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$\bar{A}$ B A' -1

Simplification of Boolean Expression using Boolean Algebra

Rules:-

1. Compliment = $(A')' = A$

2. AND = $A \cdot A = A$
   $A \cdot 0 = 0$
   $A \cdot 1 = A$
   $A \cdot A' = 0$

3. OR = $A + A = A$
   $A + 0 = A$
   $A + 1 = 1$
   $A + A' = 1$

4. Distributive law = $A + BC = (A+B)(A+C)$
   $A.(B+C) = AB + AC$

5. De Morgan's law = $(A+B)' = A' \cdot B'$
   $(A \cdot B)' = A' + B'$

6. Commutative law = $A \cdot B = B \cdot A$
   $A + B = B + A$

(Commutative law states changing the sequence of variables)

7. Associative law = $(A \cdot B) \cdot C = A \cdot (B \cdot C)$

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

Examples

(i) $AB + BC + \bar{B}C = AB + C$

$AB + C[B + \bar{B}]$

$AB + C[1]$ $\qquad \because B + \bar{B} = 1$

$AB + C = AB + C$

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

$= A + \bar{A}(B + BC + \bar{B}\bar{C}D + \bar{B}\bar{C}\bar{D}E)$ $\qquad \because A + \bar{A} = 1$

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

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

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

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

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

$= A + B + C + D + E$

(iii) $X = AB + A(B+C) + B(B+C)$

$X = \underbrace{AB + AB} + AC + \underbrace{BB} + AC$ [Open the Brackets

$= AB + AC + B + BC$ $\qquad$ [$B(1+C)$

$= \underbrace{AB + AC + B} \qquad B(1)$

$= B + AC$

(4) $(A+B)(A+C) = A+BC$

$(A+B)\ (A+C)$

$AA + AC + AB + BC$

$A + AC + AB + BC$

$A(1+C) + AB + BC$

$A\ (1)\ + AB + BC$

$A + AB + Bc$

$A(1+B) + BC$

$A(1) + BC$

$A + BC$

L.H.S. = R.H.S.

(5) Simplify :- $Z = A[B + C(AB + AC)]$

$Z = A[B + ABC + ACC]$

$Z = A[B + ABC + AC]$ $\quad \therefore A.A = A$

$Z = A[B(1+AC) + AC]$

$Z = A[B + AC]$ $\quad 1+A = 1$

$Z = AB + AAC$

$Z = AB + AC$

$Z = \boxed{A(B+C)}$

Rule- Complement the whole expression

(i) change all OR (i.e. +) to and (.)

(ii) AND (i.e. .) to OR (+)

(iii) Complement each of the individuals