$p \cdot n = n_i^2$

N_D

$\#Si \sim 10^{22}$

EE 320

Lecture 9

Engineering Electronics I

Feb. 11, 2015

p, N_A

Valence electrons - 4

Valence in a donor atom - 5

Valence in " " Acceptor atoms - 3

$p \simeq N_A$

holes / cm^3

# of electrons / cm^3 #

$N \simeq N_D$

N_D - Atoms / cm^3

N_A - #atoms / cm^3

$p = \frac{n_i^2}{N_D}$

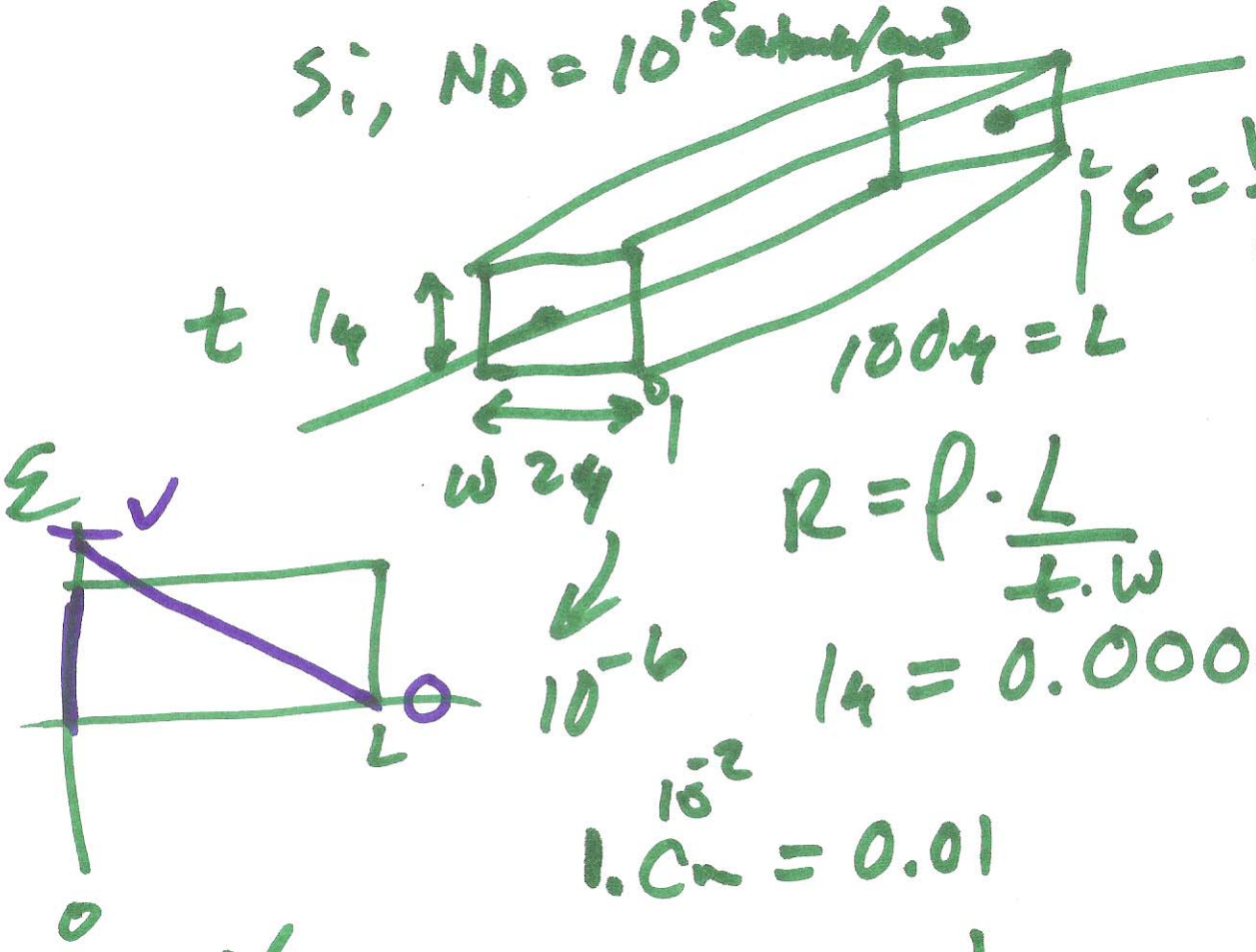
$N \simeq N_D$

$p =$

10^{16} atoms / cm^3

UNLV | ELECTRICAL & COMPUTER ENGINEERING

1)



