MOSFET – Tutorial 2

① Calculate the bias current of M_1 in Fig 1. Assume $\mu_n C_{ox} = 100\,\mu A/V^2$ and $V_{th} = 0.4V$. If the gate voltage increase by 10mV, what is the change in the drain voltage.

Ans
$I_D = 206.7\,\mu A$
$\Delta V_D = 0.766\,V$

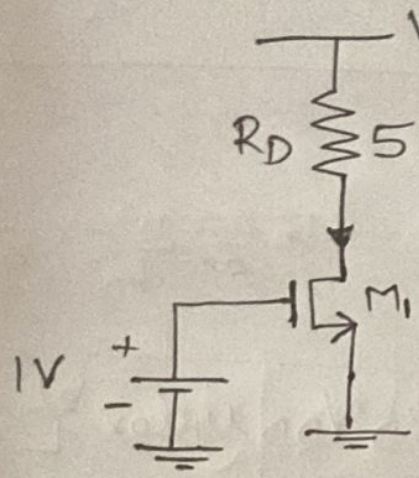

Fig 1

Given:
$\frac{W}{L} = \frac{2}{0.18}$ → for MOSFET(M_1)

② Now using the Fig 1, Determine the value of $\left(\frac{W}{L}\right)$ that place MOSFET (M_1) at the edge of saturation & Calculate the (i) drain voltage change for 1mV change at the gate.

Assume $V_{th} = 0.4$

Ans
$\left.\frac{W}{L}\right|_{max} = \frac{2.4}{0.18}$
$\Delta V_D = 4.02mV$

(ii) Also explain, what happen when R_D is doubled?

(3) Calculate the maximum allowable gate voltage in fig 1 if M_1 must remain saturated?

Hint:

At the edge of Saturation $\Rightarrow V_{GS} - V_{th} = V_{DS} = V_{DD} - I_D R_D$

Ans

$$V_{GS} = \frac{-1 + \sqrt{1 + 2 R_D V_{DD} \mu_n C_{ox} \frac{W}{L}}}{R_D \mu_n C_{ox} \frac{W}{L}} + V_{th}$$

$$\mu_n C_{ox} = 200 \mu A/V^2$$