Assignment on Digital Fundamentals & Computer Architecture.

Submitted to :-

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submitted By :-

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Regular MCA - B

Simplification Using Boolean Algebra:-

1) $A\bar{B} + A(\overline{B+C}) + B(\overline{B+C})$

Ans) $A\bar{B} + A(\bar{B}+\bar{C}) + B(\overline{B+C})$

$A\bar{B} + A(\bar{B}\bar{C}) + B(\bar{B}\bar{C})$ [Demorgan's law is applied]

$A\bar{B} + A\bar{B}\bar{C} + B\bar{B}\bar{C}$ [$B \cdot \bar{B} = 0$]

$A\bar{B} + A\bar{B}\bar{C}$

$A\bar{B}(1+\bar{C})$ $1+\bar{C} = 1$

$\underline{A\bar{B}}$

2) $[ABCC + \bar{B}\bar{D} + \overline{AB}]CD$

Ans) $[ABCC + \bar{B} + \bar{D}) + \bar{A} + \bar{B}]CD$ Demorgan's law

$[ABC + AB\bar{B} + AB\bar{D} + \bar{A} + \bar{B}]CD$ Distributive law.

$[ABC + AB\bar{D} + \bar{A} + \bar{B}]CD$ $B \cdot \bar{B} = 0$

$ABCCD + ABB\bar{D}CD + \bar{A}CD + \bar{B}CD$ Distributive law

$ABCD + \bar{A}CD + \bar{B}CD$ Rule 7 and 8.

$(AB + \bar{A})CD + \bar{B}CD$ $\bar{A} + AB = \bar{A} + B$

$(\bar{A} + B)CD + \bar{B}CD$

$\bar{A}CD + BCD + \bar{B}CD$

$\bar{A}CD + (B+\bar{B})CD$ $B + \bar{B} = 1$

$(\bar{A}+1)CD = \underline{CD}$ $\bar{A} + 1 = 1$

3) $AB\bar{C} + \bar{A}\,\bar{B}C + \bar{A}BC + \bar{A}\,\bar{B}\,\bar{C}$

Ans) $AB\bar{C} + \bar{A}\,\bar{B}C + \bar{A}BC + \bar{A}\,\bar{B}\,\bar{C}$

$AB\bar{C} + \bar{A}C(\bar{B}+B) + \bar{A}\,\bar{B}\,\bar{C}$ $\qquad A+\bar{A}=1$

$AB\bar{C} + \bar{A}C + \bar{A}\,\bar{B}\,\bar{C}$

$AB\bar{C} + \bar{A}(C + \bar{B}\,\bar{C})$ $\qquad \bar{A}\,\bar{B}+A = A+B$

$AB\bar{C} + \bar{A}(\bar{B}+C)$

$AB\bar{C} + \bar{A}\,\bar{B} + \bar{A}C$

4) $\overline{AB} + \overline{AC} + \bar{A}\,\bar{B}\,\bar{C}$

Ans) $\bar{A}+\bar{B} + \bar{A}+\bar{C} + \bar{A}\,\bar{B}\,\bar{C}$ $\qquad$ Demoagan's law.

$\bar{A}+\bar{B}+\bar{C} + \bar{A}\,\bar{B}\,\bar{C}$ $\qquad \bar{A}+\bar{A}=\bar{A}$

$\bar{A}\,[1+\bar{B}\bar{C}] + \bar{B} + \bar{C}$ $\qquad 1+\bar{B}\bar{C}=1$

$\bar{A}+\bar{B}+\bar{C}$

5) $A\bar{B}C(BD+CDE)+A\bar{C}$

Ans) $A\bar{B}C(BD+CDE)+A\bar{C}$ $\qquad$ Distaibutive law

$A\bar{B}CBD + A\bar{B}CCDE + A\bar{C}$ $\qquad C.C = C$

$A\bar{B}CBD + A\bar{B}DE + A\bar{C}$ $\qquad \bar{B}.B = 0$

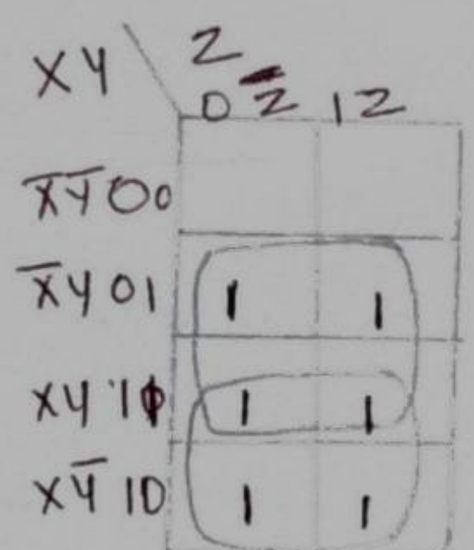
$A\bar{B}CDE + A\bar{C}$ $\qquad A.A = A$