$J \cdot 2_4 \cdot t \cdot l_4 = I$

$N \approx 10^{15} \frac{\text{electrons}}{cm^3}$

$R = \rho \cdot \frac{L}{t \cdot W}$

$\rho \approx \frac{N_i^2}{10^{15}} \approx 10^7$

10^{-6}

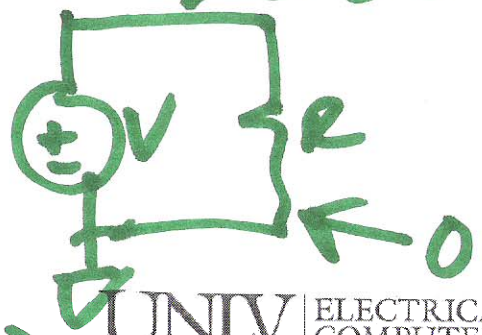
$l_4 = 0.000001\,cm = 0.000001$

$10^{-6} = l_4$

$1.\,cm = 0.01$

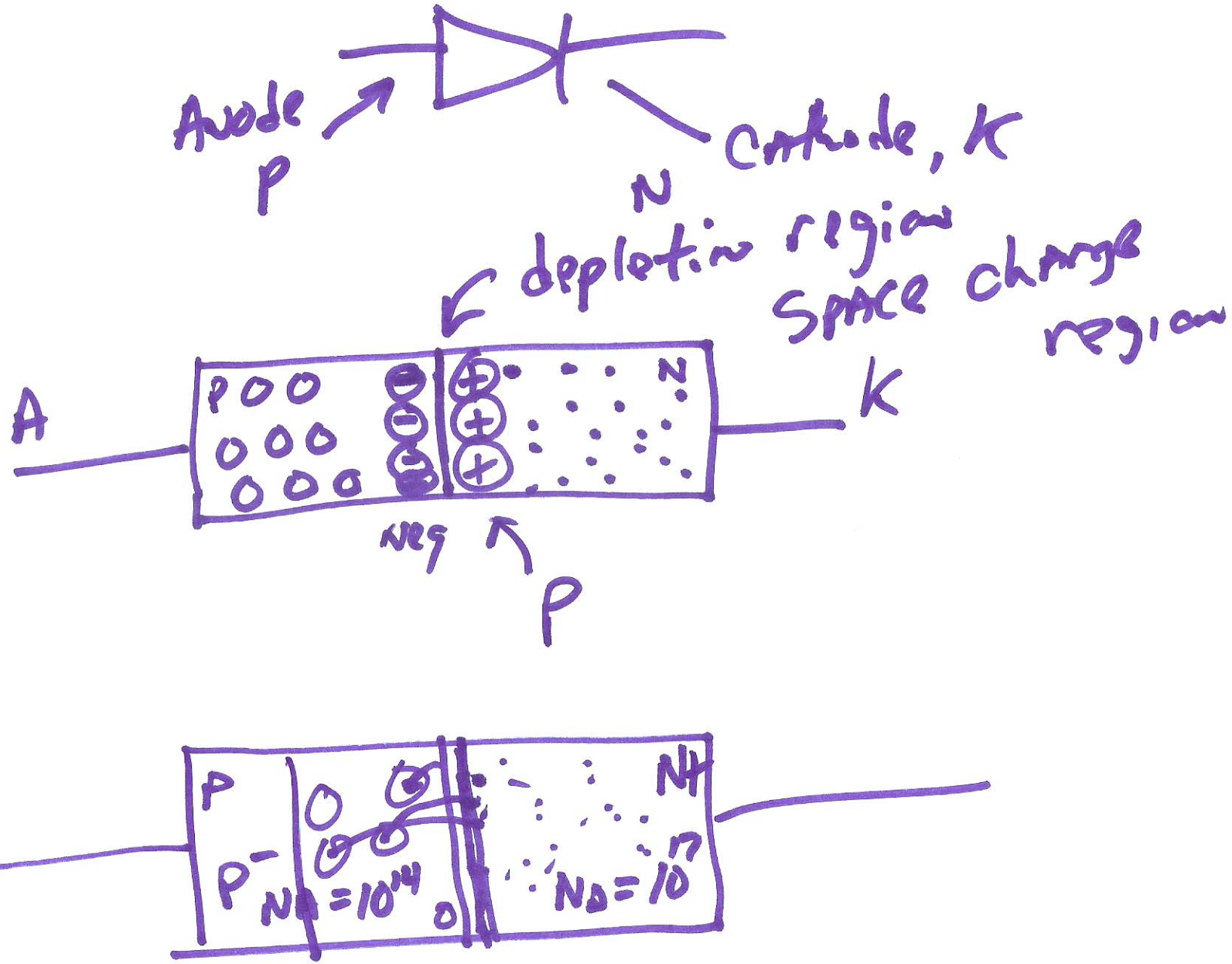
10^{-2}

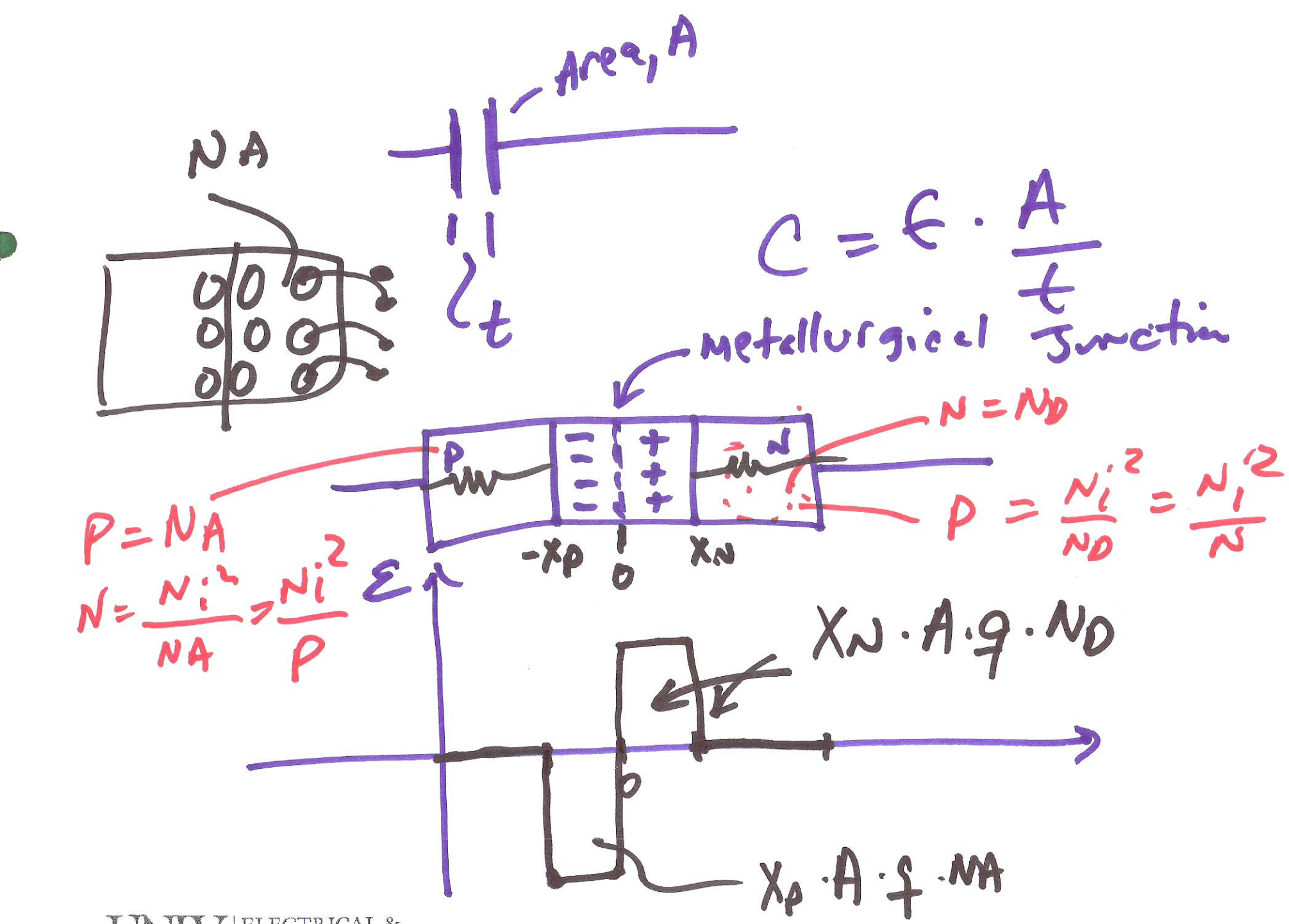
$\Omega \cdot cm = \rho = \frac{1}{(\mu_n \cdot N + \mu_p \cdot p)q} \approx \frac{1}{\mu_N \cdot N \cdot q}$

