Name: KEY **Id#**

COE 202, Term 131
Digital Logic Design

Quiz# 2

Date: Thursday, Oct. 3

Q1. Simplify the following Boolean functions to the **minimum** number of literals sum-of-product expressions using algebraic manipulation:

(i) $x'y'z' + x'y'z + x'yz + xy'z + xyz$

$= \bar{x}\bar{y}[\bar{z}+z] + \bar{x}yz + xz[\bar{y}+y]$

$= \bar{x}\bar{y} + \bar{x}yz + xz$

$= \bar{x}[\bar{y}+yz] + xz$

$= \bar{x}[\bar{y}+z] + xz$

$= \bar{x}\bar{y} + \bar{x}z + xz = \bar{x}\bar{y} + z[\bar{x}+x]$

$= \bar{x}\bar{y} + z$

(ii) A B C' + A' C' D + A B' C' + B C' D + A' D

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

$= A\bar{C} + B\bar{C}D + \bar{A}D$ ($\bar{A}\bar{C}D$ is absorbed by $\bar{A}D$)

$= A\bar{C} + B\bar{C}D + \bar{A}D + \bar{C}D$ (by consensus of $\underline{\underline{A}}\bar{C}$ & $\underline{\underline{\bar{A}}}D$)

$= A\bar{C} + \bar{A}D + \bar{C}D$ ($B\bar{C}D$ is absorbed by $\bar{C}D$)

$= A\bar{C} + \bar{A}D$ (by consensus of $\underline{\underline{A}}\bar{C}$ & $\underline{\underline{\bar{A}}}D$)

Q2. Express the function $F(A,B,C,D) = A\,B + \bar{C} + D$ as:

(i) Sum of minterms $\boldsymbol{F}(\boldsymbol{A},\boldsymbol{B},\boldsymbol{C},D) = \sum \boldsymbol{m}(\,)$

$$\begin{array}{cccc} A & B & C & D \\ 1 & 1 & - & - \end{array} = \{1100, 1101, 1110, 1111\}$$
$$= \{m12, m13, m14, m15\}$$

$$\begin{array}{cccc} A & B & C & D \\ - & - & 0 & - \end{array} = \{0000, 0001, 0100, 0101, 1000, 1001, 1100, 1101\}$$
$$= \{m0, m1, m4, m5, m8, m9, m12, m13\}$$

$$\begin{array}{cccc} A & B & C & D \\ - & - & - & 1 \end{array} = \{0001, 0011, 0101, 0111, 1001, 1011, 1101, 1111\}$$
$$= \{m1, m3, m5, m7, m9, m11, m13, m15\}$$

$$F = \sum m\,(0, 1, 3, 4, 5, 7, 8, 9, 11, 12, 13, 14, 15)$$

(ii) Product of maxterms $\boldsymbol{F}(\boldsymbol{A},\boldsymbol{B},\boldsymbol{C},D) = \prod \boldsymbol{M}(\,)$

$$F = \prod M\,(2, 6, 10)$$

Another Solution

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

$$\bar{F} = \bar{A}\,C\,\bar{D} + \bar{B}\,C\,\bar{D}$$

$$\begin{array}{cccc} A & B & C & D \\ 0 & - & 1 & 0 \end{array} = \{0010, 0110\} = \{m2, m6\}$$

$$\begin{array}{cccc} A & B & C & D \\ - & 0 & 1 & 0 \end{array} = \{0010, 1010\} = \{m2, m10\}$$

$$\bar{F} = \sum m\,(2, 6, 10)$$

$$F = \prod M\,(2, 6, 10)$$