САНКТ-ПЕТЕРГБУРГСКИЙ НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСИТЕТ

ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ, МЕХАНИКИ И ОПТИКИ

**Курсовая работа**

***«Синтез комбинационных схем»***

*Вариант 25*

Выполнил:

студент 1-го курса

группы 1125

Припадчев Артём

Проверил: Раков С.В.

Санкт-Петербург, 2013

|  |  |
| --- | --- |
| **Условие, при котором f = 1** | **Условие, при котором f = d** |
| (x4x5+x1x2x3)=3, 5, 8, 10 | (x1x2x4)=0 |

1. **Составление таблицы истинности**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| № | X1 | X2 | X3 | X4 | X5 | X1X4 | | (X1X4)10 | X2X3X5 | | | (X2X3X5)10 | | - | |  | **f** |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  | **0** |
| 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |  | **1** |
| 3 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |  | **1** |
| 4 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |  | **0** |
| 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 2 |  | **1** |
| 6 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 3 |  | **d** |
| 7 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 2 | 1 |  | **1** |
| 8 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 3 | 2 |  | **1** |
| 9 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 4 | 4 |  | **0** |
| 10 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 5 | 5 |  | **0** |
| 11 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 4 | 3 |  | **d** |
| 12 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 5 | 4 |  | **0** |
| 13 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 6 | 6 |  | **0** |
| 14 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 7 | 7 |  | **0** |
| 15 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 6 | 5 |  | **0** |
| 16 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 7 | 6 |  | **0** |
| 17 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |  | **1** |
| 18 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 1 |  | **1** |
| 19 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 3 | 0 | 0 | 0 | 0 | 3 |  | **d** |
| 20 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 3 | 0 | 0 | 1 | 1 | 2 |  | **1** |
| 21 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 2 | 0 | 1 | 0 | 2 | 0 |  | **0** |
| 22 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 2 | 0 | 1 | 1 | 3 | 1 |  | **1** |
| 23 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 3 | 0 | 1 | 0 | 2 | 1 |  | **1** |
| 24 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 3 | 0 | 1 | 1 | 3 | 0 |  | **0** |
| 25 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 1 | 0 | 0 | 4 | 2 |  | **1** |
| 26 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 2 | 1 | 0 | 1 | 5 | 3 |  | **d** |
| 27 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 3 | 1 | 0 | 0 | 4 | 1 |  | **1** |
| 28 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 3 | 1 | 0 | 1 | 5 | 2 |  | **1** |
| 29 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 2 | 1 | 1 | 0 | 6 | 4 |  | **0** |
| 30 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 7 | 5 |  | **0** |
| 31 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 3 | 1 | 1 | 0 | 6 | 3 |  | **d** |
| 32 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 7 | 4 |  | **0** |

1. **Представить булевую функцию в аналитическом виде с помощью КДНФ и ККНФ**

\_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

КДНФ: ƒ = X1X2X3X4X5 v X1X2X3X4X5 v X1X2X3X4X5 v X1X2X3X4X5 v X1X2X3X4X5 v

\_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

v X1X2X3X4X5 v X1X2X3X4X5 v X1X2X3X4X5 v X1X2X3X4X5 v X1X2X3X4X5 v X1X2X3X4X5 v

\_ \_ \_

v X1X2X3X4X5 v X1X2X3X4X5

\_ \_ \_

ККНФ: ƒ = (X1 v X2 v X3 v X4 v X5)(X1 v X2 v X3 v X4 v X5)(X1 v X2 v X3 v X4 v X5)

\_ \_ \_ \_ \_ \_ \_

(X1 v X2 v X3 v X4 v X5)(X1 v X2 v X3 v X4 v X5)(X1 v X2 v X3 v X4 v X5)

\_ \_ \_ \_ \_ \_ \_ \_ \_ \_

(X1 v X2 v X3 v X4 v X5)(X1 v X2 v X3 v X4 v X5)(X1 v X2 v X3 v X4 v X5)

\_ \_ \_ \_ \_ \_ \_ \_ \_

(X1 v X2 v X3 v X4 v X5)(X1 v X2 v X3 v X4 v X5)(X1 v X2 v X3 v X4 v X5)