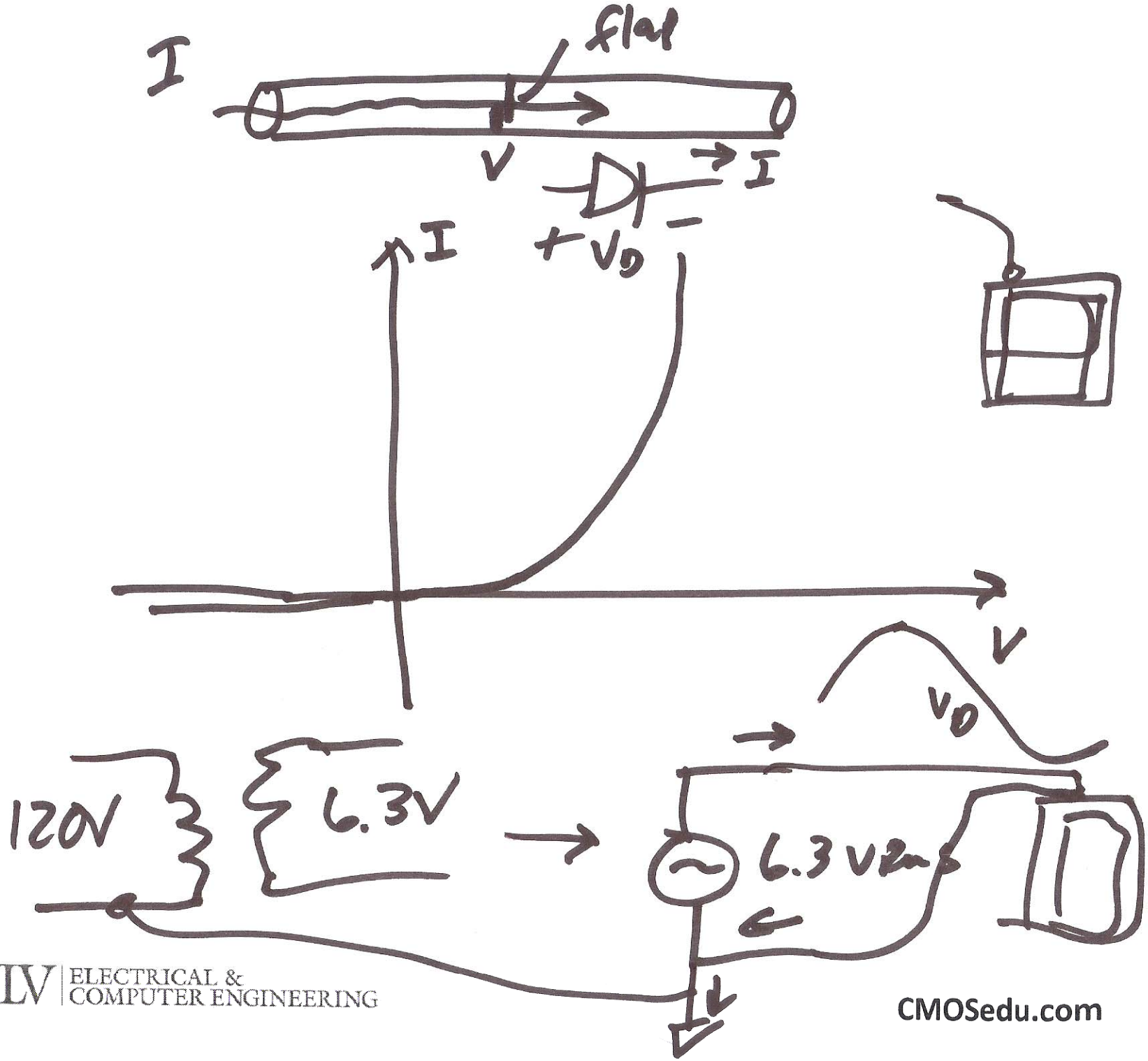


$\rho = \frac{1}{600 \frac{cm^2}{V \cdot s} \cdot 10^{15} \frac{\text{electrons}}{cm^3} \cdot 1.6 \times 10^{-19}}$

2)


Anode
P
N
Cathode, K
depletion region
Space charge region
A
P
N
K
neg
P
P
P⁻
N
$N_A = 10^{14}$
$N_D = 10^{17}$

