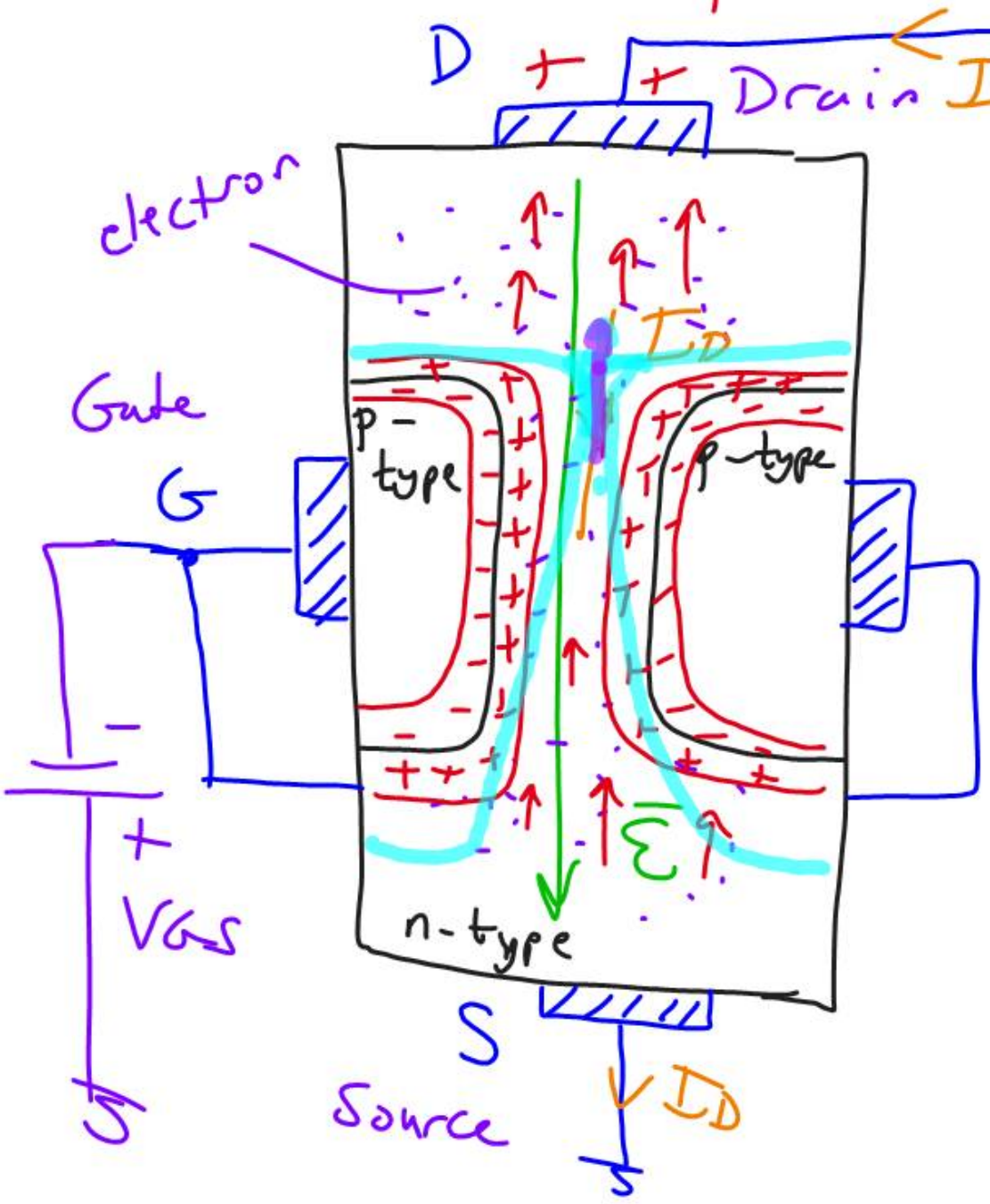
# JFET (Junction FET)

