

Basics of Electronics Engineering (12EC24)
Tutorial - 1

1. Simplify the following logic expressions using Boolean postulates and theorems. Realize these expressions using logic gates.

(a) $X = (A \oplus B) \cdot ABC + AB \cdot C$
 (b) $X = AB + (BC + ABC) + ABC + C$
 (c) $X = AB + (BC + ABC) + ABC + ABC$
 (d) $X = (A + B + C) \cdot (A + B + C) \cdot (A + B)$
 (e) $X = AB + BC + AC$
 (f) $X = ((A + B) \cdot C) + (A + B)$

2. A logic circuit has three inputs A, B and C and has outputs X and Y. The first output X is at logic 1, when only one of the inputs is at logic 1. The second output Y is at logic 1, when only one of the inputs is at logic 1. Write the logic expressions for X and Y, and realize the logic circuits using NAND gates only.

3. A logic circuit has three inputs A, B and C and has outputs X and Y. The first output X is at logic 1, when only one of the inputs is at logic 1. The second output Y is at logic 1, when only one of the inputs is at logic 1. Write the logic expressions for X and Y, and realize the logic circuits using NAND gates only.

4. Simplify the following logic expressions using K-Map:

(a) $K_1 = ABC + ABC + ABC + ABC$
 (b) $K_2 = ABC + ABC + ABC + ABC$
 (c) $K_3 = ABC + ABC + ABC + ABC$
 (d) $K_4 = ABC + ABC + ABC + ABC$
 (e) $K_5 = ABC + ABC + ABC + ABC$

②

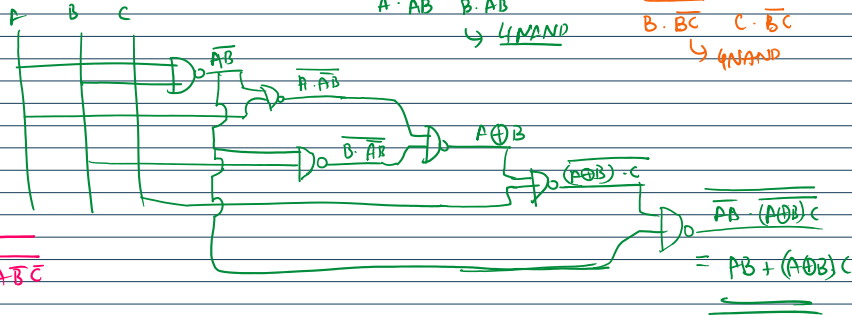
A	B	C	X	Y
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	0

$$X = \bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$$

$$\begin{aligned}
 &= \bar{A}BC + A\bar{B}C + AB(\bar{C} + C) \\
 &= \bar{A}BC + A\bar{B}C + AB(C + \bar{C}) \\
 &= \bar{A}BC + A\bar{B}C + AB \\
 &= \bar{A}BC + A\bar{B}C + AC \\
 &= B(\bar{A} + \bar{A}) + AC \\
 &= AB + BC + AC
 \end{aligned}$$

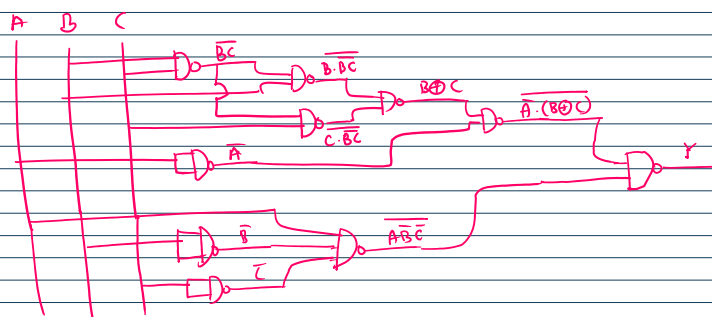
$$\begin{aligned}
 Y &= \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} \\
 &= \bar{A}(\bar{B}C + B\bar{C}) + A\bar{B}\bar{C} \\
 &= \bar{A}(B \oplus C) + A\bar{B}\bar{C} \\
 &\rightarrow \bar{A}(B \oplus C) \cdot A\bar{B}\bar{C}
 \end{aligned}$$

$$\begin{aligned}
 &\bar{A} \quad B \oplus C \\
 &\bar{A}(B \oplus C)
 \end{aligned}$$

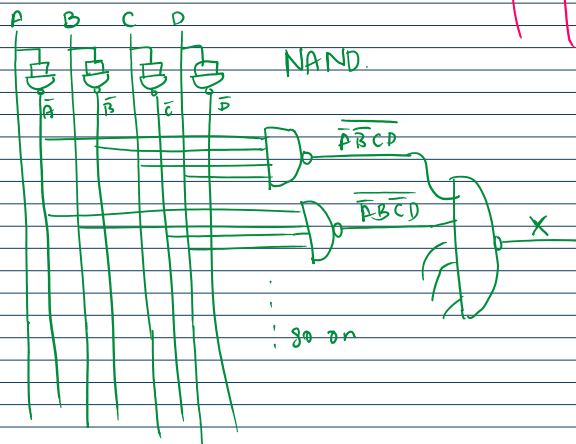


$$\begin{aligned}
 X &= \bar{A}\bar{B}CD + \bar{A}B\bar{C}D + \bar{A}BC\bar{D} \\
 &+ A\bar{B}\bar{C}D + A\bar{B}C\bar{D} + AB\bar{C}\bar{D}
 \end{aligned}$$

