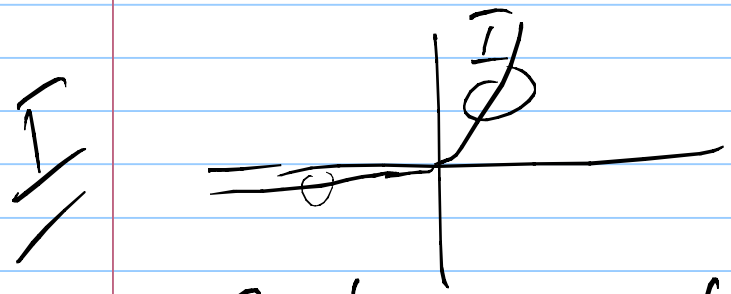
Application of p-n junction Diode

10/10/2014



Rectifier Switch.

Switch → faster.

Limiting factor

↓

minority carriers.

long diode → minority charge will be more

↓

more recovery time

↓

slow switching

for fast switching

↓

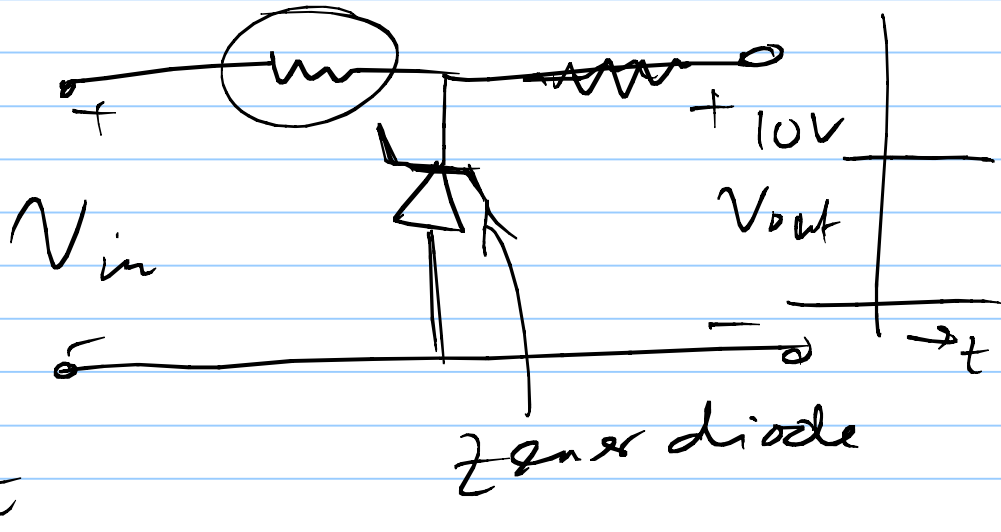
short diode.

Metal – semiconductor diode.

↓

very fast ⟶ useful for faster switching

II Breakdown Diode. → for voltage regulation

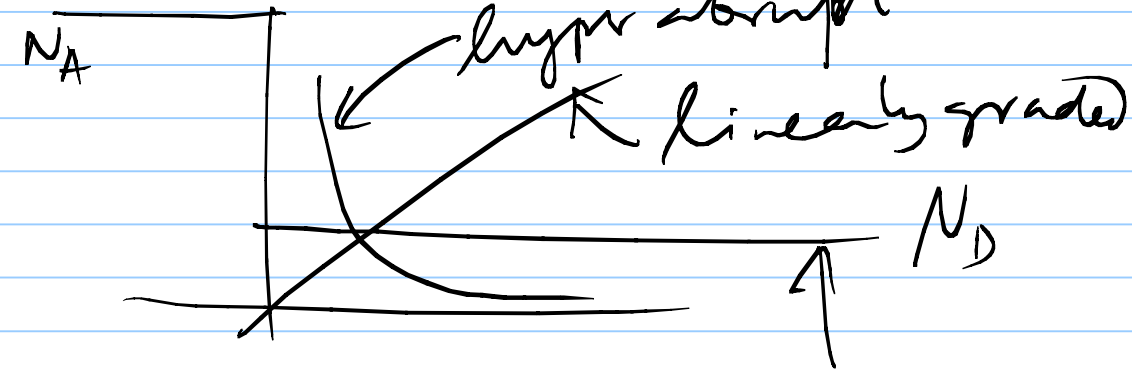


III Varactor : Variable reactor

$$C_j = \frac{C_{j0}}{\sqrt{1 + V_r/V_0}}$$

$V_r \gg V_0$ $\quad C_j \propto V_r^{-1/2}$

for abrupt jn.



$p = N_A$ in p-side

pfn jn.

