Ex

A \ BC	00	01	11	10
0	1	1	0	1
1	1	1	0	1

$\bar{F} = BC$

$F = \overline{BC} \Rightarrow F = \bar{B} + \bar{C}$

Ex

C \ AB	00	01	11	10
0	1	1	0	0
1	1	1	0	0

$\bar{F} = A$

$\therefore F = \bar{A}$

(5) Six-Variables Map :-

D

ABC \ DEF	000	001	011	010	110	111	101	100
000	0	1	3	2	6	7	5	4
001	8	9	11	10	14	15	13	12
011	24	25	27	26	30	31	29	28
010	16	17	19	18	22	23	21	20
110	48	49	51	50	54	55	53	52
111	56	57	59	58	62	63	61	60
101	40	41	43	42	46	47	45	44
100	32	33	35	34	38	39	37	36

C B C A

F E F

- Six Variables Map.

Ex) Simplify $f(A,B,C,D) = \sum 0,2,4,6,9,11,13,15,17,21,25,$ $27,29,31$? H.W

ans:– $F = BE + \bar{A}\bar{D}\bar{E} + AE$

Ex) minimaze the following Expressions using K-Map

1. $F = \bar{A}BC + A\bar{B}\bar{C} + ABC + AB\bar{C}$
2. $F = \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}C\bar{D} + A\bar{B}\bar{C}\bar{D} + \bar{A}CD + A\bar{B}C\bar{D}$
3. $F = \sum 0,1,2,4,5,6,8,9,12,13,14$
4. $F = \sum 1,2,5,7,10,14$

H.W

* product of Sums Simplification :–

Ex) Simplify the following Boolean Function in

1. Sum of Products.
2. product of Sums.

$F(A,B,C,D) = \sum(0,1,2,5,8,9,10)$

Sol?:–

AB \ CD	00	01	11	10
00	1	1	0	1
01	0	1	0	0
11	0	0	0	0
10	1	1	0	1

$F = \bar{B}\bar{D} + \bar{B}\bar{C} + \bar{A}\bar{C}D$ (SOP)

$\bar{F} = AB + CD + B\bar{D}$ (POS)

Applying De-Morgan's theorm (by taking the dual and Complementing each literal as described, we obtain the simplified function in product of sums :

(b) $F = (\bar{A}+\bar{B})(\bar{C}+\bar{D})(\bar{B}+D)$

Don't Care Condition:-

Don't care condition can be used on a Map to provide further simplification of the function. To distinguish the don't care conditions from 1's and 0's an X or d will be used. when choosing adjacent squares to simplify the function in the Map the X's may be assumed to be either 0 or 1.

Ex) Simplify the Boolean function:

$F(w,x,y,z) = \Sigma\, 1,3,7,11,15$

and don't care conditions is $d(w,x,y,z) = \Sigma\, 0,2,5$

Soln:-

wx \ yz	00	01	11	10
00	X	1	1	X
01	0	X	1	0
11	0	0	1	0
10	0	0	1	0

wx \ yz	00	01	11	10
00	X	1	1	X
01	0	X	1	0
11	0	0	1	0
10	0	0	1	0

(a) Sop

combining 1's and X's

$F = \bar{w}z + yz$

(b) Pos

combining 0's and X's

$\bar{F} = \bar{z} + w\bar{y}$

Ex) A card played has four cards, plays a game, he wins every time, A card divided by four or five, otherwise he loss. design a Logic cct, to show this processor using NAND gate only?

