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Introduction to digital system

UNIT- II (QUESTION BANK)

1. Explain SOP and POS form.

Answer SOP → When a boolean expression is represented purely as sum of minterms.

POS → When a boolean expression is represented purely as product of maxterms.

2. Define pair, Quad and Octet.

Answer Pair → ★ A pair can be formed by grouping two horizontal or two vertical '1'.

★ A pair of '1' reduces 1 variable.

Quad → ★ A quad is formed with four adjacent 1's either horizontally, vertically or two 1's horizontal & two 1's vertically adjacent

★ A quad reduces 2 variable.

Octet → ★ An octet is a group of eight adjacent 1's

★ An octet reduces three variable.

3. What are called don't care conditions?

Answer. Don't care conditions allows us to replace the empty cell of a K-map to form a grouping of variables which is longer than that of forming groups without don't care.

4. What is meant by karnaugh map or K-map method?

Answer. Karnaugh map or K-map is a graphical display of the fundamental products in a truth table.

Karnaugh map is nothing but a rectangle made up of certain number of squares, each square representing a Maxterm or Minterms.

5. Define combinational logic.

6. Define Half adder and full adder.

Answer→ Half Adder → It is a logic circuit that adds two bits. It produce outputs sum and carry. The boolean equations for SUM and CARRY are :-

$$SUM = X \oplus Y$$

$$CARRY = X.Y$$

Full Adder → It is a logic circuit that can adds three bits. It produce two outputs : Sum and CARRY. The boolean equation for SUM and CARRY are :-

$$SUM = X \oplus Y \oplus Z$$

$$CARRY = XY + YZ + ZX$$

7. What is decoder and Encoder ?

Answer → Encoder → Process of converting signal from one type to another type is called encoding e.g., decimal to binary etc. The logic circuit which perform this very job is called encoder.

Decoder → A decoder is a circuit which converts a binary number into its equivalent decimal form.

8. Explain applications of multiplexer.

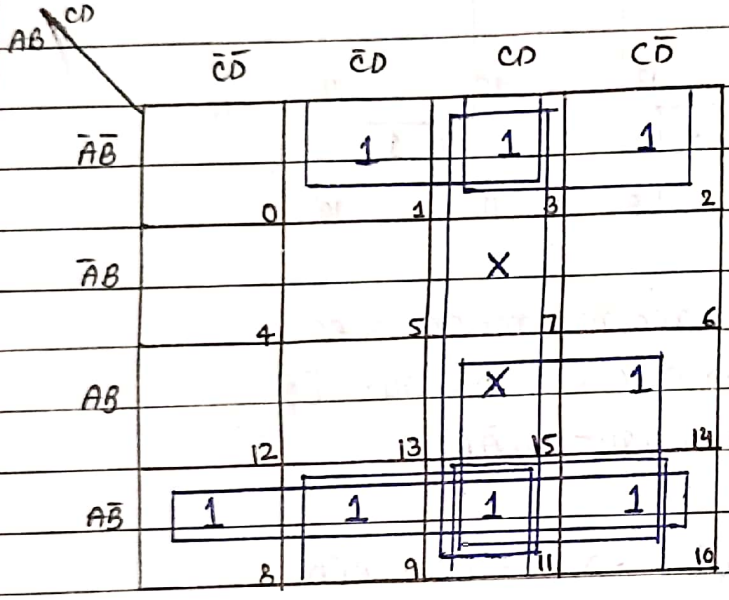
Answer ★ multiplexer is useful in routing several words to the same destination, such as bus

★ The multiplexer can also be used for parallel to serial conversion

★ multiplexer can be used to directly implement any two-level logic circuit of n variables.

