SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECB231 – DIGITAL ELECTRONICS

II YEAR/ III SEMESTER

UNIT 1 – MINIMIZATION TECHNIQUES AND LOGIC GATES

TOPIC - MINTERMS ,MAXTERMS, SUM OF PRODUCTS AND PRODUCT OF SUMS

CANONICAL FORM ?

- Canonical form in Boolean Expression can be expressed by two sub forms.

1. Standard Sum of Product - Each product term contain all the variables of the function.

eg.
F(A,B,C) =A'BC + ABC'(standard Sop since all the three variables are available)

F(A,B,C) =AB+ ABC'(not a standard Sop since 'C' variable is missing in the first function

If each term in SOP form contains all the literals then the SOP form is known as **Standard or canonical SOP form**. Each individual term in the standard SOP form is called **Minterm.**

CANONICAL FORM ?

2. Standard Product of Sum (SPOS) - Each sum term contains all the variables of the function.

eg.

F(A,B,C,D) = (A+B+C'+D) (A+B'+C+D) (A+B+C+D')- standard POS since all the four variables are available in each function.

F(A,B,C) = (A+B+C'+D) (A+B'+D) (A+B+C+D')- not a standard POS since 'C' variable is missing in the second function

If each term in POS form contains all the literals then the POS form is known as **Standard or Canonical POS form**. Each individual term in the standard POS form is called **Maxterm.**

STANDARD FORM?

- Standard SOP form means Standard Sum of Products form.
- In this form, each product term need not contain all literals.
- Hence, the product terms may or may not be the minterms.
- Thus, the Standard SOP form is the simplified form of canonical SOP form.

REPRESENTATION OF MINTERMS AND MAXTERMS

			Minterms	Maxterms
X	Y	Z	Product Terms	Sum Terms
0	0	0	$m_0 = \bar{X}\cdot\bar{Y}\cdot\bar{Z} = \min(\bar{X},\bar{Y},\bar{Z})$	$M_0 = X + Y + Z = \max(X,Y,Z)$
0	0	1	$m_1 = \bar{X}\cdot\bar{Y}\cdot Z = \min(\bar{X},\bar{Y},Z)$	$M_1 = X + Y + \bar{Z} = \max(X,Y,\bar{Z})$
0	1	0	$m_2 = \bar{X}\cdot Y\cdot\bar{Z} = \min(\bar{X},Y,\bar{Z})$	$M_2 = X + \bar{Y} + Z = \max(X,\bar{Y},Z)$
0	1	1	$m_3 = \bar{X}\cdot Y\cdot Z = \min(\bar{X},Y,Z)$	$M_3 = X + \bar{Y} + \bar{Z} = \max(X,\bar{Y},\bar{Z})$
1	0	0	$m_4 = X\cdot\bar{Y}\cdot\bar{Z} = \min(X,\bar{Y},\bar{Z})$	$M_4 = \bar{X} + Y + Z = \max(\bar{X},Y,Z)$
1	0	1	$m_5 = X\cdot\bar{Y}\cdot Z = \min(X,\bar{Y},Z)$	$M_5 = \bar{X} + Y + \bar{Z} = \max(\bar{X},Y,\bar{Z})$
1	1	0	$m_6 = X\cdot Y\cdot\bar{Z} = \min(X,Y,\bar{Z})$	$M_6 = \bar{X} + \bar{Y} + Z = \max(\bar{X},\bar{Y},Z)$
1	1	1	$m_7 = X\cdot Y\cdot Z = \min(X,Y,Z)$	$M_7 = \bar{X} + \bar{Y} + \bar{Z} = \max(\bar{X},\bar{Y},\bar{Z})$

CONVERSION OF POS TO SOP FORM

- For getting the SOP form from the POS form, we have to change the symbol ∏ to ∑.

- After that, we have to write the numeric indexes of missing variables of the given Boolean function.

Steps to convert the POS function

eg. F = Π x, y, z (2, 3, 5) = x y' z' + x y' z + x y z' into SOP form

- In the first step, we change the operational sign to Σ.
- In the second step we find the missing indexes of the terms, 000, 110, 001, 100, and 111.
- Finally, we write the product form of the noted terms.

000 = x' * y' * z'

001 = x' * y' * z

100 = x * y' * z'

110 = x * y* z'

111 = x * y * z

- Now the SOP form is

F = Σ x, y, z (0, 1, 4, 6, 7) = (x' * y' * z') + (x' * y' * z) + (x * y' * z') + (x * y* z') + (x * y * z)

CONVERSION OF SOP TO POS FORM

- To get the POS form of the given SOP form expression, we will change the symbol ∏ to ∑.
- Then next, we have to write the numeric indexes of the variables which are missing in the boolean function.

Steps used to convert the SOP function

F = ∑ x, y, z (0, 2, 3, 5, 7) = x' y' z' + z y' z' + x y' z + xyz' + xyz into POS

- In the first step, we change the operational sign to ∏.
- In the Second step, We find the missing indexes of the terms, 001, 110, and 100.
- Finally ,write the sum form of the noted terms.

001 = (x + y + z’)
100 = (x’ + y + z)
110 = (x’ + y' + z)

- Now, the POS form is

F = Π x, y, z (1, 4, 6) = (x + y + z’) * (x’ + y + z) * (x’ + y' + z)

Eg.

Convert the non standard SOP function F = AB + A C + B C

Sol:

$F = A B + A C + B C$

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

$= A B C + A B C' + A B C + A B' C + A B C + A' B C$

$= A B C + A B C' + A B' C + A' B C$

- Now , the standard SOP form of non-standard form is

$F = A B C + A B C' + A B' C + A' B C$

CONVERSION OF POS FORM TO STANDARD POS FORM OR CANONICAL POS FORM

- To get the standard POS form of the given non-standard POS form, we will add all the variables in each product term that do not have all the variables.

- By using the Boolean algebraic law (x * x' = 0) and by following the below steps, we can easily convert the normal POS function into a standard POS form.

- STEP 1:By adding each non-standard sum term to the product of its missing variable and its complement, which results in 2 sum terms

- STEP 2:By Applying Boolean algebraic law, x + y z = (x + y) * (x + z)

- STEP 3:By repeating step 1, until all resulting sum terms contain all variables

CONVERSION OF POS FORM TO STANDARD POS FORM OR CANONICAL POS FORM

Eg.

F = (p' + q + r) * (q' + r + s') * (p + q' + r' + s)

1. Term (p' + q + r)- In this case,variable s or s' is missing in this term.So we add s*s' = 1 in this term.

(p' + q + r + s*s') = (p' + q + r + s) * (p' + q + r + s')

2. Term (q' + r + s') – In this case, we add p*p' = 1 in this term for getting the term containing all the variables.

(q' + r + s' + p*p') = (p + q' + r + s') * (p' + q' + r + s')

3. Term (q' + r + s') – In this case, there is no need to add anything because all the variables are contained in this term.

Finally, standard POS form equation of the function is

F = (p' + q + r + s)* (p' + q + r + s')* (p + q' + r + s')* (p' + q' + r + s') * (p + q' + r' + s)

ASSESSMENTS

1. What is SOP & POS?
2. State Canonical form.
3. Minterms are also called as----------
4. Maxterms are also called as--------
5. Differentiate Minterms and Maxterms.

THANK YOU