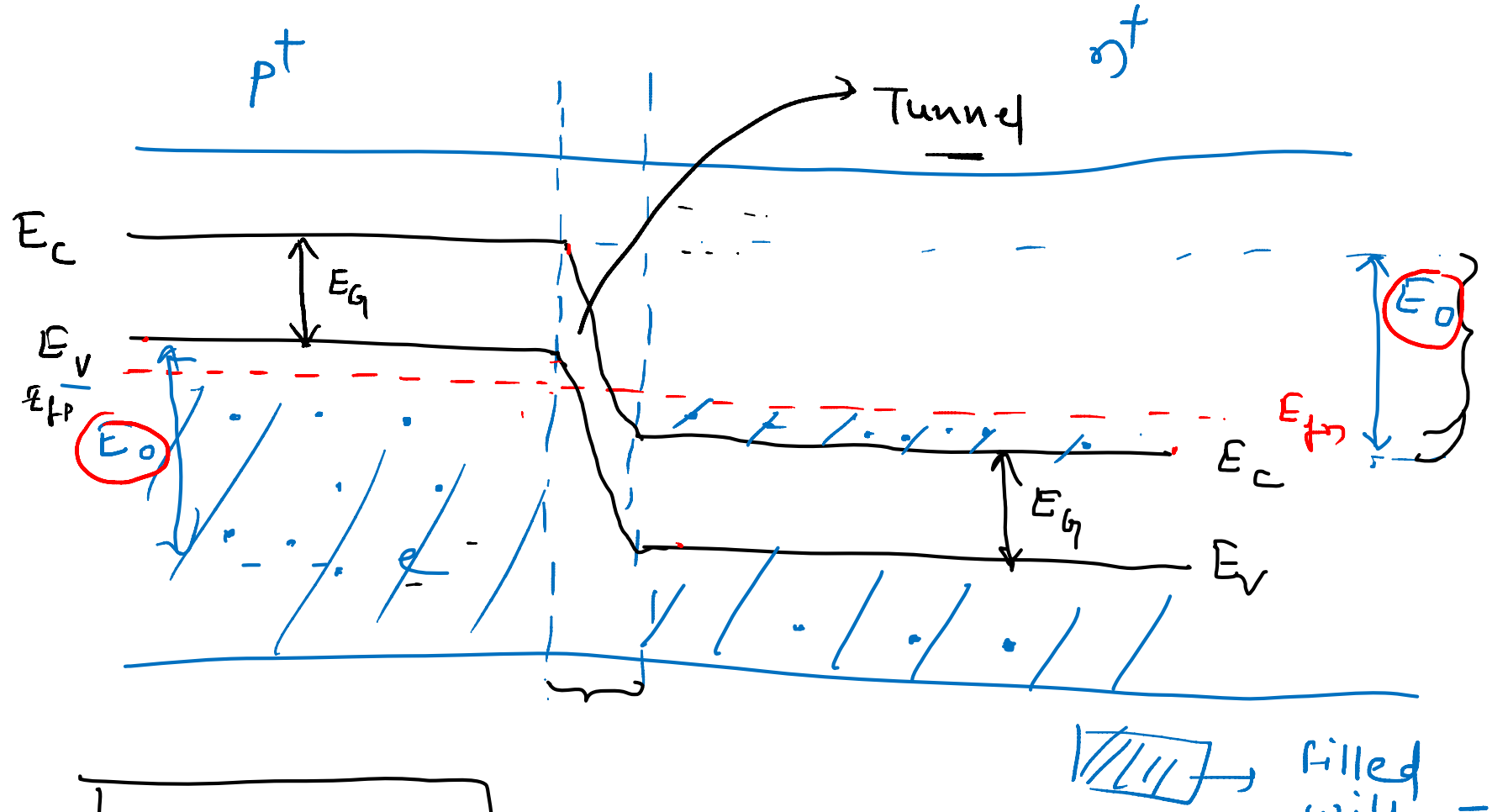