\_ \_ \_ \_ \_ \_ \_ \_ \_

(X1 v X2 v X3 v X4 v X5)(X1 v X2 v X3 v X4 v X5)

1. **Минимизация булевой функции методом Квайна-Мак-Класки**

а) Нахождение простых импликант

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ko(ƒ) N(ƒ) | | | K1(ƒ) | | | | K2(ƒ) | | | | K3(ƒ) | Z(ƒ) | |
| 1 | 00001 |  | 1 | 00x01 |  |  | 1 | x0x01 |  |  | 1x0xx |  | x0x01 |
| 2 | 00010 |  | 2 | x0001 |  |  | 2 | x0x10 |  |  |  |  | x0x10 |
| 3 | 00100 |  | 3 | 00x10 |  |  | 3 | xx010 |  |  |  |  | xx010 |
| 4 | 00101 |  | 4 | 0x010 |  |  | 4 | 001xx |  |  |  |  | 001xx |
| 5 | 00110 |  | 5 | x0010 |  |  | 5 | 100xx |  |  |  |  | 1xx10 |
| 6 | 00111 |  | 6 | 0010x |  |  | 6 | 1x00x |  |  |  |  | 1x0xx |
| 7 | 01010 |  | 7 | 001x0 |  |  | 7 | 1x0x0 |  |  |  |  |  |
| 8 | 10000 |  | 8 | 001x1 |  |  | 8 | 1x0x1 |  |  |  |  |  |
| 9 | 10001 |  | 9 | x0101 |  |  | 9 | 1x01x |  |  |  |  |  |
| 10 | 10010 |  | 10 | 0011x |  |  | 10 | 1xx10 |  |  |  |  |  |
| 11 | 10011 |  | 11 | x0110 |  |  | 11 | 110xx |  |  |  |  |  |
| 12 | 10101 |  | 12 | x1010 |  |  |  |  |  |  |  |  |  |
| 13 | 10110 |  | 13 | 1000x |  |  |  |  |  |  |  |  |  |
| 14 | 11000 |  | 14 | 100x0 |  |  |  |  |  |  |  |  |  |
| 15 | 11001 |  | 15 | 1x000 |  |  |  |  |  |  |  |  |  |
| 16 | 11010 |  | 16 | 100x1 |  |  |  |  |  |  |  |  |  |
| 17 | 11011 |  | 17 | 10x01 |  |  |  |  |  |  |  |  |  |
| 18 | 11110 |  | 18 | 1x001 |  |  |  |  |  |  |  |  |  |
|  |  |  | 19 | 1001x |  |  |  |  |  |  |  |  |  |
|  |  |  | 20 | 10x10 |  |  |  |  |  |  |  |  |  |
|  |  |  | 21 | 1x010 |  |  |  |  |  |  |  |  |  |
|  |  |  | 22 | 1x011 |  |  |  |  |  |  |  |  |  |
|  |  |  | 23 | 1x110 |  |  |  |  |  |  |  |  |  |
|  |  |  | 24 | 1100x |  |  |  |  |  |  |  |  |  |
|  |  |  | 25 | 110x0 |  |  |  |  |  |  |  |  |  |
|  |  |  | 26 | 110x1 |  |  |  |  |  |  |  |  |  |
|  |  |  | 27 | 1101x |  |  |  |  |  |  |  |  |  |
|  |  |  | 28 | 11x10 |  |  |  |  |  |  |  |  |  |

Импликантная таблица:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0-кубы | | | | | | | | | | | | | |
| Импликанты |  | 0  0  0  0  1 | 0  0  0  1  0 | 0  0  1  0  0 | 0  0  1  1  0 | 0  0  1  1  1 | 1  0  0  0  0 | 1  0  0  0  1 | 1  0  0  1  1 | 1  0  1  0  1 | 1  0  1  1  0 | 1  1  0  0  0 | 1  1  0  1  0 | 1  1  0  1  1 |
|  |  | a | b | c | d | e | f | g | h | i | j | k | l | m |
| x0x01 | A |  |  |  |  |  |  |  |  |  |  |  |  |  |
| x0x10 | B |  |  |  |  |  |  |  |  |  |  |  |  |  |
| xx010 | C |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 001xx | D |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1xx10 | E |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1x0xx | F |  |  |  |  |  |  |  |  |  |  |  |  |  |