i/p o/p

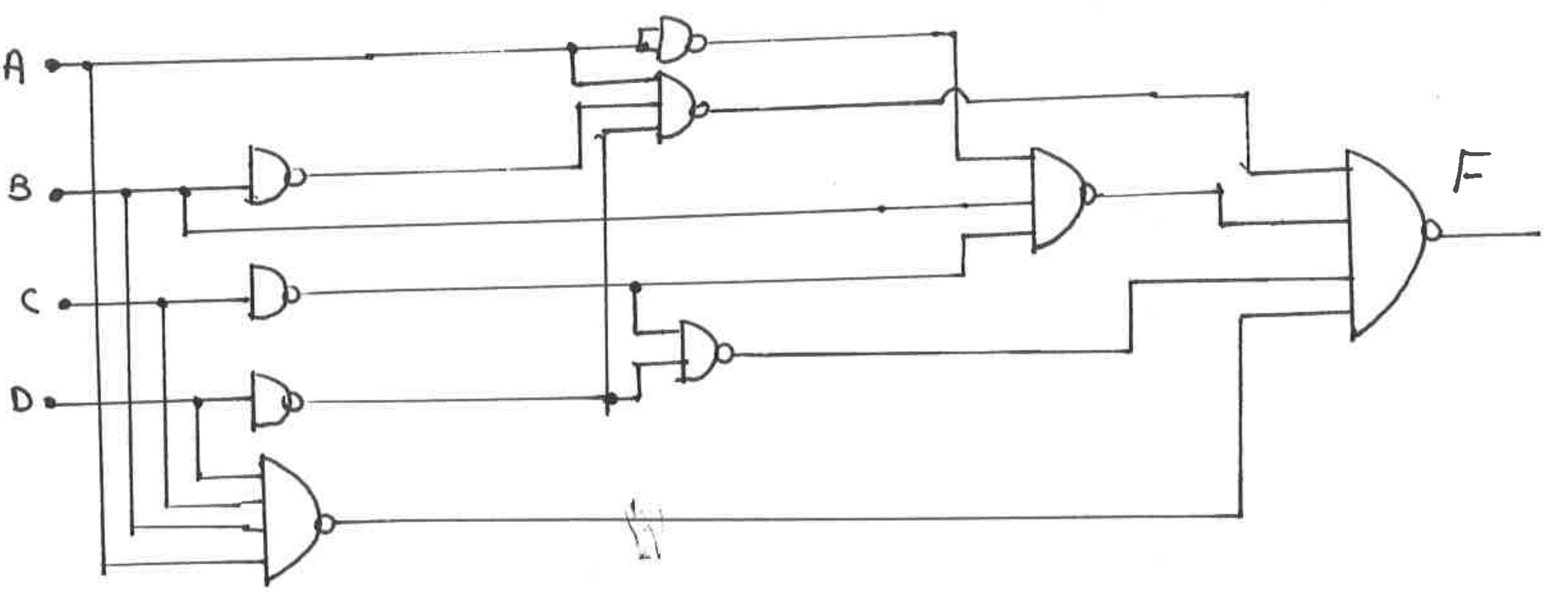
A	B	C	D	F
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

Sol?:-

$F = \sum 0, 4, 5, 8, 10, 12, 15$

AB \ CD	00	01	11	10
00	1			
01	1	1		
11	1		1	
10	1			1

$F = \bar{C}\bar{D} + A\bar{B}\bar{D} + \bar{A}B\bar{C} + ABCD$



Ex) Express F_1 and F_2 in:-

H.W
1. SOP and POS
2. Simplified f_1 and f_2 in SOP
3. Simplified f_1 and f_2 in POS

X	y	z	F_1	F_2
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Ex) Simplify $F(A,B,C,D) = \sum 0,2,4,6,9,11,13,15,17,21,25,27,29,31$

H.W

Ex) Minimize the following expressions using K-Map

1. $F = \bar{A}BC + A\bar{B}\bar{C} + AB\bar{C} + ABC$
2. $F = \bar{A}\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}\bar{D} + A\bar{B}C\bar{D} + \bar{A}CD$
3. $F = \sum 0,1,2,4,5,6,8,9,12,13,14$
4. $F = \sum 1,2,5,7,10,14$

H.W

Ex) Simplify $F = \sum 1,3,6,7,9,10,12$ / H.W
$d = \sum 11,14$

Ans: $\bar{B}D + \bar{A}BC + AB\bar{D} + AC\bar{D}$

Ex) Simplify $F = \bar{A} + \bar{B}\bar{C}$ / H.W
$d = AC + AB$

Ex) $F = \bar{B}\bar{C}\bar{D} + BC\bar{D} + AB\bar{C}$ / H.W
$d = \bar{B}C\bar{D} + \bar{A}B\bar{C}\bar{D}$