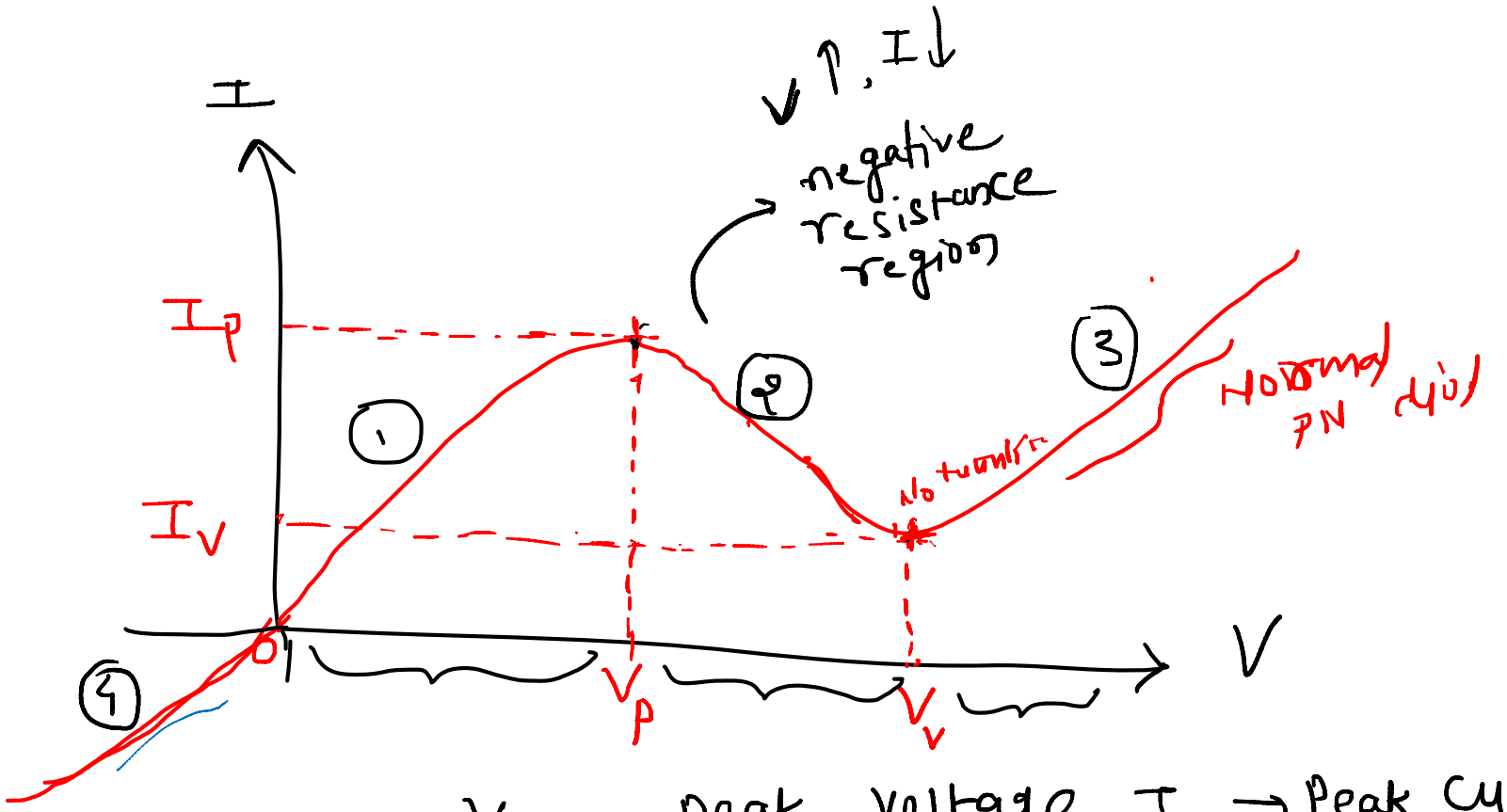
Tunnel diode