9. Simplify the Boolean expression using K-MAP

$F(A,B,C,D) = \sum m(1,2,3,8,9,10,11,14) + d(7,15)$



Quad 1 : $(m_3, m_7, m_{11}, m_{15}) = CD$

Quad 2 : $(m_8, m_9, m_{10}, m_{11}) = A\bar{B}$

Quad 3 : $(m_{10}, m_{11}, m_{14}, m_{15}) = AC$

Quad 4 : $(m_1, m_3, m_9, m_{11}) = \bar{B}D$

Quad 5 : $(m_2, m_3, m_{10}, m_{11}) = \bar{B}C$

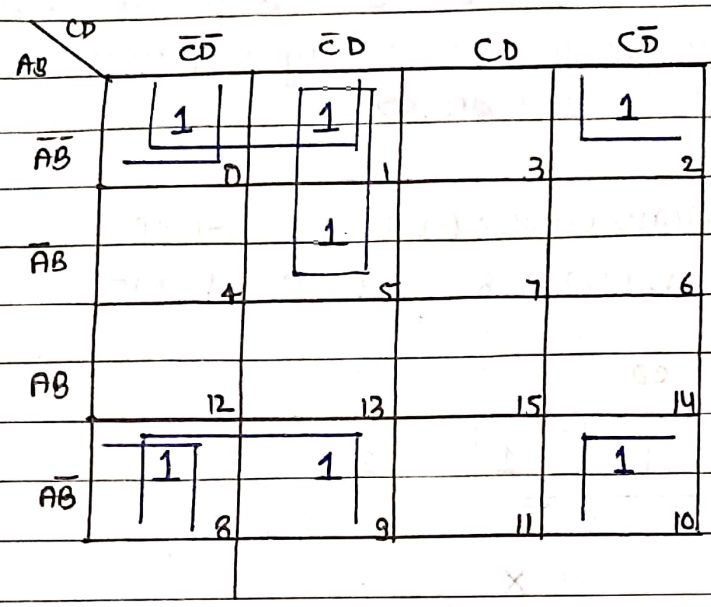
Hence, Quad 1 + Quad 2 + Quad 3 + Quad 4 + Quad 5

$= CD + A\bar{B} + AC + \bar{B}D + \bar{B}C$

10 Obtain the a) SOP b) POS expression for the function given below.

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

(a)



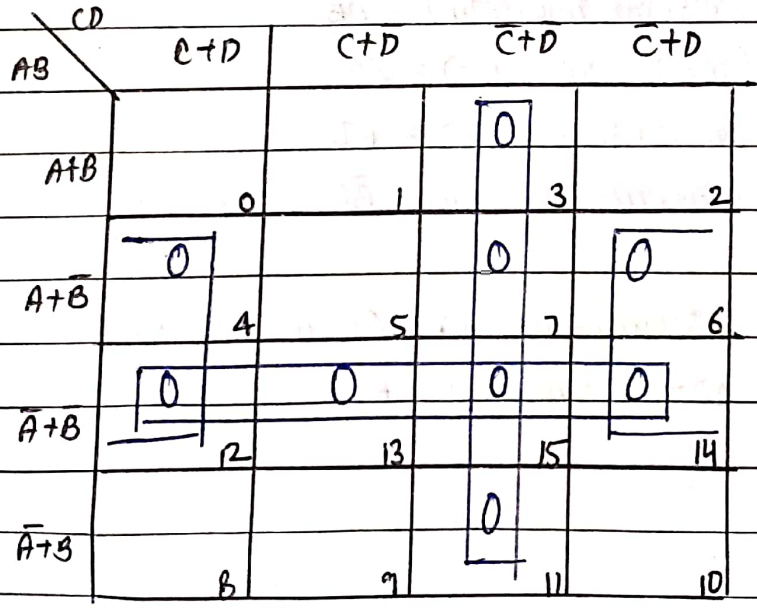
Quad 1 → $m_0, m_1, m_8, m_9 = \bar{B}\bar{C}$