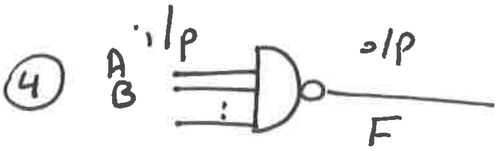
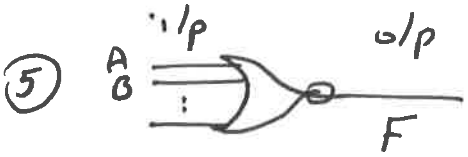
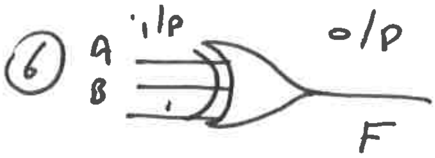
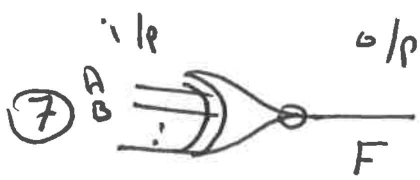
Decimal	Weighted codes						Unweighted Codes	
	8421	2421	5211	7421	5421	84-2-1	Ex-3	Gray
0	0000	0000	0000	0000	0000	0000	0011	0000
1	0001	0001	0001	0001	0001	0111	0100	0001
2	0010	0010	0100	0010	0010	0110	0101	0011
3	0011	0011	0110	0011	0011	0101	0110	0010
4	0100	0100	0111	0100	0100	0100	0111	0110
5	0101	1011	1000	0101	1000	1011	1000	0111
6	0110	1100	1001	0110	1001	1010	1001	0101
7	0111	1101	1011	1000	1010	1001	1010	0100
8	1000	1110	1110	1001	1011	1000	1011	1100
9	1001	1111	1111	1010	1100	1111	1100	1101
Don't Care Condition	10, 11, 12, 13, 14, 15	5, 6, 7, 8, 9, 10	2, 3, 5, 10, 12, 13	7, 11, 12, 13, 14, 15	5, 6, 7, 13, 14, 15	1, 2, 3, 12, 13, 14	0, 1, 2, 13, 14, 15	8, 9, 10, 11, 14, 15
Remark	/	Self-Comp.	Self-Comp.	/	/	Self-Comp.	Self-Complement	/

Logic Circuit

Electronic Logic Gates

It uses primary in Digital component they are mainly manufactured as Integrated Circuit (IC).

Units:- Imploying Transistors, Diodes, and other Solid state components. The (ASA) (American standard Association); symbols for electronic Logic gates.

Symbol	Function	Comments
① 	$F = A \cdot B$ $= AB$	AND gate
② 	$F = A+B$	OR-gate
③ 	$F = \bar{A}$	NOT-gate
④ 	$F = \overline{AB}$	NAND-gate
⑤ 	$F = \overline{A+B}$	NOR-gate
⑥ 	$F = A\bar{B} + \bar{A}B$ $F = A \oplus B$	EX-OR gate
⑦ 	$F = AB + \bar{A}\bar{B}$ $F = A \odot B$	EX-NOR gate

The Truth Table:-

A	B	AND	OR	NOR	NAND	Ex-OR	Ex-NOR
0	0	0	0	1	1	0	1
0	1	0	1	0	1	1	0
1	0	0	1	0	1	1	0
1	1	1	1	0	0	0	1

Note:-

① NAND = NOT AND = $\overline{A\cdot B}$ = $\bar{A}+\bar{B}$ = $\boxed{A\uparrow B}$ in some books

② NOR = NOT OR = $\overline{A+B}$ = $\bar{A}\cdot\bar{B}$ = $\boxed{B\downarrow B}$,

