CSE231

Assignment 04

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Section: 14

Q1

The method of assumed state is used to analyze mosfet circuit because mosfets operate in different regions (cutoff, triode, saturation). this method involves assuming the mosfets operating region solving the circuit based on that assumption and then verifying if the solution aligns with assumed region. if the assumption is incorrect then we assumed new region and the process repeat.

Question 2

a. Given that, gate current $I_G = 0$

$I_{DS} = 4mA$

V_G = Ground connected so it $V_{GS} = 0$

Ans

b.

$$I_{DS} = \frac{5 - V_D}{1}$$

$$\Rightarrow 4 = 5 - V_D$$

$$V_D = 1V$$

Ans

c.

Assume saturation, $V_S = x$

$V_{OV} = V_{GS} - V_T$

$= -x - 1$

$= -(x+1)$

$V_{GS} = V_G - V_S$

$= 0 - x$

$V_{GS} = -x$

$V_T = 1$

$I_{DS} = \frac{k}{2} V_{OV}^2$

$\Rightarrow 4 = \frac{4}{2}(x+1)^2$

$\Rightarrow 2 = (x+1)^2$

$\Rightarrow x^2 + 2x - 1 = 0$

solving eq,

$x_1 = 0.4142$

$x_2 = -2.4142$

using, $x_1 = 0.4142$

$V_{DS} = V_D - V_S$

$= 1 - x$

$= 1 - 0.4142 = 0.586\,V$

$V_{OV} = -1.414\,V$

V_{OV} negative $\therefore V_{GS} < V_T$ so mosfet off

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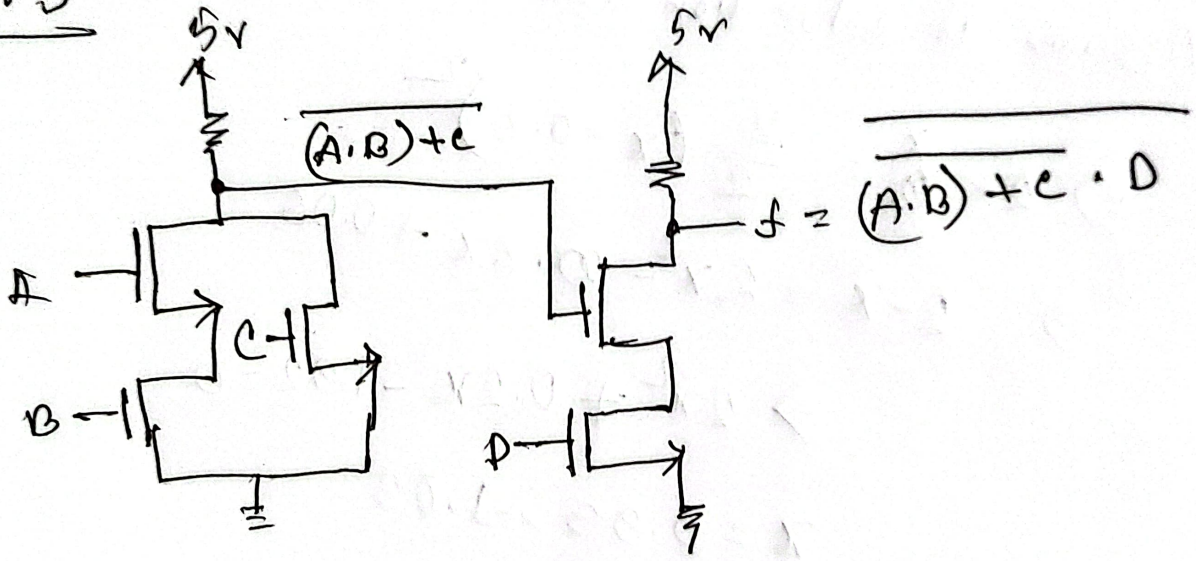
$x = -2.4142$

$V_{OV} = 1.414V$

$V_{DS} = 3.414V$

$V_{DS} > V_{OV}$ so assumption is right its saturation voltage.

Question 3



Question 4

$V_{GS} = V_G - V_S$

$= V_G - 0 = V_G = x$

$V_{DS} = V_D - V_S = V_D = V_G = x \quad (V_G = V_D)$

$V_{OV} = V_{GS} - V_T = V_G - 0.2 = x - 2$

Assume it saturation mode

$$\Rightarrow 2 - x = \frac{k}{2}(x - 0.2)^2$$

$$\Rightarrow 2 - x = 2x^2 - 0.8x + 0.08$$

$$\Rightarrow 2x^2 + 0.2x - 1.92 = 0$$

$$x = 0.93, -1.03$$

when $x = 0.93$

$V_{DS} = 0.93 - 0.2 = 0.73$

$V_O = 0.93$

$V_{GS} > V_T$

$I_D = 1.06\,mA$

$V_O = -1.03$:

$V_{GS} > V_T$

(mosfest turn On)

$I_D \neq 3.03\,mA$

$V_O = 0.93V$ and $I_D = 1.06mA$)

Question 5

$f = \bar{A}B + C\bar{B}$