Quad 2 → $m_0, m_2, m_8, m_{10} = \bar{B}\bar{D}$

Pair → $m_1, m_5 \rightarrow \bar{A}\bar{B}D$

SOP expression → $\bar{B}\bar{C} + \bar{B}\bar{D} + \bar{A}\bar{B}D$

(b) $F(A,B,C,D) = \pi M(3,4,6,7,11,12,13,14,15)$



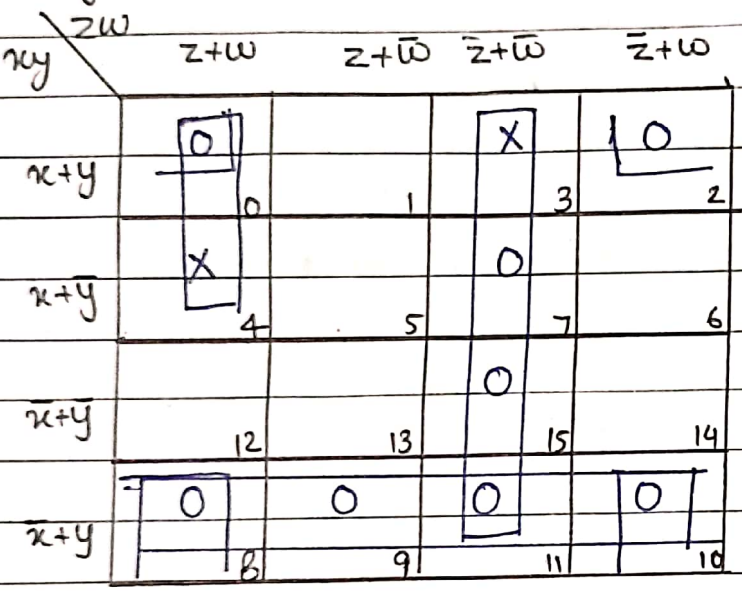
Quad 1 → $m_7, m_7, m_{11}, m_{15} = \bar{A}+\bar{B}$

Quad 2 → $m_3, m_7, m_{15}, m_{11} = \bar{C}+\bar{D}$

Quad 3 → $m_4, m_6, m_{12}, m_{14} = \bar{B}+D$

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

Ques II Reduce the expression $F(x,y,z,w) = \pi M(0,2,7,8,9,10,11,15).d(3,4)$ using K-map.



Quad 1: $M_3, M_7, M_{11}, M_{15} = \bar{z}+\bar{w}$

Quad 2: $M_8, M_9, M_{10}, M_{11} = \bar{x}+y$

Quad 3: $M_0, M_2, M_8, M_{10} = y+w$

Pair: $M_0, M_4 = x+z+w$

$POS = (\bar{z}+\bar{w})(\bar{x}+y)(y+w)(x+z+w)$

13. Obtain the complement of Boolean expression.

i) $A+B+\bar{A}\bar{B}C$

ii) $AB + A(B+C) + \bar{B}(B+C)$

i) $(A+B+A'B'C)'$

= ~~$A' \cdot B' \cdot (ABC')$~~

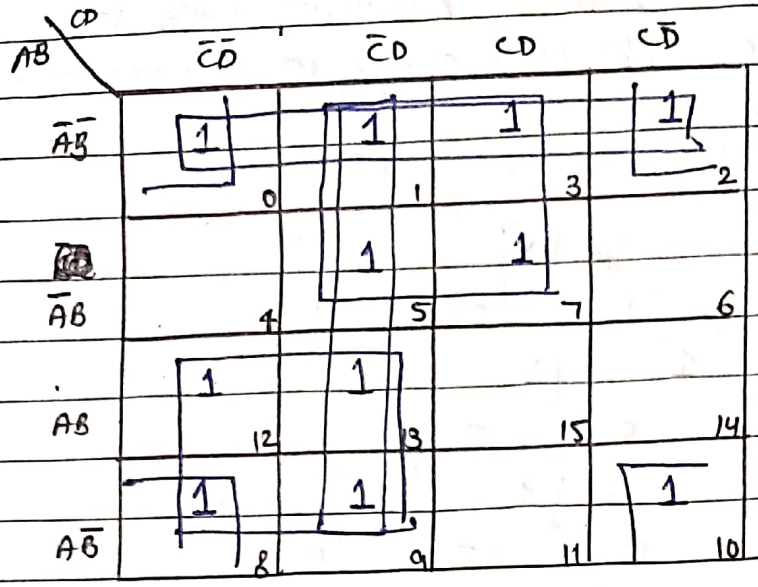
$= A' \cdot B' \cdot (A+B+C')$

ii) $(AB + A(B+C) + \bar{B}(B+C))'$

$= (AB)' \cdot [A(B+C)]' \cdot [\bar{B}(B+C)]'$

$= (\bar{A}+\bar{B}) \cdot (\bar{A} + \bar{B}\bar{C}) \cdot (B + \bar{B}\bar{C})$

