Курсовая работа по дискретной математике

«Синтез комбинационных схем»

Часть 1

Выполнил Куперштейн Дмитрий, группа P3113

Вариант 111

# Условие

|  |  |
| --- | --- |
| f = 1 | f = d |
| (X1X2 + X3X4X5) = 1, 5, 6, 7, 8 | (X3X4X5) = 6 |

# Таблица истинности

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **N** | **X1X2X3X4X5** | **X1X2** | **(X1X2)10** | **X3X4X5** | **(X3X4X5)10** | **+** | **f** |
| 0 | 00000 | 00 | 0 | 000 | 0 | 0 | 0 |
| 1 | 00001 | 00 | 0 | 001 | 1 | 1 | 1 |
| 2 | 00010 | 00 | 0 | 010 | 2 | 2 | 0 |
| 3 | 00011 | 00 | 0 | 011 | 3 | 3 | 0 |
| 4 | 00100 | 00 | 0 | 100 | 4 | 4 | 0 |
| 5 | 00101 | 00 | 0 | 101 | 5 | 5 | 1 |
| 6 | 00110 | 00 | 0 | 110 | 6 | 6 | d |
| 7 | 00111 | 00 | 0 | 111 | 7 | 7 | 1 |
| 8 | 01000 | 01 | 1 | 000 | 0 | 1 | 1 |
| 9 | 01001 | 01 | 1 | 001 | 1 | 2 | 0 |
| 10 | 01010 | 01 | 1 | 010 | 2 | 3 | 0 |
| 11 | 01011 | 01 | 1 | 011 | 3 | 4 | 0 |
| 12 | 01100 | 01 | 1 | 100 | 4 | 5 | 1 |
| 13 | 01101 | 01 | 1 | 101 | 5 | 6 | 1 |
| 14 | 01110 | 01 | 1 | 110 | 6 | 7 | d |
| 15 | 01111 | 01 | 1 | 111 | 7 | 8 | 1 |
| 16 | 10000 | 10 | 2 | 000 | 0 | 2 | 0 |
| 17 | 10001 | 10 | 2 | 001 | 1 | 3 | 0 |
| 18 | 10010 | 10 | 2 | 010 | 2 | 4 | 0 |
| 19 | 10011 | 10 | 2 | 011 | 3 | 5 | 1 |
| 20 | 10100 | 10 | 2 | 100 | 4 | 6 | 1 |
| 21 | 10101 | 10 | 2 | 101 | 5 | 7 | 1 |
| 22 | 10110 | 10 | 2 | 110 | 6 | 8 | d |
| 23 | 10111 | 10 | 2 | 111 | 7 | 9 | 0 |
| 24 | 11000 | 11 | 3 | 000 | 0 | 3 | 0 |
| 25 | 11001 | 11 | 3 | 001 | 1 | 4 | 0 |
| 26 | 11010 | 11 | 3 | 010 | 2 | 5 | 1 |
| 27 | 11011 | 11 | 3 | 011 | 3 | 6 | 1 |
| 28 | 11100 | 11 | 3 | 100 | 4 | 7 | 1 |
| 29 | 11101 | 11 | 3 | 101 | 5 | 8 | 1 |
| 30 | 11110 | 11 | 3 | 110 | 6 | 9 | d |
| 31 | 11111 | 11 | 3 | 111 | 7 | 10 | 0 |