18.04.2011




a unipolar device

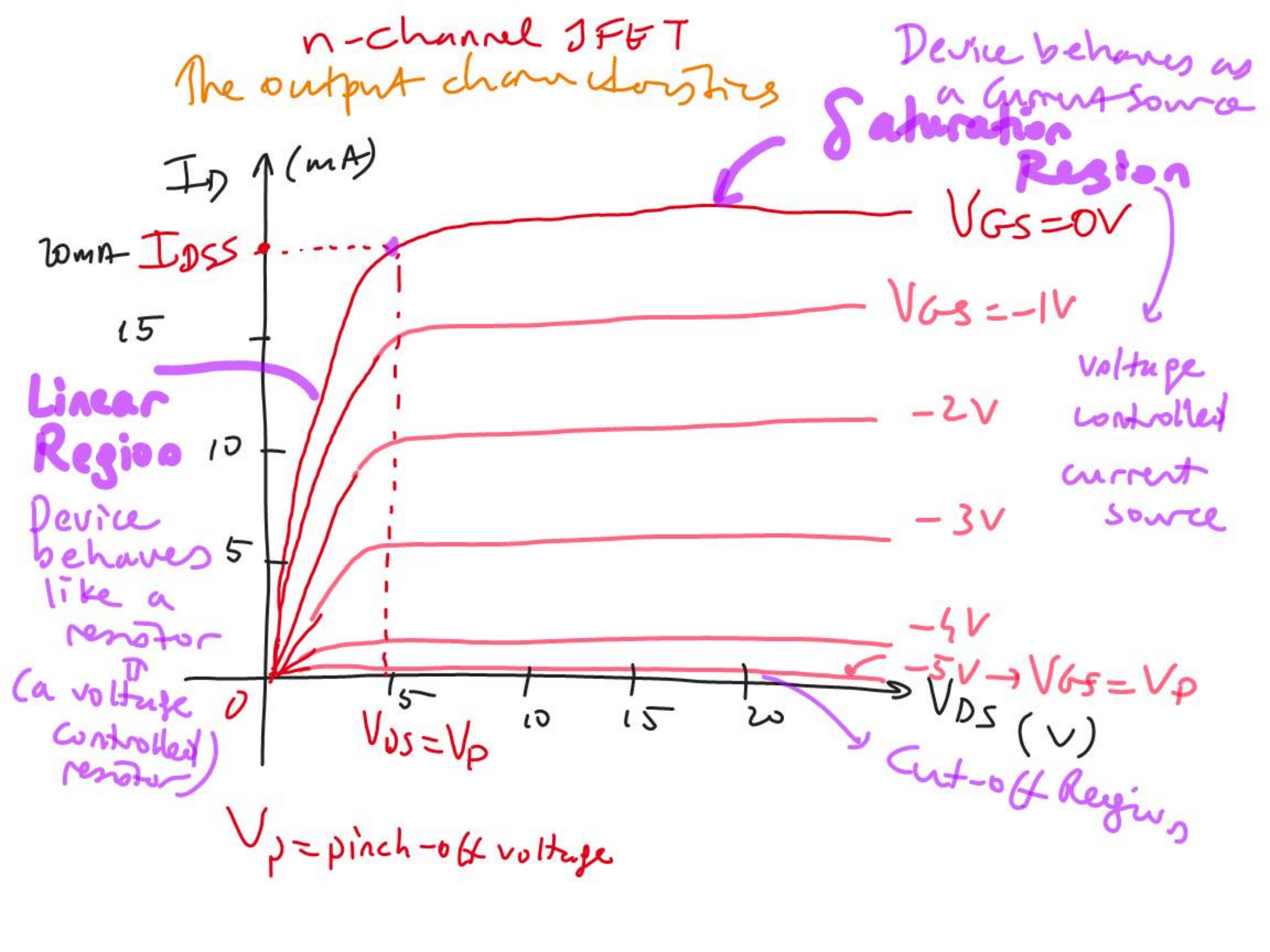
$I = q.v.n.A$

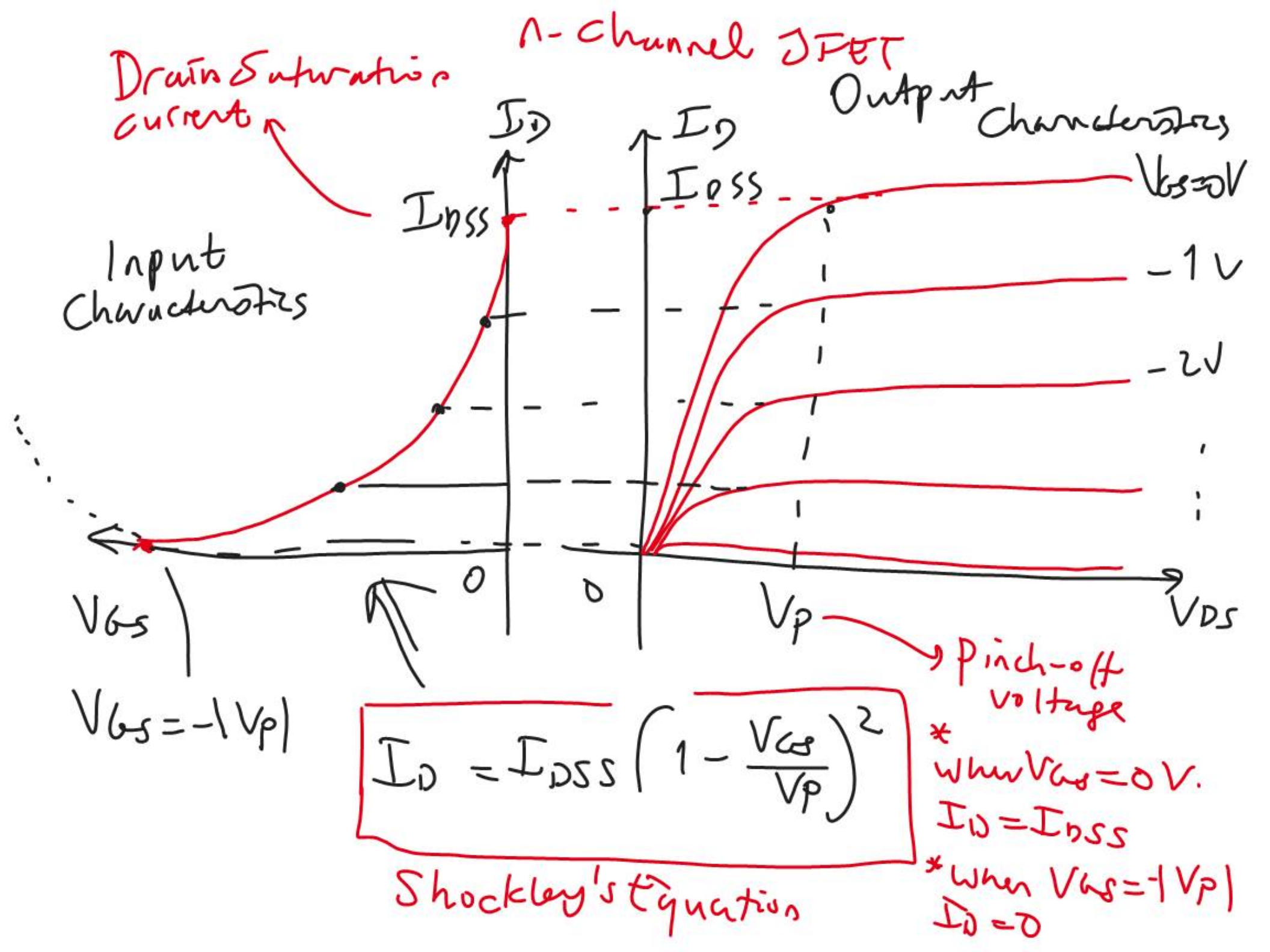
- $v$: velocity of the carriers
- $q$: Coulomb (charge) of a carrier
- $n$: concentration of the carriers ($cm^{-3}$)
- $A$: cross sectional ($cm^2$) area of the channel

The channel's cross sectional area (A) is controlled by the ($V_{GS}$) reverse biased p n Junctions.

as reverse bias voltage ($V_{GS}$) increases the depth of the depletion region increases and the channel area (A) decreases, as a result, since $I = qnvA$, $I$ decreases.

$I_D$ = Drain current


n-channel JFET
The output characteristics
Device behaves as a Current source
Saturation Region
$I_D$ (mA)
20mA
$I_{DSS}$
15
10
5
0
$V_{GS}=0V$
$V_{GS}=-1V$
$-2V$
$-3V$
$-4V$
$-5V \rightarrow V_{GS}=V_p$
Linear Region
Device behaves like a resistor
(a voltage controlled resistor)
Voltage controlled current source
5
10
15
20
$V_{DS}$ (V)
$V_{DS}=V_p$
Cut-off Region
$V_p$ = pinch-off voltage


n-channel JFET
Drain Saturation current
Output Characteristics
$I_D$
$I_{DSS}$
$V_{GS}=0V$
$-1V$
$-2V$
Input Characteristics
0
0
$V_{GS}$
$V_{GS}=-|V_P|$
$V_P$
$V_{DS}$
Pinch-off voltage
$I_D = I_{DSS}\left(1-\frac{V_{GS}}{V_P}\right)^2$
Shockley's equation
* when $V_{GS}=0V$, $I_D=I_{DSS}$
* when $V_{GS}=-|V_P|$, $I_D=0$