#### Множество существенных импликант

Ядро:

#### T=

Приведённая Импликантная таблица

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | 0  0  0  1  0 | 1  0  1  1  0 |
|  |  | b | j |
| x0x10 | B |  |  |
| xx010 | C |  |  |
| 1xx10 | E |  |  |

Определение минимального покрытия методом Петрика

z=(BvC)(BvE)=(BBvBEvCBvCE)=(BvCE)

C1= C2=

Cmin1(f)= Сmin2(f)=

S1a=11, S1b=15 S2a=14, S2b=19

Дальнейшее упрощение импликантной таблици

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | 0  0  0  1  0 | 1  0  1  1  0 |
|  |  | b | j |
| x0x10 | B |  |  |
| xx010 | C |  |  |
| 1xx10 | E |  |  |

Cmin3(f)= - идентично Cmin1(f)

S1a=11, S1b=15

МДНФ:

\_ \_ \_ \_ \_ \_ \_

f = X2X4X5 v X1X2X3 v X1X3 v X2X4X5

Сmin2(f)=

МДНФ:

\_ \_ \_ \_ \_ \_ \_ \_

f = X2X4X5 v X1X2X3 v X1X3 v X3X4X5 v X1X4X5

б) Нахождение простых имплицент

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ko() N() | | | K1() | | | | K2() | | | | K3() | Z() | |
| 1 | 00000 |  | 1 | 0x000 |  |  | 1 | 010xx |  |  | 01xxx | 1 | 10010 |
| 2 | 00011 |  | 2 | 0x011 |  |  | 2 | 01x0x |  |  | x11xx | 2 | 0x000 |
| 3 | 00101 |  | 3 | 0x101 |  |  | 3 | 01xx0 |  |  |  | 3 | 0x011 |
| 4 | 01000 |  | 4 | 0100x |  |  | 4 | 01xx1 |  |  |  | 4 | 0x101 |
| 5 | 01001 |  | 5 | 010x0 |  |  | 5 | x1x01 |  |  |  | 5 | 1x100 |
| 6 | 01010 |  | 6 | 01x00 |  |  | 6 | 01x1x |  |  |  | 6 | 1x111 |
| 7 | 01011 |  | 7 | 010x1 |  |  | 7 | 011xx |  |  |  | 7 | x1x01 |
| 8 | 01100 |  | 8 | 01x01 |  |  | 8 | x110x |  |  |  | 8 | 01xxx |
| 9 | 01101 |  | 9 | x1001 |  |  | 9 | x11x0 |  |  |  | 9 | x11xx |
| 10 | 01110 |  | 10 | 0101x |  |  | 10 | x11x1 |  |  |  |  |  |
| 11 | 01111 |  | 11 | 01x10 |  |  | 11 | x111x |  |  |  |  |  |
| 12 | 10010 |  | 12 | 01x11 |  |  | 12 | 111xx |  |  |  |  |  |
| 13 | 10100 |  | 13 | 0110x |  |  |  |  |  |  |  |  |  |
| 14 | 10111 |  | 14 | 011x0 |  |  |  |  |  |  |  |  |  |
| 15 | 11001 |  | 15 | x1100 |  |  |  |  |  |  |  |  |  |
| 16 | 11100 |  | 16 | 011x1 |  |  |  |  |  |  |  |  |  |
| 17 | 11101 |  | 17 | x1101 |  |  |  |  |  |  |  |  |  |
| 18 | 11110 |  | 18 | 0111x |  |  |  |  |  |  |  |  |  |
| 19 | 11111 |  | 19 | x1110 |  |  |  |  |  |  |  |  |  |
|  |  |  | 20 | x1111 |  |  |  |  |  |  |  |  |  |
|  |  |  | 21 | 1x100 |  |  |  |  |  |  |  |  |  |
|  |  |  | 22 | 1x111 |  |  |  |  |  |  |  |  |  |
|  |  |  | 23 | 11x01 |  |  |  |  |  |  |  |  |  |
|  |  |  | 24 | 1110x |  |  |  |  |  |  |  |  |  |
|  |  |  | 25 | 111x0 |  |  |  |  |  |  |  |  |  |
|  |  |  | 26 | 111x1 |  |  |  |  |  |  |  |  |  |
|  |  |  | 27 | 1111x |  |  |  |  |  |  |  |  |  |

