Digital Circuit Fall 2019

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Session 1

Logical caculation and Binary code

Session 1 Notes

Logical Caculation

Session 1 Homework

• **Problem 1 - 2.3 (3)** Convert 145.6875_D to Binary**.**

For integer part:

$$145_D = 1001\ 0001_B$$

For Decimal part:

$$0.6875_D = 0.1011_B$$

Hence:

$$145.6875_D = 1001\ 0001.1011_B$$

• **Problem 2 - 2.7 (4)** Prove Logical Equation: $BC + AD = (B + A)(B + D)(A + C)(C + D)$**.**

Proof:

LHS:

$$\begin{aligned} AB + CD &= \overline{\overline{BC + AD}} \\ &= \overline{\overline{BC}\ \overline{AD}} \\ &= \overline{\overline{BC}\ \overline{AD}} \\ &= \overline{(\bar{B} + \bar{C})\,(\bar{A} + \bar{D})} \\ &= \overline{\bar{A}\bar{B} + \bar{B}\bar{D} + \bar{A}\bar{C} + \bar{C}\bar{D}} \end{aligned}$$

RHS:

$$\begin{aligned} (B + A)(B + D)(A + C)(C + D) &= \overline{\overline{(B + A)(B + D)(A + C)(C + D)}} \\ &= \overline{\overline{(B + A)} + \overline{(B + D)} + \overline{(A + C)} + \overline{(C + D)}} \\ &= \overline{\bar{A}\bar{B} + \bar{B}\bar{D} + \bar{A}\bar{C} + \bar{C}\bar{D}} \end{aligned}$$

Hence:

LHS=RHS

Prove Complete.

• **Problem 3 - 2.8 (4)** Find the Reverse Expression of Logical function $L_4 = (A + \bar{B})(\bar{A} + \bar{B} + C)$.

$$\begin{aligned}
\overline{L_4} &= \overline{(A + \bar{B})(\bar{A} + \bar{B} + C)} \\
&= \overline{(A + \bar{B})} + \overline{(\bar{A} + \bar{B} + C)} \\
&= \bar{A}B + \overline{(\bar{A} + \bar{B})}\bar{C} \\
&= \bar{A}B + AB\bar{C}
\end{aligned}$$

• **Problem 4 - 2.11** Consider a specific Logical Circuit with three input $A, B\ and\ C$, its output is 1 when ture inputs are more than false inputs, vice versa. Draw value chart of this circuit and find its Logical Expression.

A	B	C	$Output$
0	0	0	0
1	0	0	0
0	1	0	0
1	1	0	1
0	1	1	1
1	1	1	1
0	0	1	0
1	0	1	1

$$L = AB + BC + AC$$

• **Problem 5 - 2.13 (7)** Simplify Logical Function: $L = \overline{(AB + \bar{B}C)(AC + \bar{A}\bar{C})}$.

$$\begin{aligned}
L &= \overline{(AB + \bar{B}C)(AC + \bar{A}\bar{C})} \\
&= \overline{(AB + \bar{B}C)} + \overline{(AC + \bar{A}\bar{C})} \\
&= \overline{AB}\,\overline{\bar{B}C} + \overline{AC}\,\overline{\bar{A}\bar{C}} \\
&= (\bar{A} + \bar{B})(B + \bar{C}) + (\bar{A} + \bar{C})(A + C) \\
&= \bar{A}B + \bar{A}\bar{C} + \cancel{\bar{B}B} + \bar{B}\bar{C} + \cancel{\bar{A}A} + \bar{A}C + \bar{C}A + \cancel{\bar{C}C} \\
&= \bar{A}(\cancel{\bar{C} + C}) + \bar{A}B + \bar{B}\bar{C} + \bar{C}A \\
&= \bar{A} + \bar{B}\bar{C} + \bar{C}A \\
&= \bar{A} + \bar{B}\bar{C} + \bar{C} \\
&= \bar{A} + \bar{C}
\end{aligned}$$

• **Problem 6 - 2.15 (6)** Use Carno Chart to simplify $L = \Sigma m(2,3,4,5,9) + \Sigma d(10,11,12,13)$**.**

$CD \diagdown AB$	0 0	0 1	1 1	1 0
0 0			1	1
0 1	1	1		
1 1	x	x		
1 0		1	x	x

$$L = \bar{A}D + A\bar{D} + BC\bar{D}$$