Filled with e^-

✓ $E_0 > E_G$ → due to heavy doping

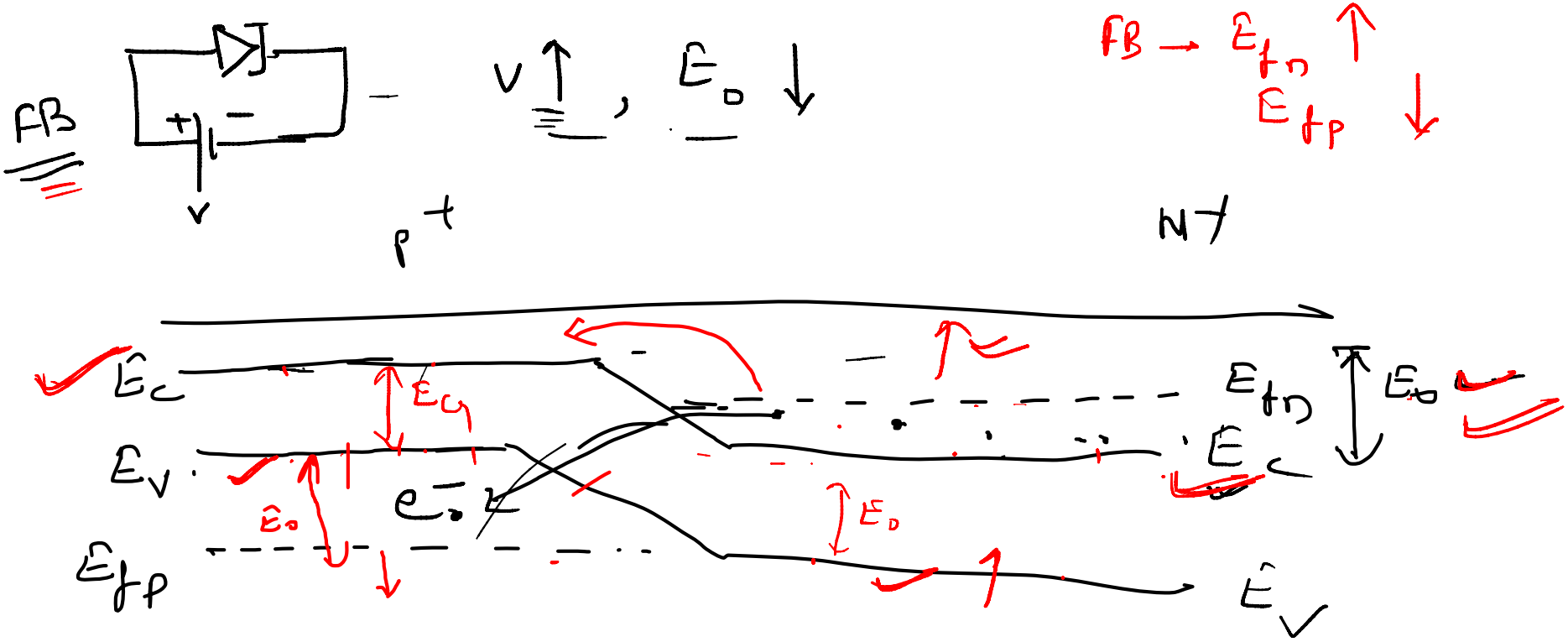
I-V Characteristic :-



V_p – peak voltage, I_p → peak current

V_v – valley voltage, I_v → valley current

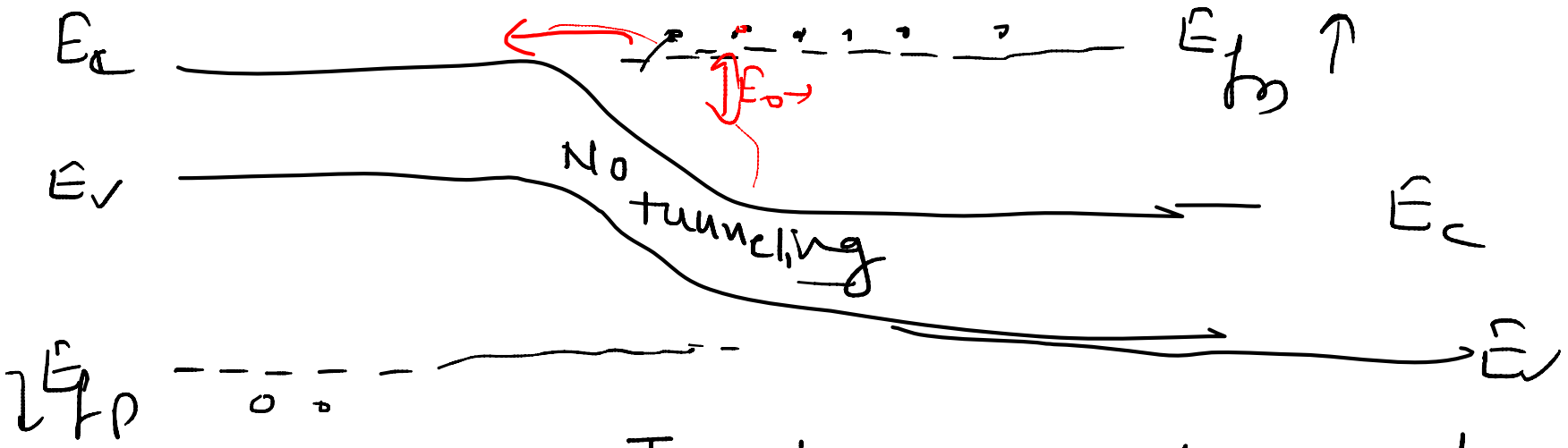
at V_v → tunneling current = 0



electrons jump easily from CB of N side to unfilled states in the VB of P side. This is called "Tunneling", creates Tunneling current.