$A\,[\bar{B}CDE+\bar{C}]$

6) Use a karnaugh map to simplify the following standard sop expression.

$$\bar{x}yz + x\bar{y}z + xy\bar{z} + \bar{x}y\bar{z} + x\bar{y}\bar{z} + xyz$$

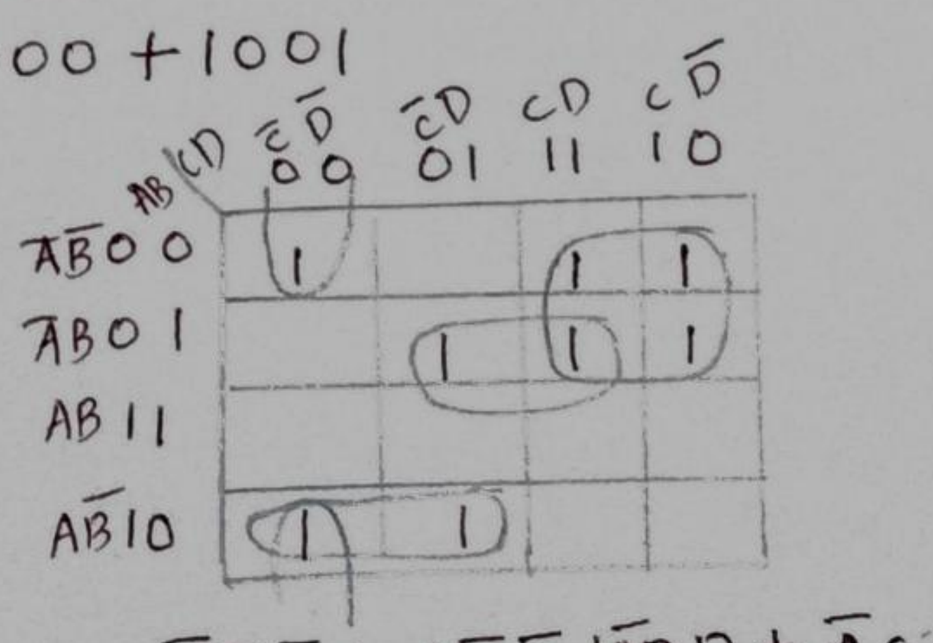
Ans) 011 + 101 + 110 + 010 + 100 + 111



$$x + y$$

7) $\bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}CD + \bar{A}B\bar{C}D + \bar{A}BC\bar{D} + \bar{A}BCD + A\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}D$

Ans) 0000 + 0010 + 0011 + 0101 + 0110 + 0111 + 1000 + 1001



$$\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C} + \bar{A}BD + \bar{A}C$$

8) Use a karnaugh map to reduce each expression to a minimum SOP.