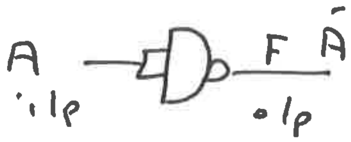
③ Ex-OR $F = A\bar{B}+\bar{A}B = A\oplus B$

④ Ex-NOR $F = AB+\bar{A}\bar{B} = A\odot B$

Universal property of NAND gate:-

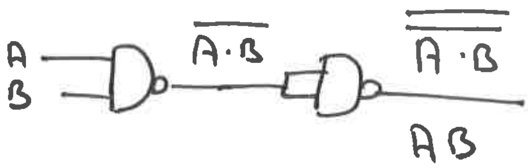
NAND gates can be used to produce any logic function. It can be used to generate the NOT function, the AND function, the OR function, and the NOR function, as shown below.

① NOT gate



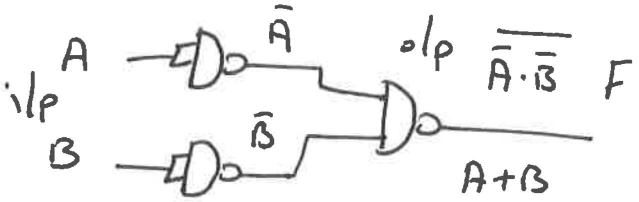
$F = \overline{A\cdot A} = \bar{A}$

② AND gate



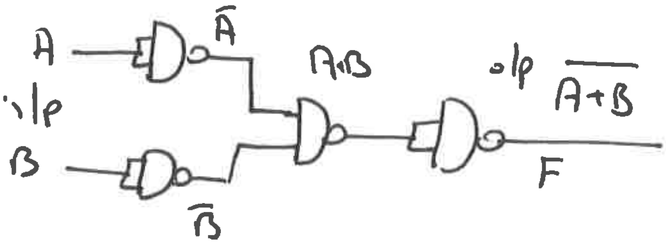
$F = AB$

③ OR gate



$F = A + B$

④ NOR gate



$F = \overline{A+B}$

Therefore the function of NAND gate can be stated into way ① The output of NAND gate is equal to the complement of the AND of the input Variables.

② The output of NAND gate is equal to the OR of the complements of the input Variables.

To use NAND gates we use " De-Morgans Theorm ".

Ex) Use only NAND gate to built..

