**11th May, 2020 JESUS AND MARY SCHOOL & COLLEGE MODULE 1**

**CLASS 12**

**COMPUTER SCIENCE**

**BOOLEAN ALGEBRA** **AND LOGIC SIMPLIFICATION**

**In this chapter some important topics which is related to Boolean algebra are explained**

**BOOLEAN OPERATIONS AND EXPRESSIONS**

Variable, complement, and literal are terms used in Boolean algebra. A variable is a symbol used to represent a logical quantity. Any single variable can have a 1 or a 0 value. The complement is the inverse of a variable and is indicated by a bar over variable (overbar). For example, the complement of the variable A is A'. If A = 1, then A' = 0. If A = 0, then A' = 1. The complement of the variable A is read as "not A" or "A bar." Sometimes a prime symbol rather than an overbar is used to denote the complement of a variable; for example, B' indicates the complement of B. A literal is a variable or the complement of a variable.

***Boolean Addition***

Boolean addition is equivalent to the OR operation. In Boolean algebra, a sum term is a sum of literals. In logic circuits, a sum term is produced by an OR operation with no AND operations involved. Some examples of sum terms are A + B, A + B + C, and A + B + C + D.

A sum term is equal to 1 when one or more of the literals in the term are 1. A sum term is equal to 0 only if each of the literals is 0.

Example

Determine the values of A, B, C, and D that make the sum term

 A + B + C + D equal to 0.

***Boolean Multiplication***

Boolean multiplication is equivalent to the AND operation. In Boolean algebra, a product term is the product of literals. In logic circuits, a product term is produced by an AND operation with no OR operations involved. Some examples of product terms are AB, AB, ABC, and ABCD.

A product term is equal to 1 only if each of the literals in the term is 1. A product term is equal to 0 when one or more of the literals are 0.

Example

Determine the values of A, B, C, and D that make the product term ABCD equal to 1.

***LAWS AND RULES OF BOOLEAN ALGEBRA*** ***■***

***Laws o f Boolean Algebra***

The basic laws of Boolean algebra-the commutative laws for addition and multiplication, the associative laws for addition and multiplication, and the distributive law-are the same as in ordinary algebra.

***Commutative Laws***

►The commutative law of addition for two variables is written as

 A+B = B+A

►The commutative law of multiplication for two variables is

A.B = B.A

A B AB BA

0 0 0 0

0 1 0 0

1 0 0 0

1 1 1 1

***Associative Laws* :**

►The associative law of addition is written as follows for three variables:

A + (B + C) = (A + B) + C

►The associative law of multiplication is written as follows for three

 variables:

A(BC) = (AB)C

***Distributive Law*:**

►The distributive law is written for three variables as follows:

A(B + C) = AB + AC

AB + AC = A(B + C).

***Absorption Law*:**

►The Absorption law is written for three variables as follows:

A + AB = A

A(A+B )= A

A B AB A+AB

 0 0 0 0

 0 1 0 0

 1 0 0 0

 1 1 1 1

***Demorgan’s Law*:**

►The Demorgan’s law is written for three variables as follows:

(A + B) ' = A' B'

(A . B) ' = A' + B'

**Principle of duality**

 A Boolean expression can be converted into another form by replacing each plus (+) sign with a dot(.) sign and each dot(.) sign with plus sign(+) each 1 with 0 and each 0 with 1. The variable must remain same during this process .The Expression so obtained Is known as dual of the Boolean expression and the process of conversion is termed principle of duality.

***■*** ***Rules of Boolean Algebra***

Rule 1. A + 0 = A

Rule 2. A + 1 = 1

Rule 3. A . 0 = 0

Rule 4. A . 1 = A

Rule 5. A + A = A

Rule 6. A + A ' = 1

Rule 7. A . A = A

Rule 8. A . A' = 0

Rule 9 ( A' ) ' = A

Rule 10. A + AB = A

Rule 11. A + A' B = A + B

Rule 12. (A + B)(A + C) = A + BC

**Example:**

Questions: Write the dual of the following expression

1. A + AB. ( C + A' D)
2. ( A + 1 ).( B + 0 ).(A' + B')
3. A+ [AB + ( A.B + C) ' + A' C' ]
4. (A.B.C. + 1) + ( A' B' + B C)
5. A. ( A.B + 1 ) + ( B.C + 0 )

Answers

1. A.A+B + (C . (A'+ D))
2. ( A . 01 ).( B . 1 ) + ( A' . B' )
3. A . [(A+B) . (( A+.B) . C) ' . (A' + C' ) ]
4. ((A+B +C) . 0) . ( (A'+ B') .( B+ C))
5. A+ (( A.+B) .0 ) . (( B+.C) .1 )

**SIMPLIFICATION USING BOOLEAN ALGEBRA**

A simplified Boolean expression uses the fewest gates possible to implement a given expression.

Example

Using Boolean algebra techniques, simplify this expression:

AB + A(B + C) + B(B + C)

Solution

Step 1: Apply the distributive law to the second and third terms in the expression, as follows:

AB + AB + AC + BB + BC

Step 2: Apply rule 7 (BB = B) to the fourth term.

AB + AB + AC + B + BC

Step 3: Apply rule 5 (AB + AB = AB) to the first two terms.

AB + AC + B + BC

Step 4: Apply rule 10 (B + BC = B) to the last two terms.

AB + AC + B

Step 5: Apply rule 10 (AB + B = B) to the first and third terms. B+AC

At this point the expression is simplified as much as possible.

Example

Find the compliment of A + ( B ' C + A B C )

Solution

Compliment of 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 ') .( A ' + B ' + C ' )

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

**WORKSHEET 1**

**Assignment Work (Review Class XI)**

1. Simplify the given Boolean expression P'Q+PQ'+ P' Q'
2. Simplify the given Boolean expression A' B C+A' B' C+A' B' C'
3. Simplify the given Boolean expression A' B' C D + A' B' C' D' + A' B' C ' D
4. What is propositional logic? and explain its types with example. (hint chapter 1 of class XI)
5. State the compliment properties. Find the compliment of the following Boolean expression using De Morgan’s law:

A .B' + A' + B.C

1. Write down the dual expression of the following expression:

 x(y′z′ + yz)

1. Define the following term with example (Chapter 1 of Class XI)
2. Converse
3. Inverse
4. Contrapositive
5. Write a program in Java to accept a decimal number and convert to Hexadecimal number.

Example

 Input n =1998

 Output 7CE

1. Write a program in Java to input your city name and delete the all vowel letters.

Example

Input: BALRAMPUR

Output: BLRMPR

1. Write a program in Java to input 10 numbers in single dim. array and find the greatest prime number.

**Note: -** Please do all this work in your old copies which will be check when school be re-open.

**Please consider this important**