16. Reduce using mapping the expression Summation of minterms (0, 1, 2, 3, 5, 7, 8, 9, 10, 12, 13) and implement it in universal logic.



Quad 1 $(m_0, m_1, m_2, m_3) = \bar{A}\bar{B}$

Quad 2 $(m_1, m_5, m_9, m_{15}) = \bar{C}D$

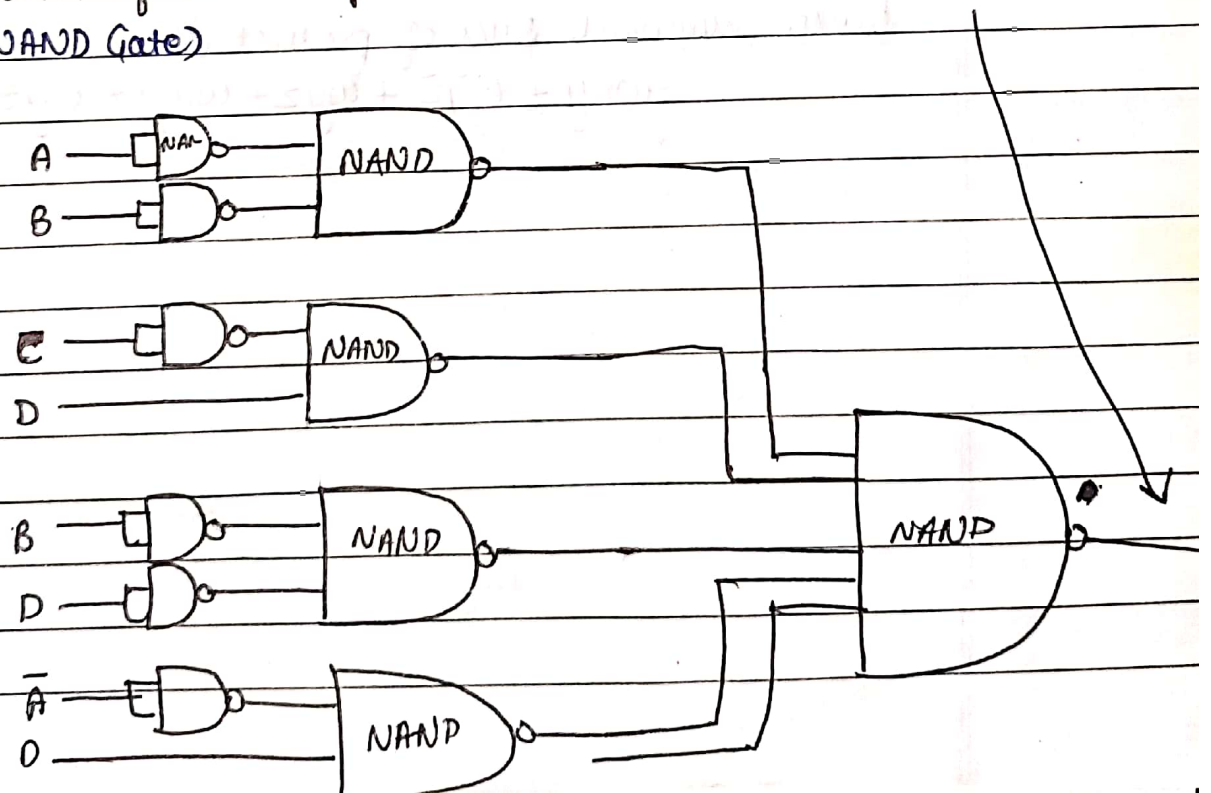
Quad 3 $(m_0, m_2, m_8, m_{10}) = \bar{B}\bar{D}$

