

数字电子技术作业(一)

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2.1.3 应用反演规则和对偶规则,求下列函数的非函数和对偶函数:

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

$$(2)L = \bar{A} \cdot \bar{B} + \overline{\bar{A} \cdot B \cdot \bar{C} \cdot D}$$

解:

$$(1)\bar{L} = (\bar{A} + \bar{B})(A + B), L' = (A + B)(\bar{A} + \bar{B})$$

$$(2)\bar{L} = (A + B)(\overline{A + \bar{B} + C + D}), L' = (\bar{A} + \bar{B})(\overline{\bar{A} + B + \bar{C} + D})$$

2.2.3 试写出下列各个函数的最小项表达式:

$$(3)L = \overline{AB} + ABD(B + \bar{C}D)$$

$$(4)L = \overline{(AB + BC)AB}$$

解:

(3)

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

(4)

$$\begin{aligned} L &= \overline{(AB + BC)AB} \\ &= \overline{AB} \cdot \overline{BC} + AB \\ &= (\bar{A} + B)(\bar{B} + C) + AB \\ &= B + \bar{A}C \\ &= B(\bar{A} + A)(\bar{C} + C) \\ &= ABC + \bar{A}B\bar{C} + \bar{A}BC + AB\bar{C} + \bar{A}BC \end{aligned}$$

2.3.1 用代数法将下列各式化简成最简的与-或表达式

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

$$(2) \overline{B} + ABC + \overline{AC} + \overline{AB}$$

$$(3) \overline{ABC\overline{D}} + \overline{ABD} + \overline{BC\overline{D}} + \overline{ABCD} + \overline{BC}$$

$$(4) \overline{AC + \overline{ABC} + \overline{BC} + \overline{ABC}}$$

解:

(1)

$$\begin{aligned} L &= \overline{\overline{AB} + \overline{A} \cdot \overline{B} + (A + \overline{B})(\overline{A} + B)} \\ &= \overline{\overline{B} + \overline{AB} + \overline{AB}} \\ &= \overline{\overline{AB} + \overline{AB}} \\ &= \overline{\overline{AB} \cdot \overline{AB}} \end{aligned}$$

$$= (A + \overline{B})(\overline{A} + B)$$

$$= \overline{AB} + A\overline{B}$$

(2)

$$\begin{aligned} L &= \overline{B} + \overline{A\overline{B}C} + \overline{A} + \overline{C} + \overline{A} + \overline{B} \\ &= \overline{A} + \overline{B} + \overline{C} + \overline{A\overline{B}C} \\ &= \overline{A} + \overline{BC} + \overline{B} + \overline{C} \\ &= \overline{A} + \overline{B} + \overline{C} \end{aligned}$$

(3)

$$\begin{aligned} L &= \overline{ABC} + \overline{ABD} + \overline{BC\overline{D}} + \overline{BC} \\ &= \overline{BC} + \overline{BD} + \overline{AB} \end{aligned}$$

(4)

$$\begin{aligned} L &= \overline{(AC + \overline{ABC}) \cdot \overline{BC} \cdot \overline{ABC}} \\ &= C(A + \overline{AB})(B + \overline{C})(\overline{A} + \overline{B} + C) \\ &= (A + B)BC(\overline{A} + \overline{B} + C) \\ &= (ABC + BC)(\overline{A} + \overline{B} + C) \\ &= \overline{ABC} + \overline{ABC} + BC \\ &= BC \end{aligned}$$

2.4.3 用卡诺图法化简下列各式:

$$(1) \overline{A\overline{B}CD} + \overline{AB\overline{C}D} + \overline{A\overline{B}} + \overline{A\overline{D}} + \overline{A\overline{B}C}$$

$$(2) \overline{A\overline{B}CD} + D(\overline{B} \cdot \overline{CD}) + (A + C)\overline{B\overline{D}} + \overline{A(\overline{B} + C)}$$

$$(3) L(A, B, C, D) = \sum m(0, 2, 4, 8, 10, 12)$$

$$(4) L(A, B, C, D) = \sum m(0, 4, 6, 13, 14, 15) + \sum d(1, 2, 3, 5, 7, 9, 10, 11)$$

解:

(1)卡诺图如下：(其中列为AB, 行为CD)

L	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	1	1	0	1
10	1	1	1	1

Figure 1: 2.4.3(1)

故原式= $A\bar{D} + A\bar{C} + A\bar{B}$

(2)先简单化简表达式： $L = A\bar{B}CD + \bar{B} \cdot \bar{C}D + AB\bar{D} + B\bar{C}\bar{D} + \bar{A}B\bar{C}$

卡诺图如下：(其中列为AB, 行为CD)

L	00	01	11	10
00	0	1	0	0
01	1	1	0	1
11	1	0	0	1
10	0	1	1	0

Figure 2: 2.4.3(2)

故原式= $B\bar{D} + \bar{A} \cdot \bar{C}D + A\bar{B}D$

(3)卡诺图如下：(其中列为AB, 行为CD)

L	00	01	11	10
00	1	0	0	1
01	1	0	0	0
11	1	0	0	0
10	1	0	0	1

Figure 3: 2.4.3(3)

$$\text{故原式} = \bar{C} \cdot \bar{D} + \bar{A} \cdot \bar{B} \cdot \bar{D} + AB\bar{D}$$

(3)卡诺图如下：(其中列为AB, 行为CD)

L	00	01	11	10
00	1	0	0	1
01	1	0	0	0
11	1	0	0	0
10	1	0	0	1

Figure 4: 2.4.3(3)

$$\text{故原式} = \bar{C} \cdot \bar{D} + \bar{B} \cdot \bar{D}$$

(4)卡诺图如下：(其中列为AB, 行为CD)

L	00	01	11	10
00	1	×	×	×
01	1	×	×	1
11	0	1	1	1
10	0	×	×	×

Figure 5: 2.4.3(4)

$$\text{故原式} = \bar{A} + C + D$$

2.4.4 用卡诺图化简法,求下列函数的最简或-与表达式

$$(1)L(A,B,C,D) = A\bar{C} + AD + \bar{B} \cdot \bar{C} + \bar{B}D$$

$$(2)L(A,B,C,D) = \sum m(3,4,5,7,13,14,15)$$

解：

(1)卡诺图如下：(其中列为AB, 行为CD)

L	00	01	11	10
00	1	1	1	0
01	0	0	0	0
11	1	1	1	0
10	1	1	1	0

Figure 6: 2.4.4(1)

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

(2)卡诺图如下：(其中列为AB, 行为CD)

L	00	01	11	10
00	0	0	1	0
01	1	1	1	0
11	0	1	1	1
10	0	0	0	0

Figure 7: 2.4.4(2)

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