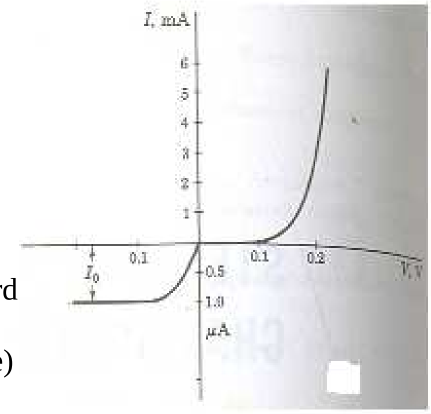
When the device is driven from one extreme condition to other extreme condition , then it is used as a switch.
Popularly diodes and transistors are used as switches.

Diode as a switch : diode is used as a switch if it is driven from forward bias condition(low resistance path) to reverse bias condition (high resistance path)

in forward bias Diode is used as a closed switch and in reverse bias it is used as a open switch.

Piece wise linear diode characteristics:



Actual V-I characteristics of a diode is shown in figure,

From V-I characteristics of a diode,

We know under reverse bias condition , current flowing

Through diode is small (reverse saturation current)and in forward

Bias condition (if applied voltage is more than the cut in voltage)

Current flowing through diode increases exponentially with applied

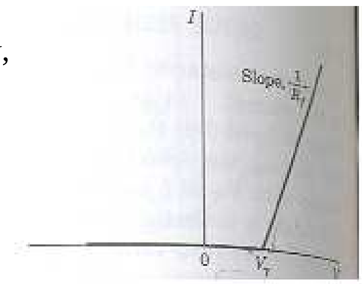
Voltage.

To get piece wise linear V-I characteristics of a diode we need
To use two approximations. Those are

(i) in reverse bias current through the diode is zero

(ii) in forward Bias condition (if applied voltage is more than the cut in voltage) Current flowing through diode increases linearly with applied Voltage.

Piece wise linear V-I characteristics of a diode is shown below,



Based on this we can say that diode is a piece wise
Linear device.

Transistor as a switch: transistor is used as a switch if it is driven from cutoff region to saturation region.
If transistor is in cutoff region ,it is used as open switch

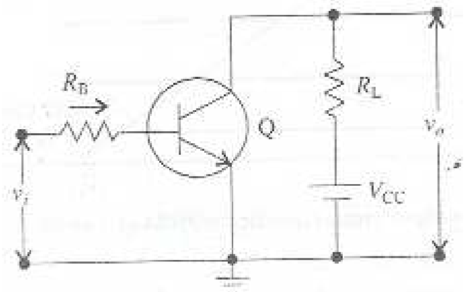
If transistor is in saturation region , it is used as closed switch.

If a transistor is driven from cutoff region to active region then also it is used as a switch.

Later on we will discuss about this.

Preferably transistor is used as a switch in CE configuration because small value of input current is sufficient to produce large value of output current. Where as in CB configuration, large value of input current is required to produce large output and similarly in CC configuration , large value of input voltage is required to produce more output voltage.

Transistor switching times: circuit diagram for transistor as a switch is shown in figure Assume that V2 & V1 is sufficient to keep the transistor in cutoff and saturation regions.



Here initially $V_i = V_2$,
So transistor is in cutoff region (OFF state)
Then collector current is zero. And output voltage is V_{CC} .

As shown in the waveform , input voltage

Suddenly changes from V_2 to V_1but voltage across

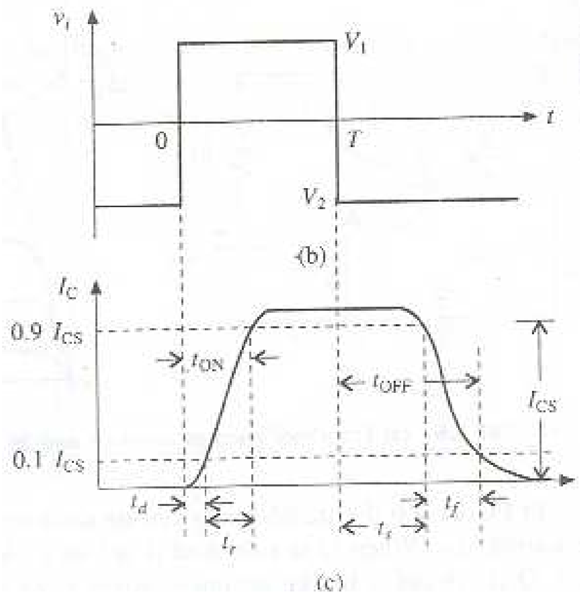
The emitter junction can not changes instantaneously

Due to the junction capacitance. So transistor takes some

Finite Amount of time to move from cutoff to satuation.

Similarly transistor takes some finite amount of time

To move from saturation to cutoff when input changes from V_1 to V_2. if transistor is in ON state output voltage is $V_{CE(sat)}$



Turn on time(T_{ON}): time taken by the transistor to move from cutoff to saturation region.

Turn on time is the sum of delay time and rise time

Delay time(t_d):time taken by the collector current waveform To rise from 0% to 10% of its final value.

rise time(t_r):time taken by the collector current waveform to rise from 10% to 90% of its final value.

Turn off time(T_{OFF}): time taken by the transistor to move from saturation region to cutoff . Turn off time is the sum of storage time and fall time

storage time(t_s):time taken by the collector current waveform to fall from 100% to 90% of its final value.

fall time(t_f): time taken by the collector current waveform to fall from 90% to 10% of its final value.