a) $A + B\bar{C} + CD$

Ans) $A(B+\bar{B}) \Rightarrow AB + A\bar{B}$

$AB(C+\bar{C}) \Rightarrow ABC + AB\bar{C}$

$A\bar{B}(C+\bar{C}) \Rightarrow A\bar{B}C + A\bar{B}\bar{C}$

$ABC(D+\bar{D}) \Rightarrow ABCD + ABC\bar{D}$

$AB\bar{C}(D+\bar{D}) \Rightarrow AB\bar{C}D + AB\bar{C}\bar{D}$

$A\bar{B}C(D+\bar{D}) \Rightarrow A\bar{B}CD + A\bar{B}C\bar{D}$

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

$B\bar{C}(A+\bar{A}) \Rightarrow AB\bar{C} + \bar{A}B\bar{C}$

$AB\bar{C}(D+\bar{D}) \Rightarrow AB\bar{C}D + AB\bar{C}\bar{D}$

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

$CD(A+\bar{A}) \Rightarrow ACD + \bar{A}CD$

$ACD(B+\bar{B}) \Rightarrow ABCD + A\bar{B}CD$

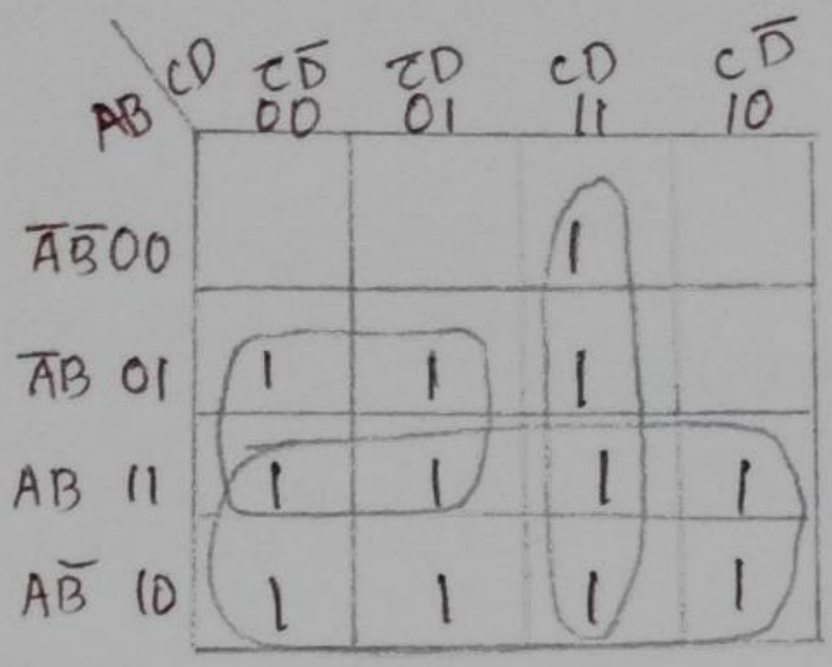
$\bar{A}CD(B+\bar{B}) \Rightarrow \bar{A}BCD + \bar{A}\bar{B}CD$

$\therefore$

$ABCD + ABC\bar{D} + AB\bar{C}D + AB\bar{C}\bar{D} + A\bar{B}CD + A\bar{B}C\bar{D} + A\bar{B}\bar{C}D + A\bar{B}\bar{C}\bar{D} + AB\bar{C}D + AB\bar{C}\bar{D} + \bar{A}B\bar{C}D + \bar{A}B\bar{C}\bar{D} + ABCD + A\bar{B}CD + \bar{A}BCD + \bar{A}\bar{B}CD$

Binary form is :-

$1111 + 1110 + 1101 + 1100 + 1011 + 1010 + 1001 + 1000 + 1101 + 1100 + 0101 + 1010 + 1111 + 1011 + 0111 + 0011$