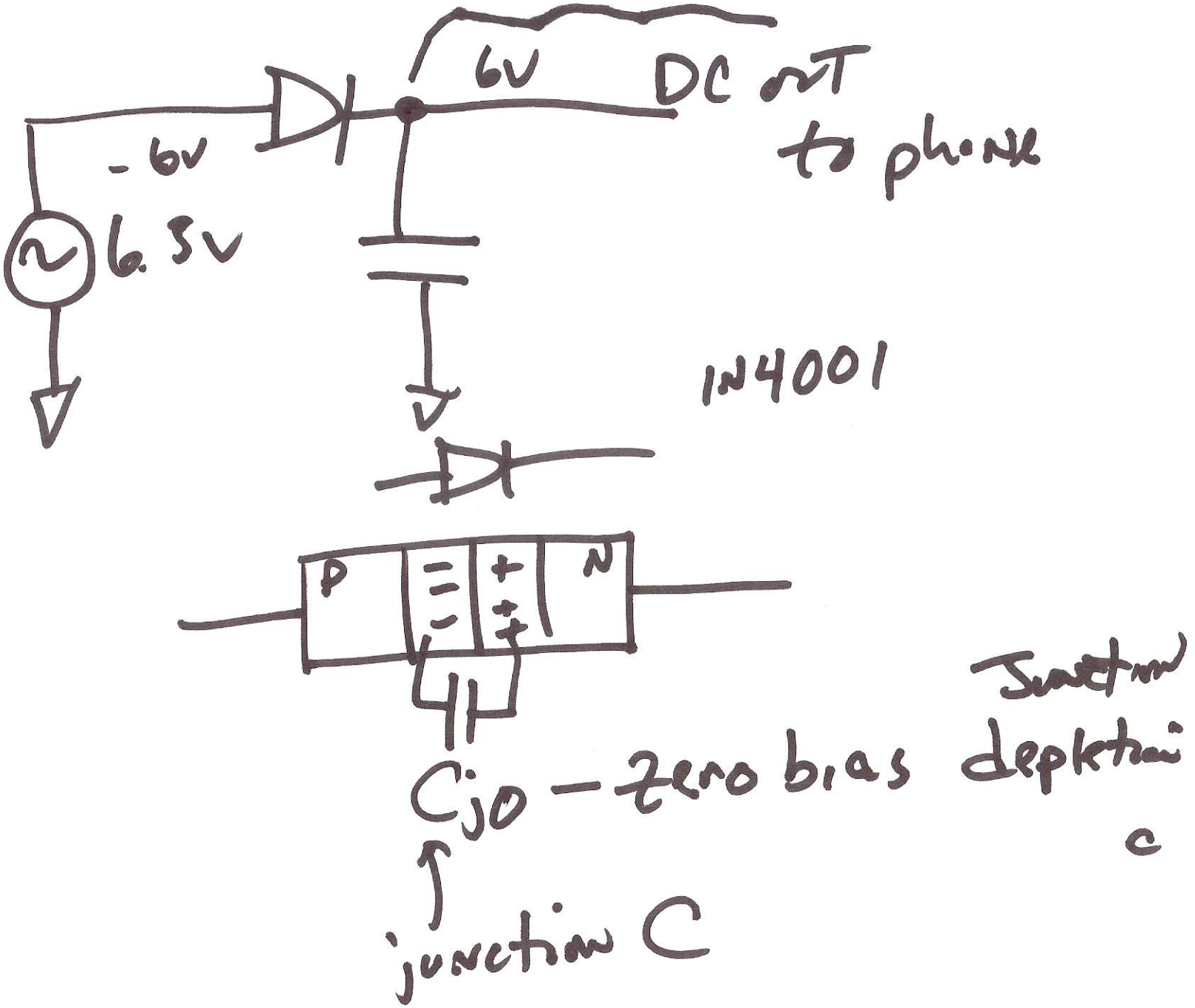

Area, A
NA
t
$C = \epsilon \cdot \frac{A}{t}$
metallurgical Junction
P
N
$N = N_D$
$P = N_A$
$P = \frac{N_i^2}{N_D} = \frac{N_i^2}{N}$
$N = \frac{N_i^2}{N_A} \Rightarrow \frac{N_i^2}{P}$
$-X_P$
0
X_N
$\mathcal{E}$
$X_N \cdot A \cdot q \cdot N_D$
$X_P \cdot A \cdot q \cdot N_A$