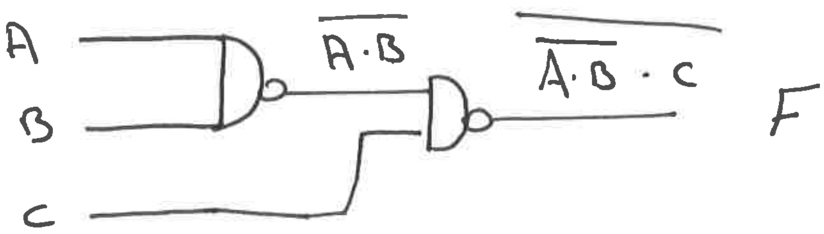
① $F = A\cdot B + \bar{C}$

② $F = \bar{A}B + \bar{A}\bar{C}D + \bar{A}\bar{C}E$

③ $F = \bar{A}\bar{B} + \bar{A}B$

Sol:- ① $F = \overline{\overline{A\cdot B + \bar{C}}}$

$F = \overline{A\cdot B + \bar{C}} = \overline{\overline{A\cdot B}\cdot C}$

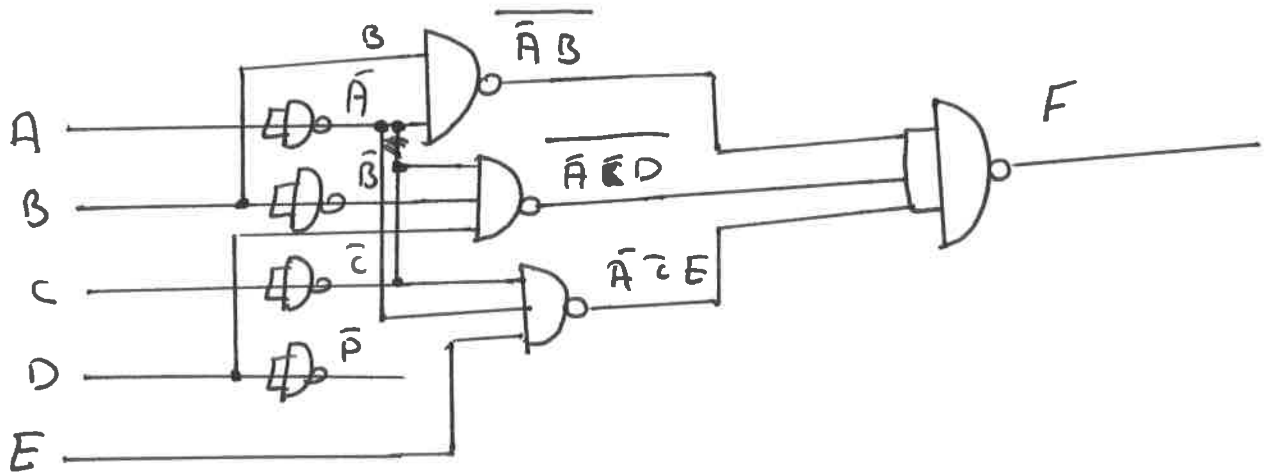


Sol) ②

$$F = \bar{A}B + \bar{A}\bar{C}D + \bar{A}\bar{C}E$$

$$F = \overline{\overline{\bar{A}B + \bar{A}\bar{C}D + \bar{A}\bar{C}E}}$$

$$F = \overline{\overline{\bar{A}B} \cdot \overline{\bar{A}\bar{C}D} \cdot \overline{\bar{A}\bar{C}E}}$$

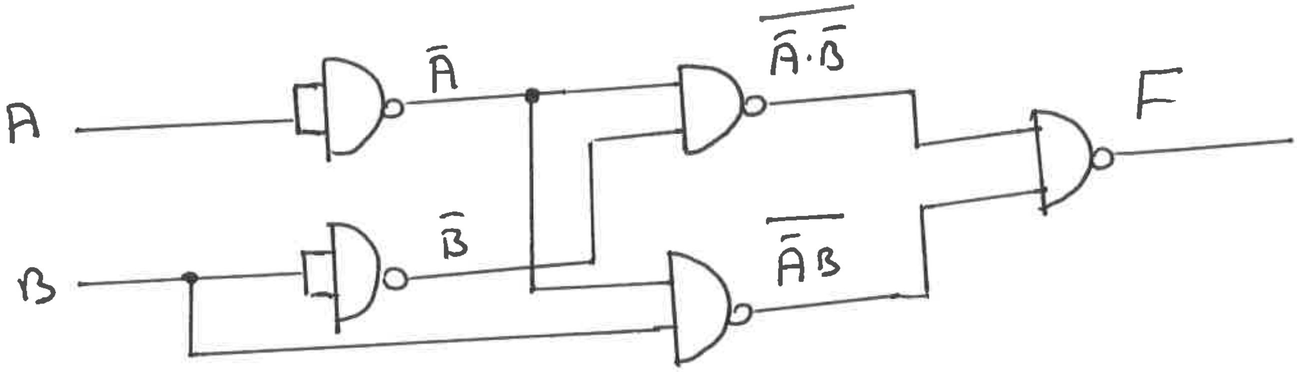


③

$$F = \bar{A}\bar{B} + \bar{A}B$$

$$F = \overline{\overline{\bar{A}\bar{B} + \bar{A}B}}$$

$$F = \overline{\overline{\bar{A}\bar{B}} \cdot \overline{\bar{A}B}}$$



H.W:-

① $F = \bar{A}B + A + \bar{A}\bar{B} + B$

② $F = A\bar{C} + \bar{A}D + BC$

③ $F = AB\bar{C}\bar{D} + AC + A\bar{D}$

④ $F = A \oplus B \oplus C$

⑤ $F = A \odot B \odot C$