SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECB204 – LINEAR AND DIGITAL CIRCUITS

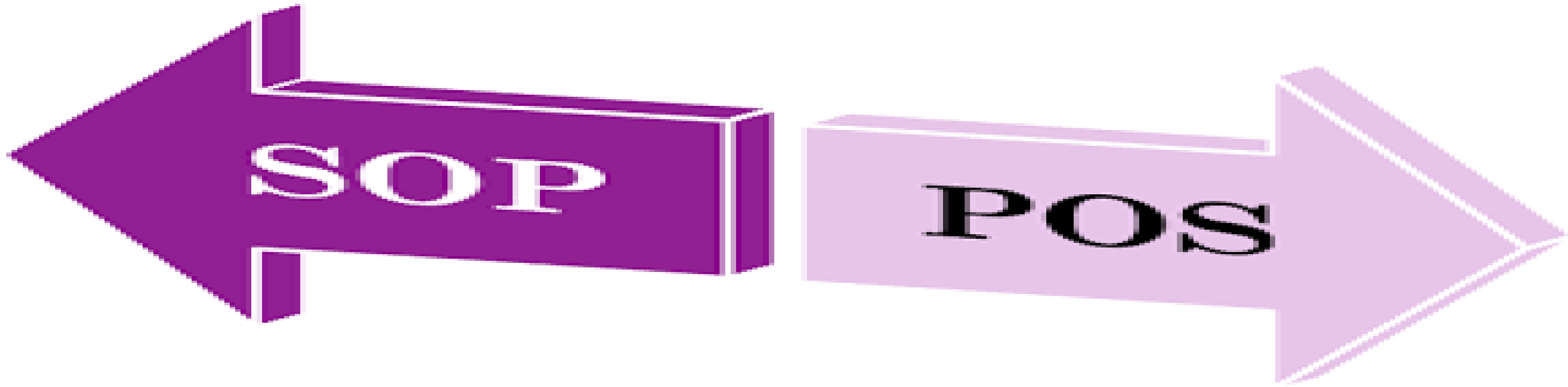
II YEAR/ III SEMESTER

UNIT 3 – GATES AND MINIMIZATION TECHNIQUES

TOPIC 5 - MINTERMS AND MAXTERMS, SUM OF PRODUCTS AND PRODUCT OF SUMS

MINTERMS AND MAXTERMS

- **MINTERMS :**The product of all literals, either with complement or without complement, is known as **minterm**. Can be represented by the letter ‘**m**’.
- **MAXTERMS:**The sum of all literals, either with complement or without complement, is known as **maxterm**. Can be represented by the letter ‘**M**’
- **SOP:** A canonical sum of products is a Boolean expression that entirely consists of minterms. Can be represented by the symbol ‘ ∑’
- **POS:** A canonical product of sum is a Boolean expression that entirely consists of maxterms. Can be represented by the symbol **‘∏**’



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 BETWEEN CANONICAL FORMS

- To convert the canonical expressions, we have to change the symbols ∏, ∑.
- These symbols are changed when we list out the index numbers of the equations.
- From the original form of the equation, these indices numbers are excluded.
- The SOP and POS forms of the boolean function are duals to each other.

CONVERSION BETWEEN CANONICAL FORMS

Steps to convert the canonical forms of the equations

1.Change the operational symbols used in the equation, such as ∑, ∏.

2. Use the Duality's De-Morgan's principal to write the indexes of the terms that are not presented in the given form of an equation or the index numbers of the Boolean function

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 = ∑ 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')

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

- To getting the standard SOP form of the given non-standard SOP form, we have to add all the variables in each product term which 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 SOP function into standard SOP form.

- Multiply each non-standard product term by the sum of its missing variable and its complement.

- Repeat step 1, until all resulting product terms contain all variables

For each missing variable in the function, the number of product terms doubles.

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)

THANK YOU