V ↑↑ , E_o ↓↓

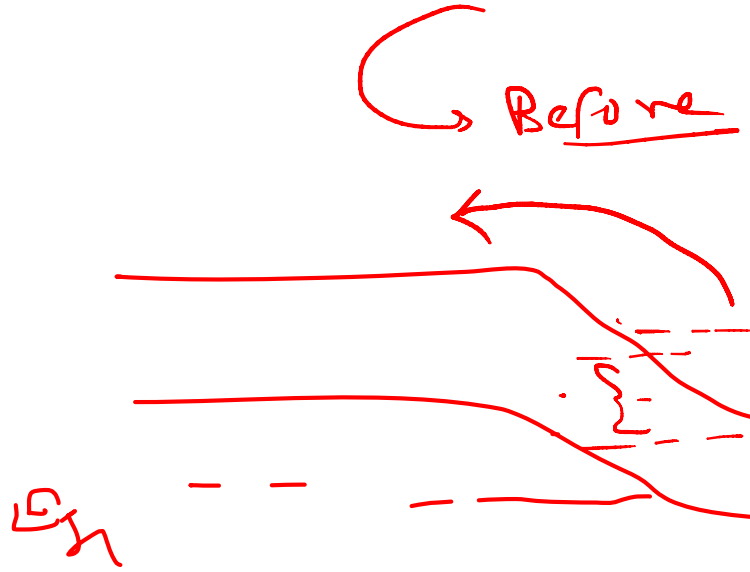
FB — $V \uparrow\uparrow\uparrow$, $E_0 \downarrow\downarrow\downarrow$



Tunneling current ⟶ decreasing

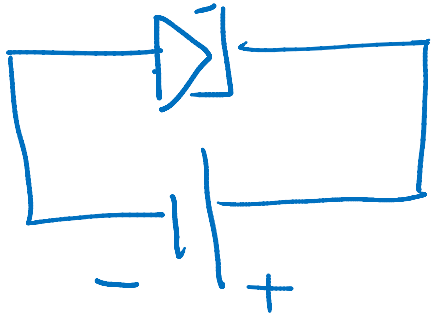
at $V_r \to 0$

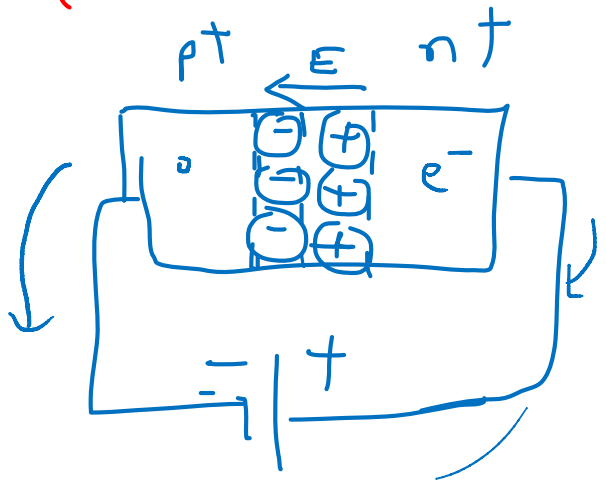
but $V_r \to E_0$ ⇓ → carriers will easily cross the junction & reaches to other side.



(Normal PN diode)