Quad 4 $(m_1, m_3, m_5, m_7) = \bar{A}D$

Quad 5 $(m_{12}, m_{13}, m_8, m_9) = A\bar{C}$

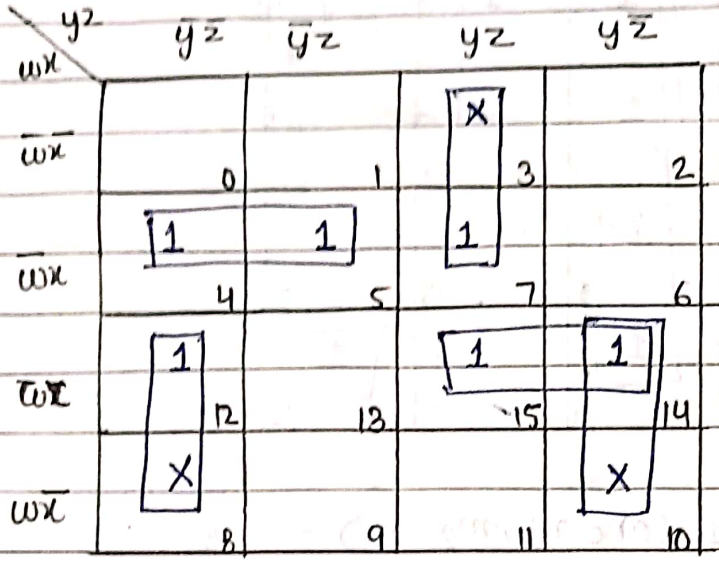
SOP = $\bar{A}\bar{B} + \bar{C}D + \bar{B}\bar{D} + \bar{A}D + A\bar{C}$

Universal Gate for the expression, $\bar{A}\bar{B} + \bar{C}D + \bar{B}\bar{D} + \bar{A}D + A\bar{C}$ (using NAND Gate)



17. Determine the minimal sum of product form of
i) $f(w,x,y,z) = \sum m(4,5,7,12,14,15) + d(3,8,10)$
ii) $f(A,B,C,D) = \pi M(0,3,5,6,8,12,15)$

Answer i)



Pair1 $(m_4, m_5) = \bar{w}x\bar{y}$
Pair2 $(m_8, m_{12}) = w\bar{y}\bar{z}$
Pair3 $(m_3, m_7) = \bar{w}yz$
Pair4 $(m_{14}, m_{15}) = wxy$
Pair5 $(m_{10}, m_{11}) = wy\bar{z}$

Hence, minimal sum of product is,
$\bar{w}x\bar{y} + w\bar{y}\bar{z} + \bar{w}yz + wxy + wy\bar{z}$ Ans

18. Explain and design the circuit diagram of about full Adder?

Answer → It is a logic circuit that can add three bits. It produces two output : SUM and CARRY. The boolean equation for SUM and CARRY are :-