# Аналитический вид

**КДНФ**:

**ККНФ:**

# Минимизация булевой функции методом Квайна--Мак-Класки

Максимальные кубы:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***K0(f) ∪ N(f)*** | | | ***K1(f)*** | | | | | ***K2(f)*** | | | | ***Z(f)*** | | |
| 1 | 00001 | *v* | 1 | 00X01 | 1-2 |  | 1 | | 0X1X1 | 2-13 | 1 | | 00X01 |
| 2 | 00101 | *v* | 2 | 001X1 | 2-4 | *V* | 2 | | XX101 | 3-21 | 2 | | 01X00 |
| 3 | 00110 | *v* | 3 | 0X101 | 2-7 | *V* | 3 | | 0X11X | 5-15 | 3 | | 1X011 |
| 4 | 00111 | *v* | 4 | X0101 | 2-12 | *V* | 4 | | XX110 | 6-22 | 4 | | 1101X |
| 5 | 01000 | *v* | 5 | 0011X | 3-4 | *V* | 5 | | 011XX | 10-15 | 5 | | 11X10 |
| 6 | 01100 | *v* | 6 | 0X110 | 3-8 | *V* | 6 | | X110X | 10-25 | 6 | | 0X1X1 |
| 7 | 01101 | *v* | 7 | X0110 | 3-13 | *V* | 7 | | X11X0 | 11-26 | 7 | | XX101 |
| 8 | 01110 | *v* | 8 | 0X111 | 4-9 | *V* | 8 | | 1X10X | 18-25 | 8 | | 0X11X |
| 9 | 01111 | *v* | 9 | 01X00 | 5-6 |  | 9 | | 1X1X0 | 19-26 | 9 | | XX110 |
| 10 | 10011 | *v* | 10 | 0110X | 6-7 | *V* |  | |  |  | 10 | | 011XX |
| 11 | 10100 | *v* | 11 | 011X0 | 6-8 | *V* | K3(f) = ∅ | | | | 11 | | X110X |
| 12 | 10101 | *v* | 12 | X1100 | 6-16 | *V* |  | |  |  | 12 | | X11X0 |
| 13 | 10110 | *v* | 13 | 011X1 | 7-9 | *V* |  | |  |  | 13 | | 1X10X |
| 14 | 11010 | *v* | 14 | X1101 | 7-17 | *V* |  | |  |  | 14 | | 1X1X0 |
| 15 | 11011 | *v* | 15 | 0111X | 8-9 | *V* |  | |  |  |  | |  |
| 16 | 11100 | *v* | 16 | X1110 | 8-18 | *V* |  | |  |  |  | |  |
| 17 | 11101 | *v* | 17 | 1X011 | 10-15 |  |  | |  |  |  | |  |
| 18 | 11110 | *v* | 18 | 1010X | 11-12 | *V* |  | |  |  |  | |  |
|  |  |  | 19 | 101X0 | 11-13 | *V* |  | |  |  |  | |  |
|  |  |  | 20 | 1X100 | 11-16 | *V* |  | |  |  |  | |  |
|  |  |  | 21 | 1X101 | 12-17 | *V* |  | |  |  |  | |  |
|  |  |  | 22 | 1X110 | 13-18 | *V* |  | |  |  |  | |  |
|  |  |  | 23 | 1101X | 14-15 |  |  | |  |  |  | |  |
|  |  |  | 24 | 11X10 | 14-18 |  |  | |  |  |  | |  |
|  |  |  | 25 | 1110X | 16-17 | *V* |  | |  |  |  | |  |
|  |  |  | 26 | 111X0 | 16-18 | *V* |  | |  |  |  | |  |

## Импликантная таблица:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Простые импликанты (максимальные кубы) | | 0-кубы | | | | | | | | | | | | | |
| 00001 | 00101 | 00111 | 01000 | 01100 | 01101 | 01111 | 10011 | 10100 | 10101 | 11010 | 11011 | 11100 | 11101 |
| **1** | **00X01** | (\*) | **\*** |  |  |  |  |  |  |  |  |  |  |  |  |
| **2** | **01X00** |  |  |  | (\*) | **\*** |  |  |  |  |  |  |  |  |  |
| **3** | **1X011** |  |  |  |  |  |  |  | (\*) |  |  |  | **\*** |  |  |
| 4 | 1101X |  |  |  |  |  |  |  |  |  |  | \* | \* |  |  |
| 5 | 11X10 |  |  |  |  |  |  |  |  |  |  | \* |  |  |  |
| 6 | 0X1X1 |  | \* | \* |  |  | \* | \* |  |  |  |  |  |  |  |
| 7 | XX101 |  | \* |  |  |  | \* |  |  |  | \* |  |  |  | \* |
| 8 | 0X11X |  |  | \* |  |  |  | \* |  |  |  |  |  |  |  |
| **9** | **XX110** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 10 | 011XX |  |  |  |  | \* | \* | \* |  |  |  |  |  |  |  |
| 11 | X110X |  |  |  |  | \* | \* |  |  |  |  |  |  | \* | \* |
| 12 | X11X0 |  |  |  |  | \* |  |  |  |  |  |  |  | \* |  |
| 13 | 1X10X |  |  |  |  |  |  |  |  | \* | \* |  |  | \* | \* |
| 14 | 1X1X0 |  |  |  |  |  |  |  |  | \* |  |  |  | \* |  |

## Приведённая импликантная таблица

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Простые импликанты (максимальные кубы) | | | 0-кубы | | | | | | | |
| 00111 | 01101 | 01111 | 10100 | 10101 | 11010 | 11100 | 11101 |
| 4 | 1101X | A |  |  |  |  |  | \* |  |  |
| 5 | 11X10 | B |  |  |  |  |  | \* |  |  |
| 6 | 0X1X1 | C | \* | \* | \* |  |  |  |  |  |
| 7 | XX101 | D |  | \* |  |  | \* |  |  | \* |
| 8 | 0X11X | E | \* |  | \* |  |  |  |  |  |
| 10 | 011XX | F |  | \* | \* |  |  |  |  |  |
| 11 | X110X | G |  | \* |  |  |  |  | \* | \* |
| 12 | X11X0 | H |  |  |  |  |  |  | \* |  |
| 13 | 1X10X | I |  |  |  | \* | \* |  | \* | \* |
| 14 | 1X1X0 | J |  |  |  | \* |  |  | \* |  |

## Ядро

## Определение минимального покрытия методом Петрика

Применим закон поглощения:

Возможны следующие варианты покрытия:

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Возможны два минимальных покрытия: и . Тогда

**МДНФ** :.

**МДНФ** :

# Минимизация булевой функции на картах Карно

## Единичные покрытия



Получаем

**МДНФ**:

Важно отметить, что цены минимальных покрытий, полученных методом Квайна—Мак-Класки и с помощью карт Карно совпадают.

## Нулевые покрытия



Получим

**МКНФ**: