COE 360 Dr. Aiman El-Malch

HW#2

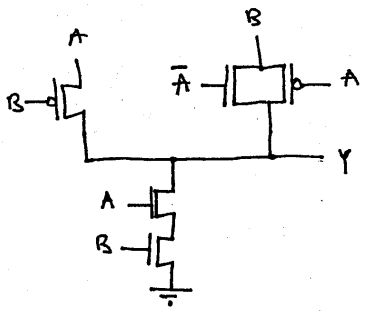
Q1 (i)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

$\Rightarrow Y = \bar{A}B + A\bar{B} = A \oplus B$

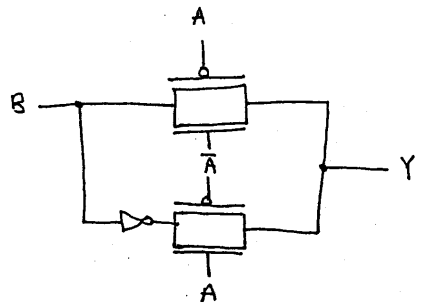
(ii) The problem with this implementation is that for the input combination A=0 & B=0 does not produce a good 0, i.e. 0 volt. The output Y will be discharged to $|V_{tp}|$ and then the pmos transistors will turn off.

One solution to overcome this problem is shown below:



In this implementation, when A=0 & B=0, the output Y will discharge completely to 0 volts because of the nmos transistor controlled by $\bar{A}$.

(iii) Transmission gate implementation:



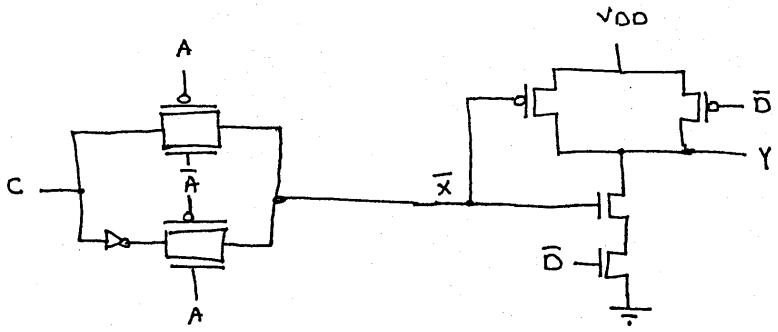
Q2

(i) $Y = \bar{A}\bar{C} + \bar{A}D + AC + AD$

$= \underbrace{\bar{A}\bar{C} + AC}_{\text{XNOR}} + D$

Let $X = \bar{A}\bar{C} + AC \Rightarrow Y = X + D$

$\bar{Y} = \bar{X}\bar{D}$, $\bar{X} = \bar{A}C + A\bar{C}$

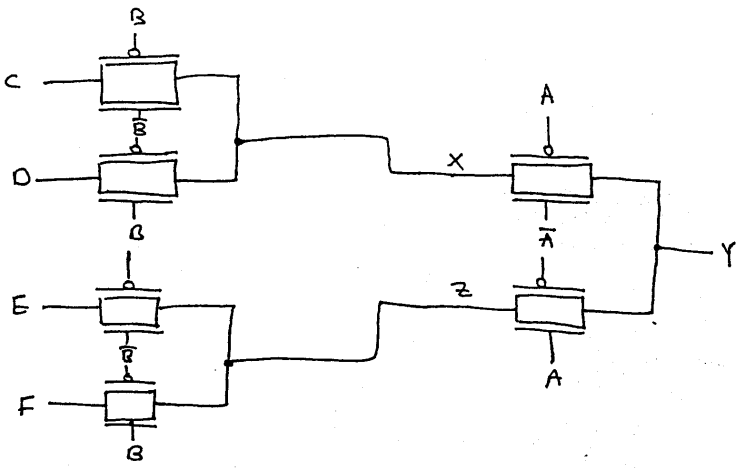


(ii) $Y = \bar{A}\bar{B}C + \bar{A}BD + A\bar{B}E + ABF$

$= \bar{A}\left[\underbrace{\bar{B}C + BD}_{\text{MUX}}\right] + A\left[\underbrace{\bar{B}E + BF}_{\text{MUX}}\right]$

Let $X = \bar{B}C + BD$ and $Z = \bar{B}E + BF$

$\Rightarrow Y = \underbrace{\bar{A}X + AZ}_{\text{MUX}}$

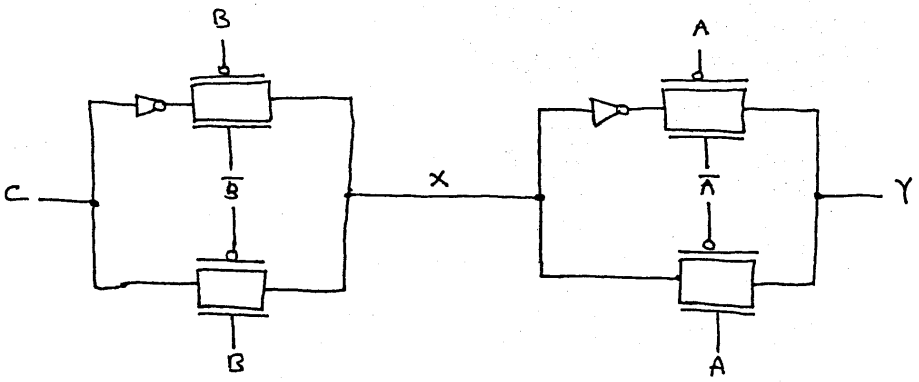


(iii) $Y = A\bar{B}\bar{C} + \bar{A}B\bar{C} + ABC + \bar{A}\bar{B}C$

$= A\underbrace{[\bar{B}\bar{C} + BC]}_{\text{XNOR}} + \bar{A}\underbrace{[B\bar{C} + \bar{B}C]}_{\text{XOR}}$

Let $X = \bar{B}\bar{C} + BC$, $\bar{X} = \bar{B}C + B\bar{C}$

$\Rightarrow Y = \underbrace{AX + \bar{A}\bar{X}}_{\text{XNOR}}$



Q3 (i) $Y = \bar{A}C + \bar{B}D$

(ii) Let us call the first part of the circuit X.

Then, $X = \bar{A}\bar{B}$

$$\Rightarrow Y = XC + \bar{X}D$$
$$= \bar{A}\bar{B}C + (A+B)D$$
$$= \bar{A}\bar{B}C + AD + BD$$

Q4 Falling-edge DFF