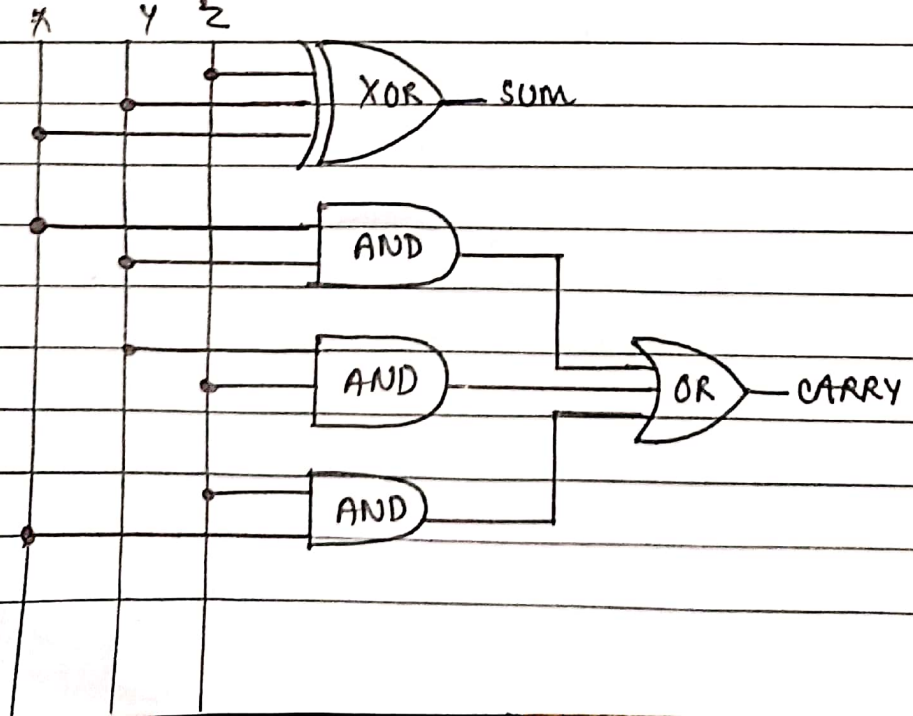
$$SUM = X \oplus Y \oplus Z$$

$$CARRY = XY + YZ + ZX$$

Truth Table of full adder.

X	Y	Z	Carry	Sum
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	1

Circuit Diagram :-



19. Explain about 1-bit magnitude comparator?

Answer→ A comparator used to compare two bits is called a single bit comparator. It consists of two inputs each for two single bit numbers and three outputs to generate less than, equal to and greater two binary numbers.

20. Design and explain Half binary adder in detail?

Answer→ It is a logic circuit that adds two bits. It produces the output SUM and CARRY. The boolean equation for SUM and CARRY are:-

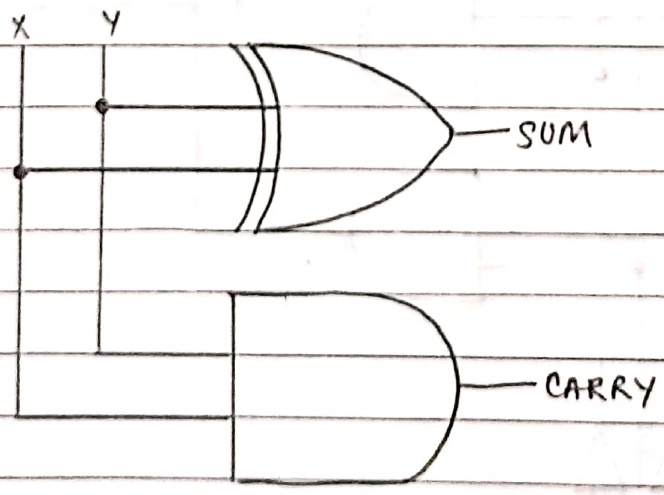
$$SUM = X \oplus Y$$

$$CARRY = X \cdot Y$$

Truth Table for Half Adder :-

X	Y	Carry	Sum
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

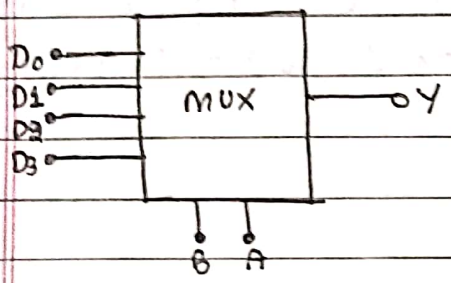
Circuit Diagram



21. What is multiplexer? Design and explain the circuit diagram of 4x1 multiplexer.

Ans Multiplexer is the device that has multiple input and a single line output. The select line determine which input is connected to the output.

Block Diagram



Truth Table.

B	A	Y
0	0	D_0
0	1	D_1
1	0	D_2
1	1	D_3

BA are the select lines.

Circuit Diagram