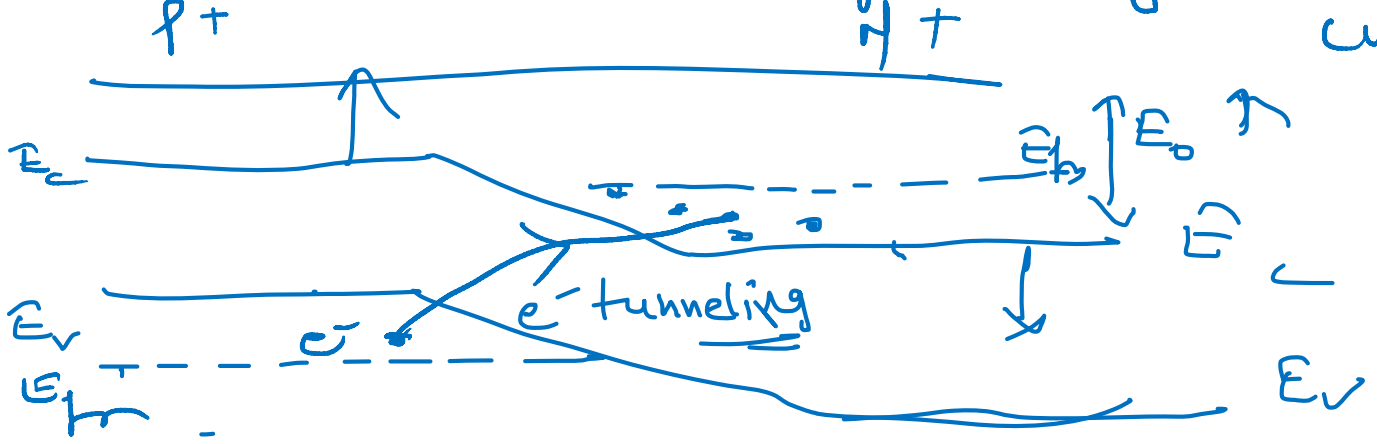
Reverse biasing of Tunnel diode:-





Both the electric fields are in same direction so they will added and overall E ↑, Potential barrier ↑

But due to heavily doping → tunneling current will be more



Applications of Tunnel diode :-

(1) Very high speed switch

→ Because e^- tunneling takes place with a speed of light 3×10^8 m/s.

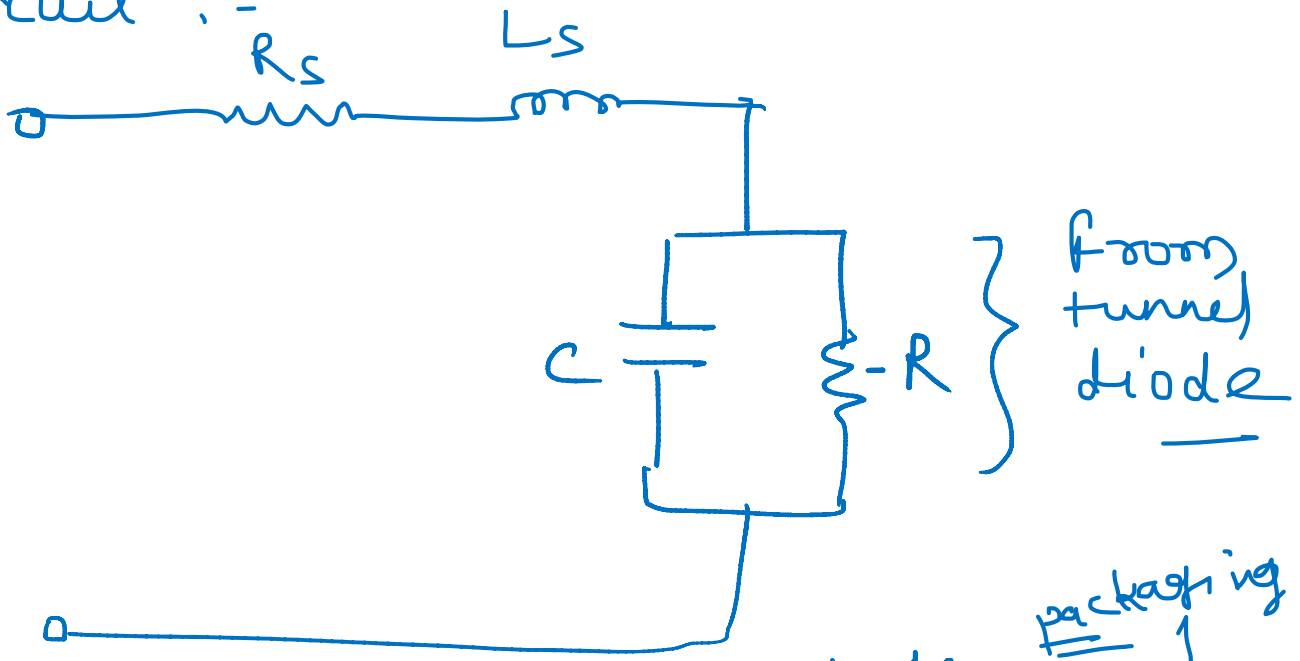
(2) High frequency oscillator.

