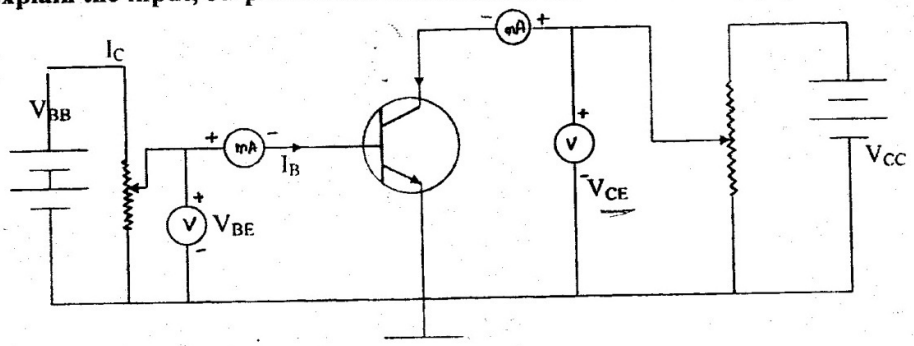
Q.15 Explain the input, output and current transfer characteristics of CE mode.

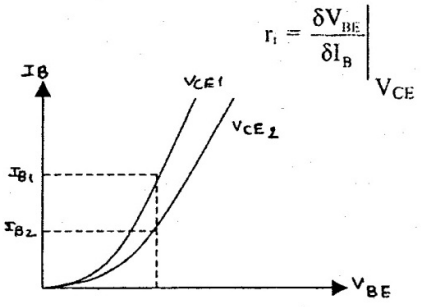
Ans.

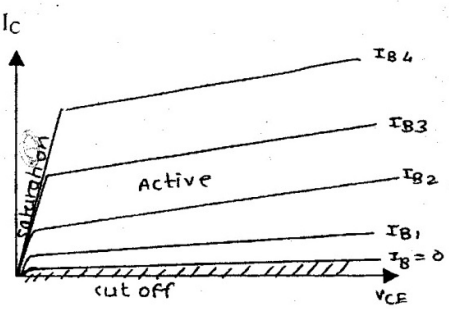


Input characteristics : It is a set of graphs of input current v/s input voltage for constant value of output voltage. In CE mode it is a graph of I_B v/s V_{BE} for constant value of V_{CE}. As we increase the V_{BE} by adjusting value rheostat R_{h1}, the increase in base current is negligible. However, as V_{BE} increases above the turn on voltage of base-emitter junction diode, the base current increases.

If we keep V_{BE} constant and increase V_{CE} then the I_B decreases. This is because as we increase V_{CE}, the collector-base junction is more reverse biased due to which **depletion region widens more in the base region than in the collector region** (This is because of the fact that base is lightly doped as compared to collector region). This reduces the effective width of the base region. Hence, the recombination in the base region reduces. This reduces the base current. **This effect is called Early effect.**

The ratio of change in V_{BE} to that of I_B is called input resistance of transistor.





Output characteristics : The output characteristics is set of graph of output current v/s output voltage for constant value of input current. In CE mode output characteristics is graph of I_C v/s V_{CE} for constant value of I_B. This graph is divided into three regions as follows :

(a) **Active region :** **In this region collector-base junction is reverse biased and emitter-base junction is forward biased.** Therefore, I_C is almost independent of V_{CE} (slight dependence of I_C on V_{CE} is due to early effect). However, I_C increases with the increase in I_B and **this results in the amplification action of transistor**. In this region a small change in I_B causes large change in I_C.

(b) **Saturation region :** In this region, **both the junctions i.e. base-collector and base-emitter are forward biased**. The collector current in this region is maximum and does not change with the change in base current.

(c) **Cutoff region :** In this region, **both the junctions i.e. base-collector and base-emitter are reverse biased.** The collector current in this region is minimum (almost zero) and does not change with the change in base current.

To use transistor as an amplifier, it is used in active region and to use it as a switch in computers it is operated in the saturation and cutoff regions.

	CE	CC	CB
Voltage gain, A_v	High R_C/r'_e	Low $\cong 1$	High R_C/r'_e
Current gain, $A_{i(max)}$	High β_{ac}	High β_{ac}	Low $\cong 1$
Power gain, A_p	Very high $A_i A_v$	High $\cong A_i$	High $\cong A_v$
Input resistance, $R_{in(max)}$	Low $\beta_{ac} r'_e$	High $\beta_{ac} R_E$	Very low r'_e
Output resistance, R_{out}	High R_C	Very low $(R_s/\beta_{ac}) \parallel R_E$	High R_C