$n = N_D$ in n-side

$= G x^m$ if $m = 0 \Rightarrow$ abrupt
$m = 1 \Rightarrow$ linearly graded

For hyper abrupt jn. $m = -3/2$

$C_j \propto V_r^{-n}$ $\quad n = \frac{1}{m+2}$

$C_j \propto V_r^{-1/2}$ if $m = 0$ abrupt

$n = \frac{1}{2}$

$C_j \propto V_r^{-1/3}$ if $m = 1 \rightarrow$ linearly graded

$n = \frac{1}{3}$

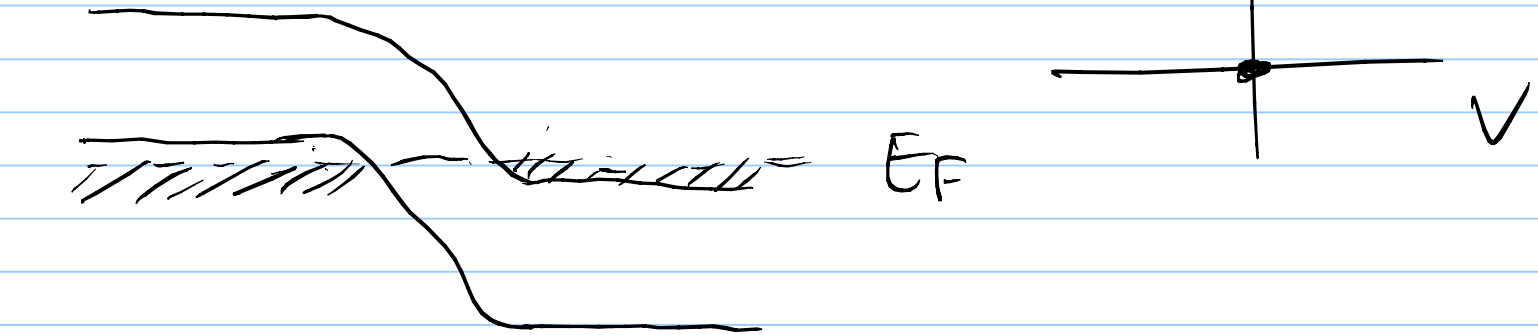
$n = \frac{1}{-3/2+2} = 2$ if $m = -3/2 \rightarrow$ hyper abrupt