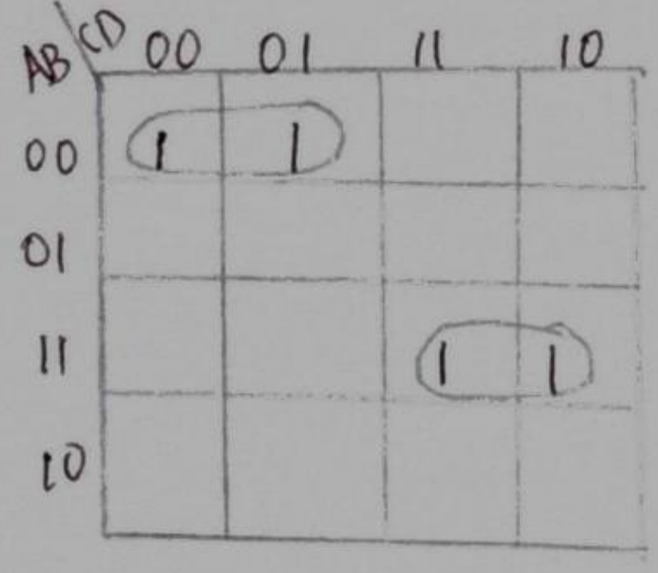


$$B\bar{C} + A + CD$$

b) $\bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + ABCD + ABC\bar{D}$

Binary form:-

0000 + 0001 + 1111 + 1110



$\therefore \quad \bar{A}\bar{B}\bar{C} + ABC$

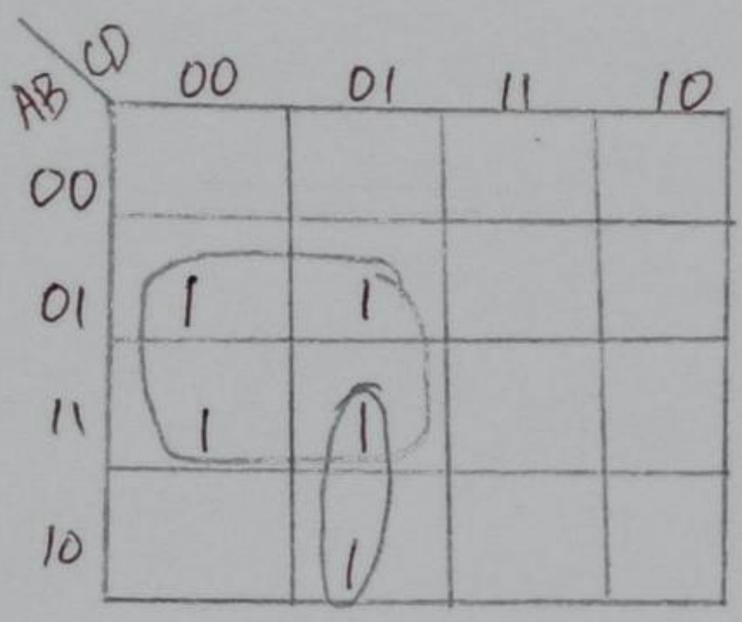
d) ~~$(\bar{A}B + A\bar{B})(CD + C\bar{D})$~~

c) $\bar{A}B(C\bar{C}\bar{D} + \bar{C}D) + AB(C\bar{C}\bar{D} + \bar{C}D) + A\bar{B}\bar{C}D$

$\bar{A}B\bar{C}\bar{D} + \bar{A}B\bar{C}\bar{D} + AB\bar{C}\bar{D} + AB\bar{C}D + A\bar{B}\bar{C}D$

Binary form:-

0100 + 0100 + 1100 + 1101 + 1001

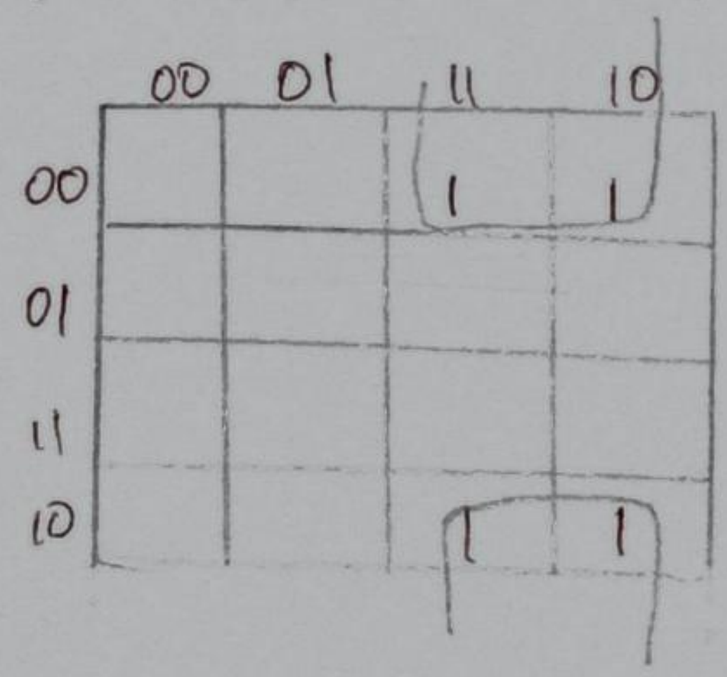


$B\bar{C} + A\bar{C}D$

d) $(\bar{A}\bar{B} + A\bar{B})(CD + C\bar{D})$

$\bar{A}\bar{B}CD + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}CD$

0011 + 0010 + 1010 + 1011



$\bar{B}C$

e) $\bar{A}\bar{B} + A\bar{B} + \bar{C}\bar{D} + C\bar{D}$

$\bar{A}\bar{B}(C+\bar{C}) \Rightarrow \bar{A}\bar{B}C + \bar{A}\bar{B}\bar{C}$

$\bar{A}\bar{B}C(D+\bar{D}) \Rightarrow \bar{A}\bar{B}CD + \bar{A}\bar{B}C\bar{D}$

