MOSFET operation :-

→ The basic structure of nMOS Tr built on a p-type substrate consists of MOS capacitor with two p-n junctions placed immediately adjacent to channel region and is controlled by MOS gate.

→ The carriers i.e. e^- in nMOS Tr enter through source(S) and leave through drain (D) and controlled by C_1 (gate voltage)

→ To ensure that both p-n junctions are reverse biased initially, the substrate potential is < V_1, V_D, V_S. ($-V_B$)

→ When $0 < V_{GS} < V_{TO}$, the gate region betn S & D is depleted and no carriers flow in channel.

→ As $V_{GS} > V_{TO}$, the midgap energy level at surface is pulled below fermi-level [illegible] to turn

A MOS Tr has $V_{TO} = 0.75V$ and $\phi_F = 0.3V$. The body effect coefficient $\gamma = 0.54$.

→ calculate threshold voltage at $V_{SB} = 4V$.

→ Determine the amount of channel implant required to raise the threshold voltage from 0.75V to 1.2V. given $C_{ox} = 3.8 \times 10^{-8}$ F/cm².

$$V_T = V_{TO} + \gamma\left(\sqrt{|-2\phi_F + V_{SB}|} - \sqrt{|-2\phi_F|}\right)$$

$$= 0.75V + 0.54\left(\sqrt{|-0.6+4|} - \sqrt{|-0.6|}\right)$$

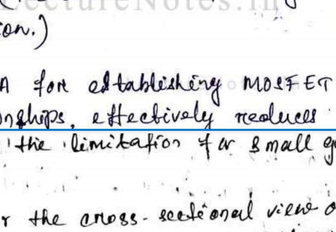
$$= 0.75 + 0.54(2.145 - 0.77)$$

$$= 1.5 \text{ V.}$$

$qN_D = 4V.$

GCA (Gradual channel approximation) :-

→ The analytical derivation of MOSFET V-I relationships for bias conditions well [illegible]



(n-channel MOS operating in linear region.)

→ GCA for establishing MOSFET V-I relationships, effectively reduces the

→ GCA has the limitation for small geometry MOSFETs.

→ Consider the cross-sectional view of the n-channel MOSFET operating in linear mode as shown in above fig.

→ Here $V_S = V_B = 0$.

→ V_{GS} and V_{DS} are the external parameters controlling the drain (channel) current (I_D)

→ $V_{GS} > V_{TO}$, to create a conducting channel (inversion layer) betn source and drain.

→ A coordinate system is defined for the structure where x direction ⊥ surface and y-direction ∥ to surface.

→ channel length = L, ranging from y=0 to y=L.

→ The y coordinate origin (y=0) is at source end of channel