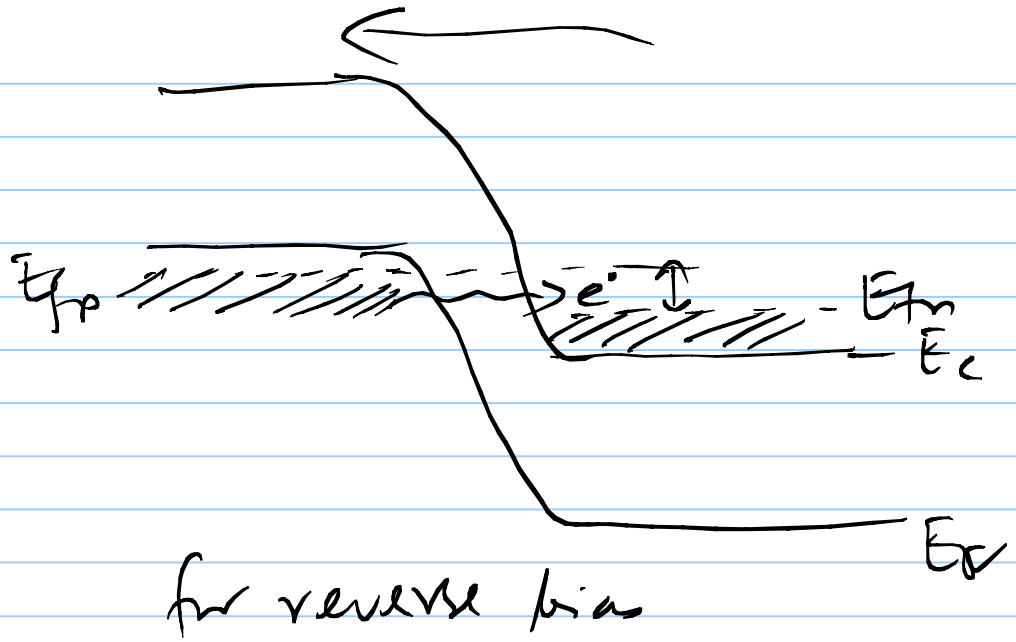
$$C_j = V_r^{-2}$$

$$\omega_r = \frac{1}{\sqrt{LC}} \propto \frac{1}{\sqrt{V_r^{-n}}} \propto V_r$$

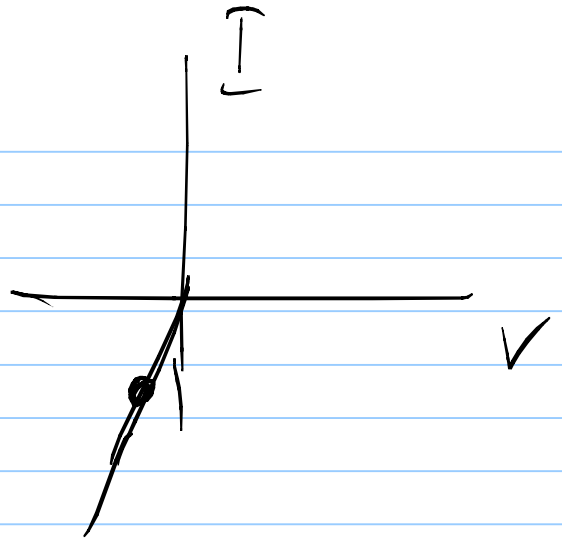
IV

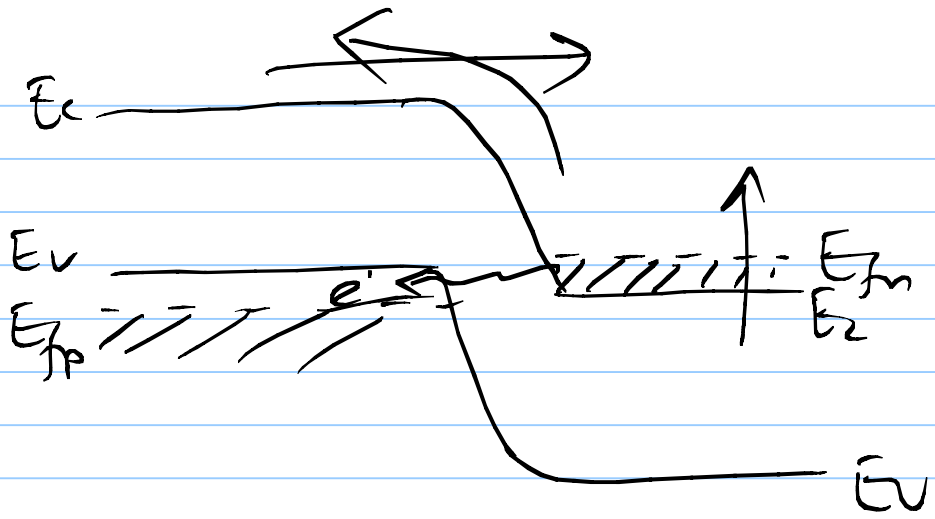
Tunnel Diode

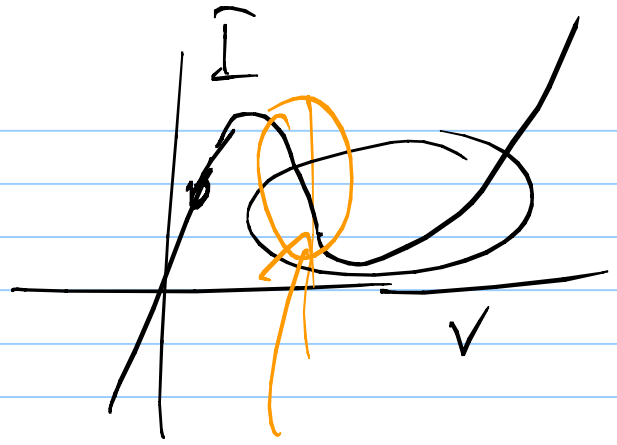




for reverse bias





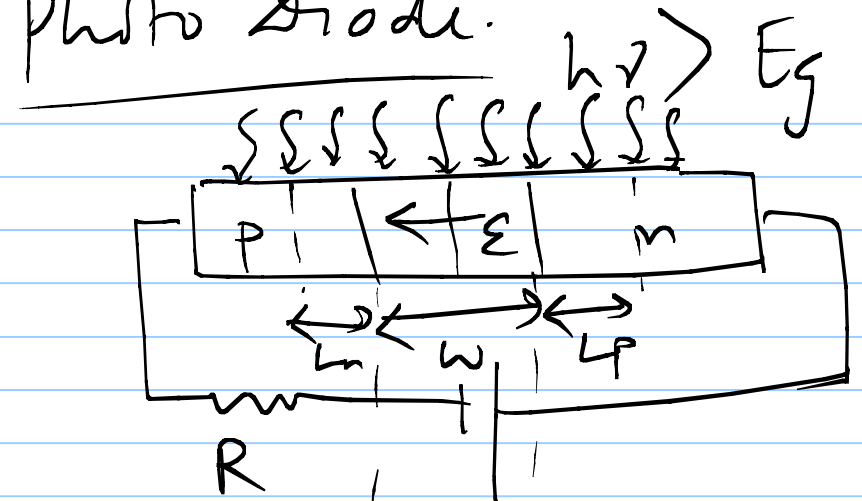


negative resistance.

negative resistance is very useful for oscillator, amplifier ---

V

Photo Diode.



g_{op} EHP/cm³-sec.

$$\delta p_{op} = g_{op} \tau_p$$

$$I_{op}^{p_n} = \frac{qA L_p \delta p_{op}}{\tau_p}$$

$$= qA L_p g_{op}$$

$$I_{op} = qA L_n g_{op} + qA W g_{op} + qA L_p g_{op}$$

$$I = I_0\left(e^{V/V_T} - 1\right) - I_{op}$$

$$\approx -I_0 - I_{op}$$