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

$A\bar{B}C(C+\bar{C}) \Rightarrow A\bar{B}C + A\bar{B}\bar{C}$

$A\bar{B}C(D+\bar{D}) \Rightarrow A\bar{B}CD + A\bar{B}C\bar{D}$

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

$\bar{C}\bar{D}(A+\bar{A}) \Rightarrow A\bar{C}\bar{D} + \bar{A}\bar{C}\bar{D}$

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

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

$C\bar{D}(A+\bar{A}) \Rightarrow AC\bar{D} + \bar{A}C\bar{D}$

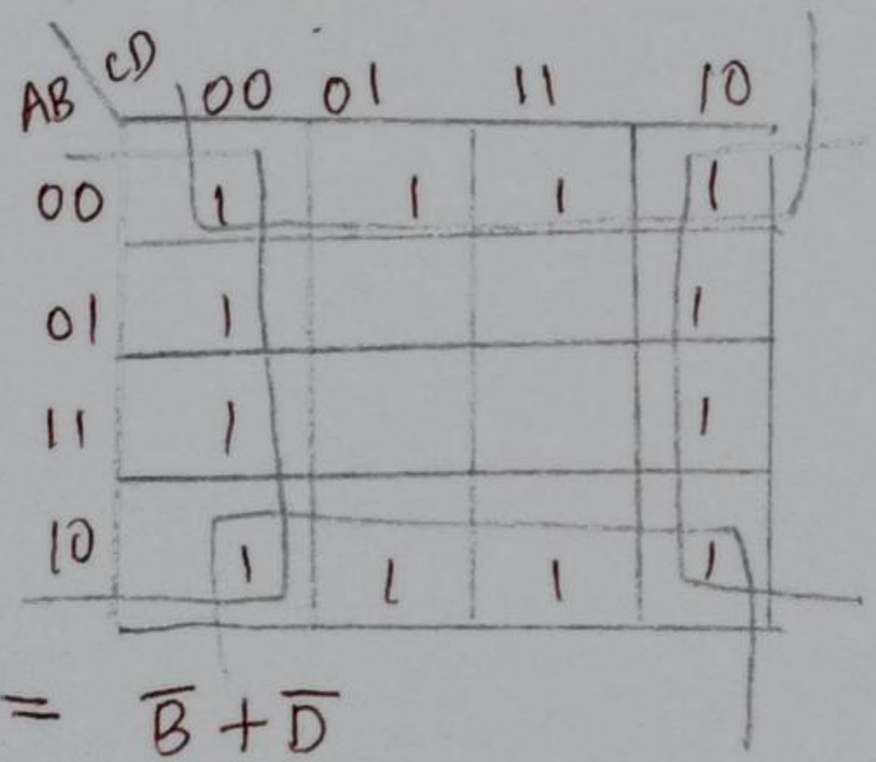
$AC\bar{D}(B+\bar{B}) \Rightarrow ABC\bar{D} + A\bar{B}C\bar{D}$

$\bar{A}C\bar{D}(B+\bar{B}) \Rightarrow \bar{A}BC\bar{D} + \bar{A}\bar{B}C\bar{D}$

That is;

$A\bar{B}CD + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}\bar{D} + A\bar{B}CD + A\bar{B}C\bar{D} + A\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}\bar{D} + A\bar{C}\bar{D}B + A\bar{C}\bar{D}\bar{B} + \bar{A}B\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}\bar{D} + AC\bar{D}B + A\bar{B}C\bar{D} + \bar{A}BC\bar{D} + \bar{A}\bar{B}C\bar{D}$

Binary form:- 0011 + 0010 + 0001 + 0000 + 1011 + 1010 + 1001 + 1000 + 1100 + 0100 + ~~1011~~ 1110 + 0110



$= \bar{B} + \bar{D}$