AB	CD	$\bar{C}\bar{D}$	$\bar{C}D$	$C\bar{D}$	CD
$\bar{A}\bar{B}$	00				
$\bar{A}B$	01				
$A\bar{B}$	11				
AB	10				

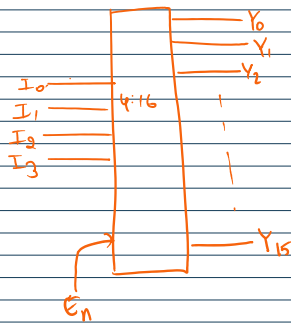


$$Y =$$



$$\begin{aligned}
 X &= \bar{A}\bar{B}CD + \bar{A}B\bar{C}D + \bar{A}BC\bar{D} + A\bar{B}\bar{C}D + A\bar{B}C\bar{D} + AB\bar{C}\bar{D} \\
 &= \bar{A}\bar{B}CD + \bar{A}B(C \oplus D) + A\bar{B}(C \oplus D) + AB\bar{C}\bar{D} \\
 &= \bar{A}\bar{B}CD + (C \oplus D)(A \oplus B) + AB\bar{C}\bar{D}
 \end{aligned}$$

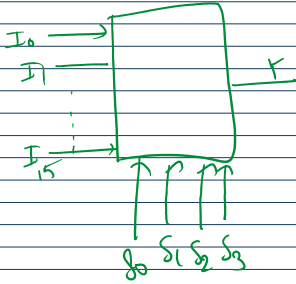
④ 4:16 decoder



E_n	I_0	I_1	I_2	I_3	Y_0	Y_1	Y_2	Y_3	...	Y_{15}
0	X	X	X	X	0	0	0	0	...	0
1	0	0	0	0	1	0	0	0	...	0
	0	0	0	1		1				
	0	0	1				1			
	0	1						1		
	1								1	
										1

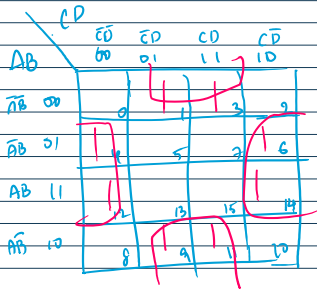
$$Y_0 = \overline{I_0} \overline{I_1} \overline{I_2} \overline{I_3} G_n$$

⑤ 1 MUX



S_0	S_1	S_2	S_3	Y
0	0	0	0	I_0
0	0	0	1	I_1
0	0	1	0	I_2
0	0	1	1	I_3
0	1			
0	1			
0	1			
0	1			
1				
1				
1				
1				
1				
1				
1				
1				

$$f(abcd) = \sum m(13469111214)$$

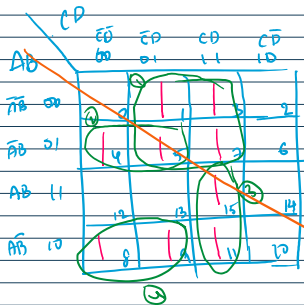


2 quad

$$\rightarrow BD + BD$$

$$B \oplus D$$

$$f(abcd) = \sum m(13457891115)$$



- ① $\rightarrow \overline{A}D$
- ② $\rightarrow A\overline{B}\overline{C}$
- ③ $\rightarrow ACD$
- ④ $\rightarrow A\overline{B}C$

$$\overline{A}D + A\overline{B}\overline{C} + ACD + A\overline{B}C$$

$$\overline{A}D + ACD + A\overline{B}(\overline{C} + C)$$

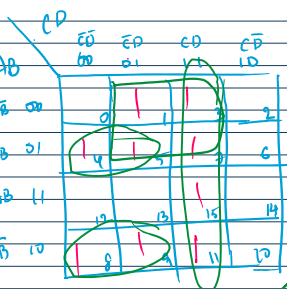
$$D(\overline{A} + AC) + \overline{A}\overline{B}$$

$$D(\overline{A} + C)$$

$$\overline{A}D + CD + \overline{A}\overline{B}$$

$$CD + \overline{A}D + \overline{A}\overline{B}\overline{C} + A\overline{B}\overline{C}$$

$$CD + \overline{A}D + \overline{C}(A \oplus B)$$



✓

$$(abcd) = a'b'd + bcd + ab'd + bc'd$$

		CD			
		00	01	11	10
AB	00	0	1	3	2
	01	4	5	7	6
	11	12	13	15	14
	10	8	9	11	10