Имплицентная таблица:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0-кубы | | | | | | | | | | | | | | |
| Имплиценты |  | 0  0  0  0  0 | 0  0  0  1  1 | 0  1  0  0  0 | 0  1  0  0  1 | 0  1  0  1  1 | 0  1  1  0  0 | 0  1  1  0  1 | 0  1  1  1  0 | 0  1  1  1  1 | 1  0  1  0  0 | 1  0  1  1  1 | 1  1  1  0  0 | 1  1  1  0  1 | 1  1  1  1  1 |
|  |  | a | b | c | d | e | f | g | h | i | j | k | l | m | n |
| 10010 | A |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 0x000 | B |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 0x011 | C |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 0x101 | D |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1x100 | E |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1x111 | F |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| x1x01 | G |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 01xxx | H |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| x11xx | I |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Приведённая имплицентная таблица:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0-кубы | | | | | | |
| Имплиценты |  | 0  1  0  0  1 | 0  1  1  0  0 | 0  1  1  0  1 | 0  1  1  1  0 | 0  1  1  1  1 | 1  1  1  0  1 |
|  |  | d | f | g | h | i | m |
| 0x101 | D |  |  |  |  |  |  |
| x1x01 | G |  |  |  |  |  |  |
| 01xxx | H |  |  |  |  |  |  |
| x11xx | I |  |  |  |  |  |  |

#### Множество существенных имплицент

Ядро:

#### T=

Определение минимального покрытия методом Петрика

z=(GvH)(HvI)(DvGvHvI)(HvI)(HvI)(GvI)= (GvH)(HvI)(GvI)=(GvH)(HGvHIvIGvI)=(HGvHIGvIGvGIvHGvHIvHIGvIH)= (GHvGIvHI)

C1= C2= C3=

C1(f)= С2(f)= С3(f)=

S1a=21, S1b=27 S2a=21, S2b=27 S3a=20, S3b=26

МКНФ:

\_ \_ \_ \_

f = (X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)

\_ \_ \_ \_ \_ \_ \_

(X1 v X3 v X4 v X5)(X2 v X4 v X5)(X1 v X2)

\_ \_ \_ \_

f = (X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)

\_ \_ \_ \_ \_ \_ \_ \_

(X1 v X3 v X4 v X5)(X2 v X4 v X5)(X2 v X3)

\_ \_ \_ \_

f = (X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)

\_ \_ \_ \_ \_ \_ \_

(X1 v X3 v X4 v X5)(X1 v X2) (X2 v X3)

1. **Минимизация булевой функции на картах Карно**

4

Единичные покрытия

1

2

1 вариант:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **X1=0** |  |  | X4X5 | | | |  | **X1=1** |  |  | X4X5 | | | |
|  |  |  | 00 | 01 | 11 | 10 |  |  |  |  | 00 | 01 | 11 | 10 |
| X2X3 | 00 |  | 1 |  | 1 |  | X2X3 | 00 | 1 | 1 | 1 | d |
| 01 | 1 | d | 1 | 1 |  | 01 |  | 1 |  | 1 |
| 11 |  |  |  |  |  | 11 |  |  |  | d |
| 10 |  |  |  | d |  | 10 | 1 | d | 1 | 1 |

C1(f)=

3

S1a=11, S1b=15

МДНФ:

\_ \_ \_ \_ \_ \_ \_

f = X2X4X5 v X1X2X3 v X1X3 v X2X4X5

1

3

2

2 вариант:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **X1=0** |  |  | X4X5 | | | |  | **X1=1** |  |  | X4X5 | | | |
|  |  |  | 00 | 01 | 11 | 10 |  |  |  |  | 00 | 01 | 11 | 10 |
| X2X3 | 00 |  | 1 |  | 1 |  | X2X3 | 00 | 1 | 1 | 1 | d |
| 01 | 1 | d | 1 | 1 |  | 01 |  | 1 |  | 1 |
| 11 |  |  |  |  |  | 11 |  |  |  | d |
| 10 |  |  |  | d |  | 10 | 1 | d | 1 | 1 |

