SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A+' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

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 (SSOP) - Each product term contains 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

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

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 min terms.
- 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	$m_0 = \overline{X}\cdot\overline{Y}\cdot\overline{Z} = \min(\overline{X},\overline{Y},\overline{Z})$	$M_0 = X+Y+Z = \max(X,Y,Z)$
0	0	1	$m_1 = \overline{X}\cdot\overline{Y}\cdot Z = \min(\overline{X},\overline{Y},Z)$	$M_1 = X+Y+\overline{Z} = \max(X,Y,\overline{Z})$
0	1	0	$m_2 = \overline{X}\cdot Y\cdot\overline{Z} = \min(\overline{X},Y,\overline{Z})$	$M_2 = X+\overline{Y}+Z = \max(X,\overline{Y},Z)$
0	1	1	$m_3 = \overline{X}\cdot Y\cdot Z = \min(\overline{X},Y,Z)$	$M_3 = X+\overline{Y}+\overline{Z} = \max(X,\overline{Y},\overline{Z})$
1	0	0	$m_4 = X\cdot\overline{Y}\cdot\overline{Z} = \min(X,\overline{Y},\overline{Z})$	$M_4 = \overline{X}+Y+Z = \max(\overline{X},Y,Z)$
1	0	1	$m_5 = X\cdot\overline{Y}\cdot Z = \min(X,\overline{Y},Z)$	$M_5 = \overline{X}+Y+\overline{Z} = \max(\overline{X},Y,\overline{Z})$
1	1	0	$m_6 = X\cdot Y\cdot\overline{Z} = \min(X,Y,\overline{Z})$	$M_6 = \overline{X}+\overline{Y}+Z = \max(\overline{X},\overline{Y},Z)$
1	1	1	$m_7 = X\cdot Y\cdot Z = \min(X,Y,Z)$	$M_7 = \overline{X}+\overline{Y}+\overline{Z} = \max(\overline{X},\overline{Y},\overline{Z})$

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 write the numeric indexes of missing variables of the given Boolean function.

CONVERSION OF POS TO SOP FORM

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.

CONVERSION OF SOP TO POS FORM

Steps used to convert the SOP function

$F = \sum x, y, z\ (0, 2, 3, 5, 7) = x' y' z' + z y' z' + x y' z + xyz' + xyz$ 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

$F = \Pi x, y, z\ (1, 4, 6) = (x + y + z') * (x' + y + z) * (x' + y' + z)$

CONVERSION OF SOP FORM TO STANDARD SOP FORM OR CANONICAL SOP FORM

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.

- First step, by adding each non-standard sum term to the product of its missing variable and its complement, which results in 2 sum terms

- Second step,by Applying Boolean algebraic law, x + y z = (x + y) * (x + z)

- Third step, 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 and Standard form.
3. Minterms are also called as----------
4. Maxterms are also called as--------
5. Differentiate Canonical and Standard form.

THANK YOU