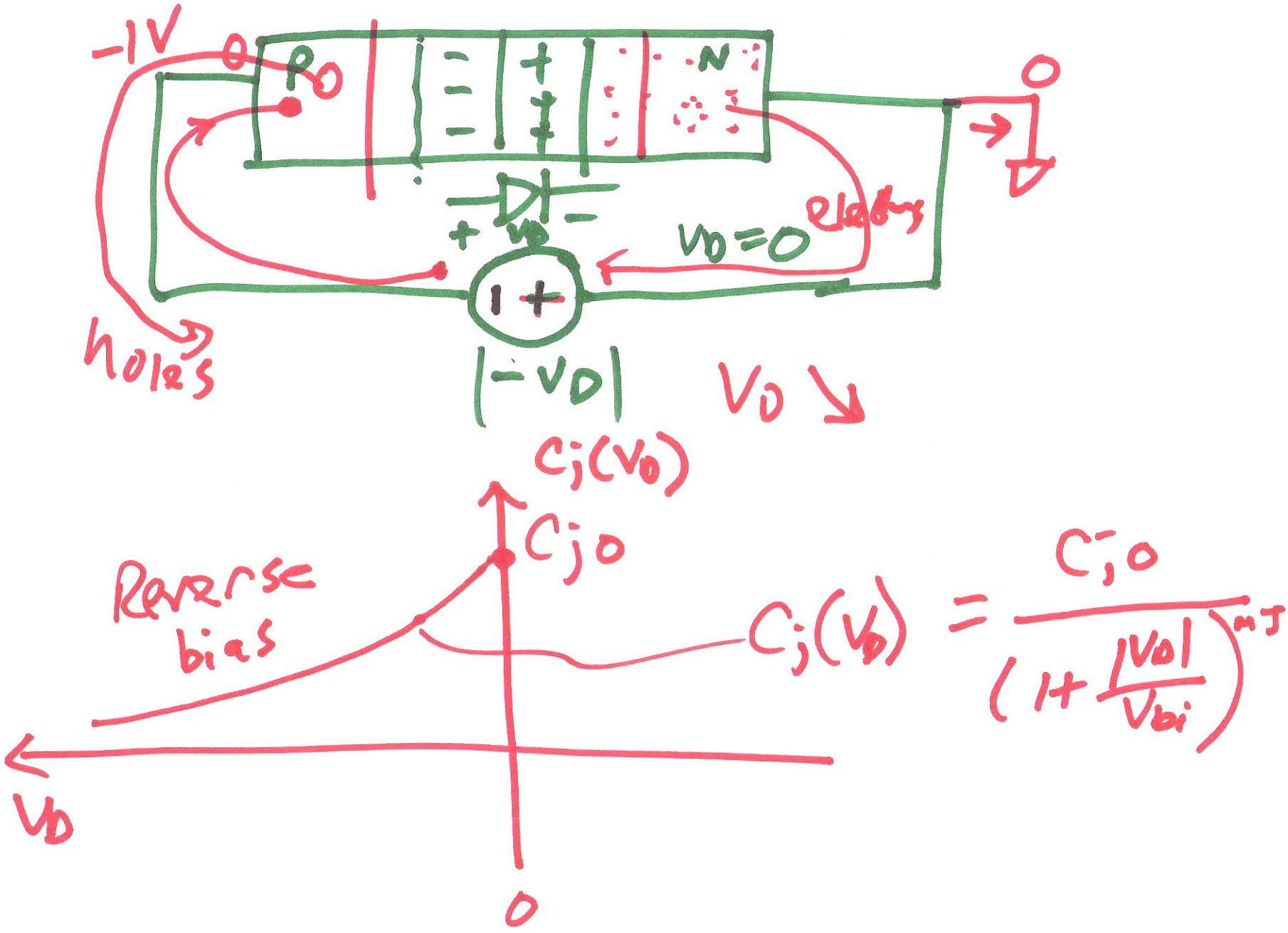


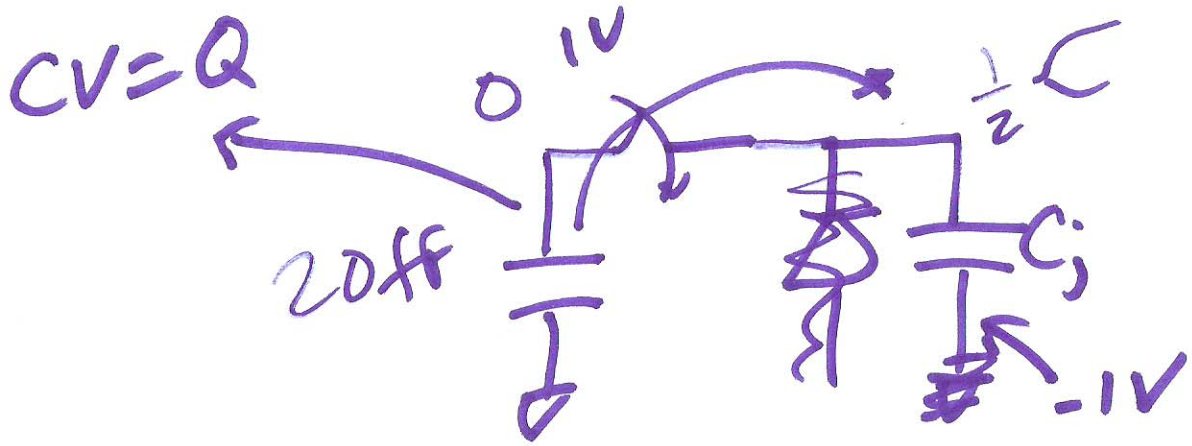
UNLV | ELECTRICAL & COMPUTER ENGINEERING

CMOSedu.com

5)