С2(f)=

5

4

МДНФ:

\_ \_ \_ \_ \_ \_ \_ \_

f = X2X4X5 v X1X2X3 v X1X3 v X3X4X5 v X1X4X5

S2a=14, S2b=19

Нулевые покрытия

4

3

1 вариант:

2

1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **X1=0** |  |  | X4X5 | | | |  | **X1=1** |  |  | X4X5 | | | |
|  |  |  | 00 | 01 | 11 | 10 |  |  |  |  | 00 | 01 | 11 | 10 |
| X2X3 | 00 | 0 |  | 0 |  |  | X2X3 | 00 |  |  |  | d |
| 01 |  | d |  |  |  | 01 | 0 |  | 0 |  |
| 11 | 0 | 0 | 0 | 0 |  | 11 | 0 | 0 | 0 | d |
| 10 | 0 | 0 | 0 | d |  | 10 |  | d |  |  |

6

C1(f)=

5

S1a=21, S1b=27

МКНФ:

\_ \_ \_ \_

f = (X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)

\_ \_ \_ \_ \_ \_ \_

(X1 v X3 v X4 v X5)(X2 v X4 v X5)(X1 v X2)

4

3

1

2 вариант:

2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **X1=0** |  |  | X4X5 | | | |  | **X1=1** |  |  | X4X5 | | | |
|  |  |  | 00 | 01 | 11 | 10 |  |  |  |  | 00 | 01 | 11 | 10 |
| X2X3 | 00 | 0 |  | 0 |  |  | X2X3 | 00 |  |  |  | d |
| 01 |  | d |  |  |  | 01 | 0 |  | 0 |  |
| 11 | 0 | 0 | 0 | 0 |  | 11 | 0 | 0 | 0 | d |
| 10 | 0 | 0 | 0 | d |  | 10 |  | d |  |  |

5

С2(f)=

6

S2a=20, S2b=26

МКНФ:

\_ \_ \_ \_

f = (X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)

\_ \_ \_ \_ \_ \_ \_

(X1 v X3 v X4 v X5)(X1 v X2) (X2 v X3)

6

2

3 вариант:

1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **X1=0** |  |  | X4X5 | | | |  | **X1=1** |  |  | X4X5 | | | |
|  |  |  | 00 | 01 | 11 | 10 |  |  |  |  | 00 | 01 | 11 | 10 |
| X2X3 | 00 | 0 |  | 0 |  |  | X2X3 | 00 |  |  |  | d |
| 01 |  | d |  |  |  | 01 | 0 |  | 0 |  |
| 11 | 0 | 0 | 0 | 0 |  | 11 | 0 | 0 | 0 | d |
| 10 | 0 | 0 | 0 | d |  | 10 |  | d |  |  |

3

С3(f)=

5

4

S3a=21, S3b=27

МКНФ:

\_ \_ \_ \_

f = (X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)

\_ \_ \_ \_ \_ \_ \_ \_

(X1 v X3 v X4 v X5)(X2 v X4 v X5)(X2 v X3)

1. **Факторизация и декомпозиция булевой функции.**

а) Факторизация и декомпозиция МДНФ

Cmin1(f)

МДНФ:

\_ \_ \_ \_ \_ \_ \_

f = X2X4X5 v X1X2X3 v X1X3 v X2X4X5

Sq=15

Факторизация:

\_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

f = X2X4X5 v X1X2X3 v X1X3 v X2X4X5 = X2 (X4X5 v X1X3 v X4X5) v X1X3

Sq=15

 Факторизация не целесообразна (не даёт уменьшение цены схемы, увеличивая задержку), однако она позволит уменьшить цену схемы при её синтезе в базисе Жегалкина.

Декомпозиция также нецелесообразна.