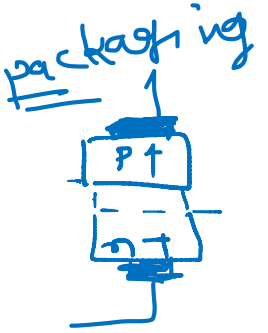
↳ Negative resistance region of tunnel diode is used.

↳ Tunel diode becomes unstable

↳ voltage across diode will oscillate.

Equivalent circuit :-





R_s – series resistance } Arise from contacts & packaging

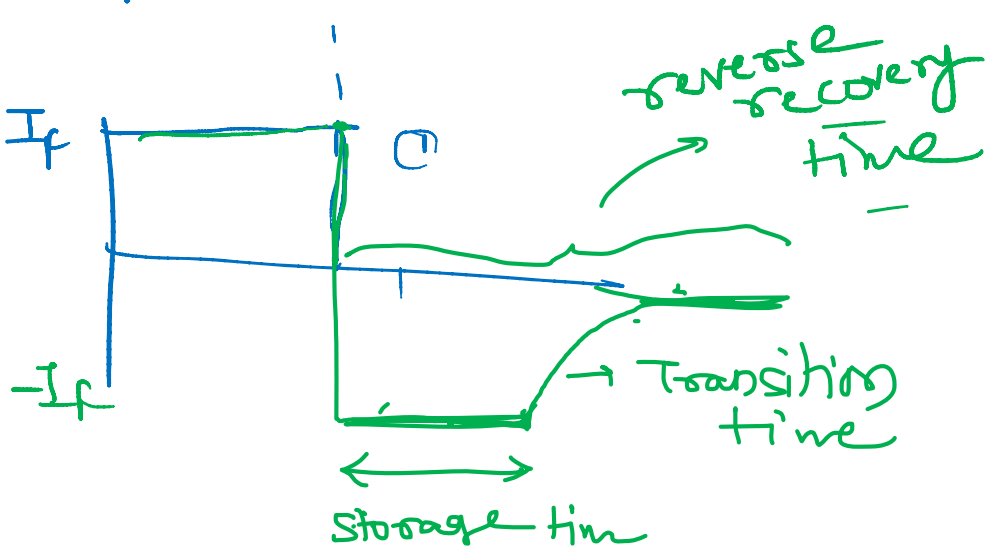
L_s – series inductance

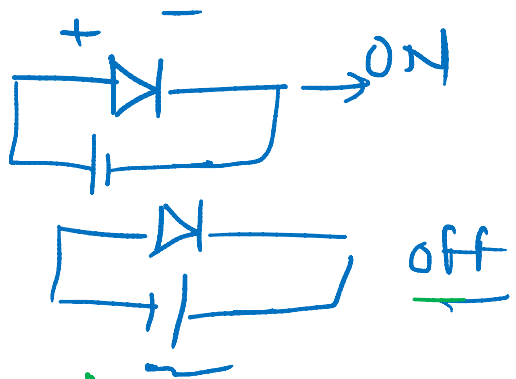
C – Junction capacitance } from tunnel diode

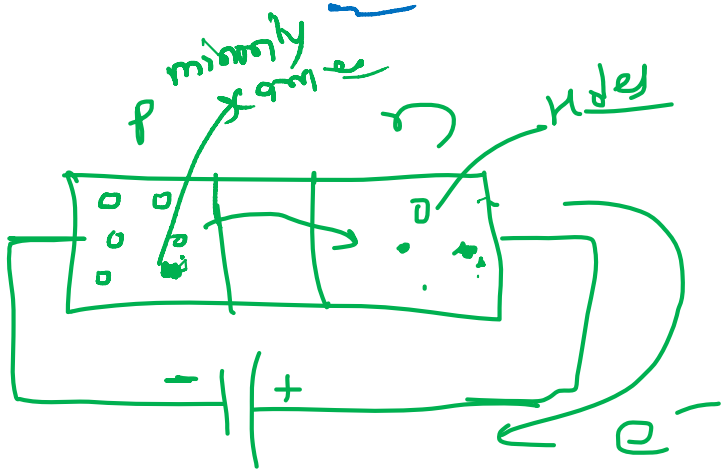
$-R$ – Negative resistance

Reverse recovery time of diode

When external voltage is applied and diode is working in forward biasing mode, depletion region width is negligible (or very small)







Schottky diode

→ Used for high speed switching applications

↳ Because of less reverse recovery time.

↳ Because it has very narrow depletion region.

↳ Less potential barrier