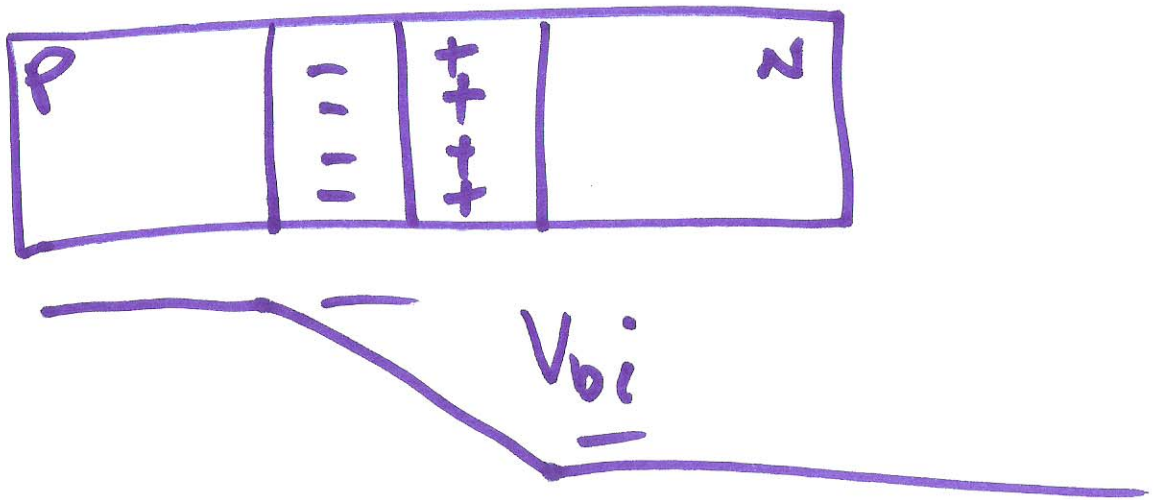

6V
DC out
to phone
-6V
6.3V
1N4001
P
N
Cj0 – zero bias depletion
junction C

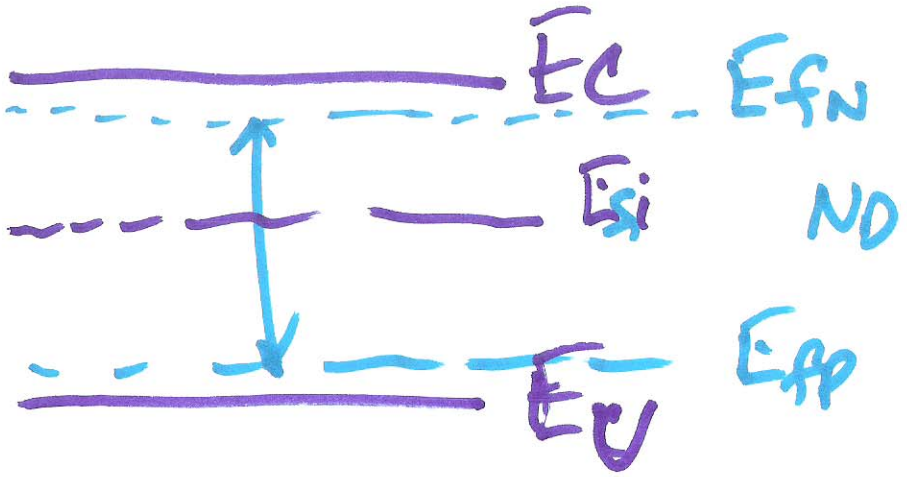

-1V
0
P
N
0
holes
$V_D = 0$
electrons
$|-V_D|$
$V_D \searrow$
$C_j(V_D)$
C_{j0}
Reverse bias
$C_j(V_D) = \frac{C_{j0}}{\left(1 + \frac{|V_D|}{V_{bi}}\right)^{m_J}}$
V_D
0



1T 1C

Memory Cell


P
N
V_{bi}


E_C
E_{fN}
E_i
N_D
E_{fp}
E_V