npn bjt is in active region of operation

⑦ Simplified diagram for fig(a)



⑧ In reality, voltage divider biasing is used for BJT to work as an amplifier (fig c)



C_{C1} & C_{C2}
 They will block DC
 & allow AC signals
 to pass through

C_E : bypass capacitor
 ↓
 allow ac signal
 to flow through it
 & bypass R_E

R_1 & R_2 : Voltage divider bias arrangement

↓ provide voltage at base terminal from V_{CC}

$$\text{i.e } V_B = \frac{R_2}{R_1 + R_2} V_{CC}$$

→ V_B is fraction of V_{CC}

⑨ Voltage divider bias ($R_1 - R_2$) & V_{CC} will make sure that npn bjt operates in active region of operation.

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