Cmin2 (f)

МДНФ:

\_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

f = X2X4X5 v X1X2X3 v X1X3 v X3X4X5 v X1X4X5

Sq=19

Факторизация:

\_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

f = X2X4X5 v X1X2X3 v X1X3 v X3X4X5 v X1X4X5 = X4X5 (X1 v X3 ) v X2X4X5 v X1X2X3 v X1X3

Sq=17



Декомпозиция:

\_

X1X3 = Z Sq=2

\_ \_

X1 v X3 = Z Sq=3

\_ \_ \_ \_ \_ \_

f = X4X5 Z v X2X4X5 v X2Z v X1X3 Sq=14+3=17

Декомпозиция не даёт выигрыша в цене схемы, поэтому в данном случае она нецелесообразна.

б) Факторизация и декомпозиция МКНФ

Cmin1(f)

МКНФ:

\_ \_ \_ \_

f = (X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)

\_ \_ \_ \_ \_ \_ \_

(X1 v X3 v X4 v X5)(X2 v X4 v X5)(X1 v X2)

Sq = 27

Факторизация:

\_ \_ \_ \_ \_

f= (X1 v (X2 (X3 v X4 v X5) (X3 v X4 v X5))) (X1 v X3 v X4 v X5)

\_ \_ \_ \_ \_ \_

(X1 v X3 v X4 v X5) (X2 v X4 v X5)

Sq = 26

Z1 = X4 v X5 Sq = 2

\_ \_

Z2 = X4 v X5 Sq = 2

\_ \_

Z3 = X1 v X3 Sq = 2

\_ \_ \_

f = (X1 v (X2 (X3 v Z1) (X3 v Z2))) (Z1 v Z3) (Z2 v Z3) (X2 v X4 v X5)

Sq = 9 + 7 + 4 + 6 = 26

Декомпозиция не даёт выигрыша в цене схемы, поэтому в данном случае она нецелесообразна.

Cmin2(f)

МКНФ:

\_ \_ \_ \_

f = (X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)

\_ \_ \_ \_ \_ \_ \_ \_

(X1 v X3 v X4 v X5)(X2 v X4 v X5)(X2 v X3)

Sq = 27

Декомпозиция:

Z1 = X1 v X3 Sq = 2

\_ \_

Z2 = X1 v X3 Sq = 2

Z3 = X4 v X5 Sq = 2

\_ \_

Z4 = X4 v X5 Sq = 2

\_ \_ \_ \_

f = (Z1 v Z3) (Z1 v Z4) (Z2 v Z3) (Z2 v Z4 ) (X2 v X4 v X5)(X2 v X3)

Sq = 27

Не уменьшает цену схемы, однако даёт возможности для дальнейшей факторизации:

\_ \_ \_ \_

f = (Z1 v (Z3 Z4)) (Z2 v (Z3 Z4)) (X2 v X4 v X5)(X2 v X3)

Sq = 17 + 8 =25

Далее опять декомпозиция:

Z5 = Z3 Z4 Sq = 2

\_ \_ \_ \_

f = (Z1 v Z5) (Z2 v Z5) (X2 v X4 v X5)(X2 v X3)



Sq = 13 + 10 =23

И опять факторизация:

\_ \_ \_ \_

f = (Z5 v (Z1 Z2)) (X2 v X4 v X5)(X2 v X3)

Sq = 12 + 10 =22

Cmin3(f)

МКНФ:

\_ \_ \_ \_

f = (X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)(X1 v X3 v X4 v X5)

\_ \_ \_ \_ \_ \_ \_

(X1 v X3 v X4 v X5)(X1 v X2) (X2 v X3)

Sq = 26

Факторизация:

\_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

f = (X1 v (X3 v X4 v X5) (X3 v X4 v X5) X2) (X1 v X3 v X4 v X5) (X1 v X3 v X4 v X5) (X2 v X3)

Sq = 12 + 10 =25

Декомпозиция:

\_ \_

Z1 = X1 v X3 Sq = 2

\_ \_

Z2 = X4 v X5 Sq = 2

Z3 = X4 v X5 Sq = 2

\_ \_ \_

f = (X1 v (X3 v Z3) (X3 v Z2) X2) (Z1 v Z3) (Z1 v Z2) (X2 v X3)

Sq = 19 + 6 = 25

Далее опять факторизация:

\_ \_ \_

f = (X1 v (X3 v (Z2 Z3)) X2) (Z1 v (Z2 Z3)) (X2 v X3)

Sq = 17 + 6 = 23

И опять декомпозиция:

Z4 = Z2 v Z3 Sq = 2

\_ \_ \_

f = (X1 v (X3 v Z4) X2) (Z1 v Z4) (X2 v X3)

Sq = 13 + 8 = 21

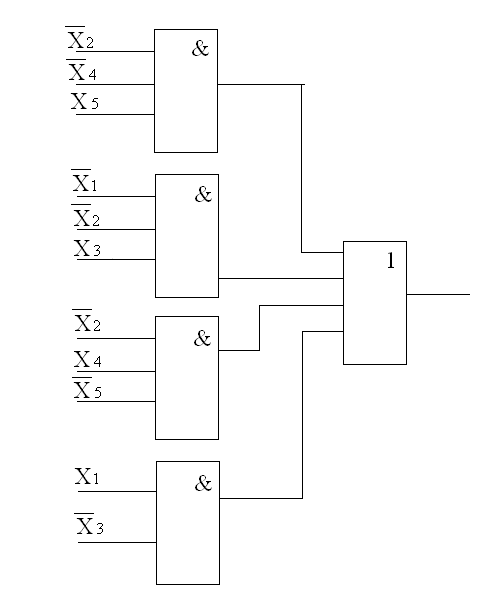
**6. Построение комбинационной схемы**

МДНФ:

\_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_ \_

f = X2X4X5 v X1X2X3 v X1X3 v X2X4X5

а) Построение схемы в булевом базисе с парафазными входами



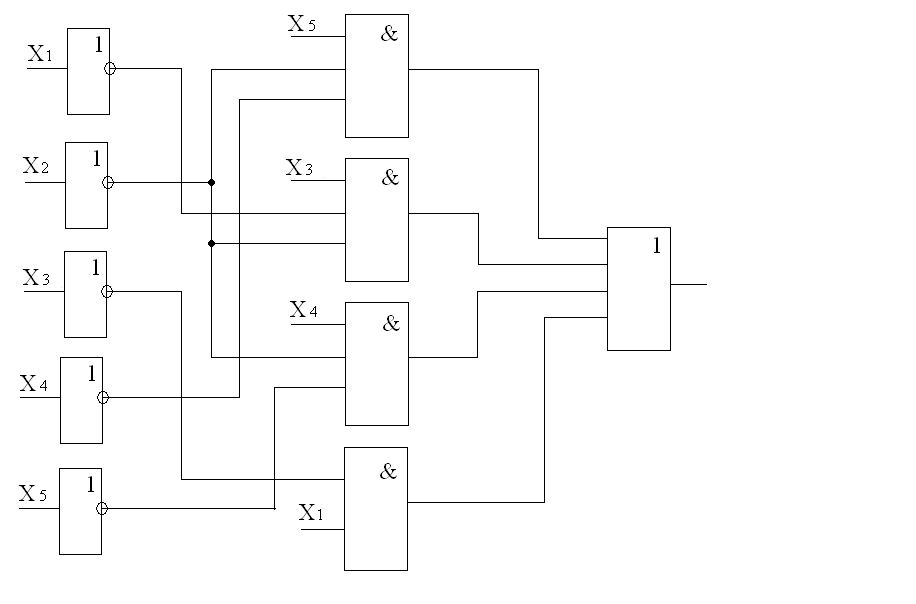
Sq = 15

T = 2

Анализ схемы:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Входные данные | | | | | Реакция схемы |  |
| X1 | X2 | X3 | X4 | X5 |  |  |
| 0 | 1 | 1 | 1 | 0 | 0 | + |
| 1 | 0 | 0 | 0 | 0 | 1 | + |

б) Построение схемы в булевом базисе с однофазными входами



Sq = 20

T = 3

Анализ схемы:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Входные данные | | | | | Реакция схемы |  |
| X1 | X2 | X3 | X4 | X5 |  |  |
| 0 | 1 | 1 | 1 | 0 | 0 | + |
| 1 | 0 | 0 | 0 | 0 | 1 | + |