Министерство науки и высшего образования Российской Федерации

Федеральное государственное автономное образовательное учреждение высшего образования

«Национальный исследовательский университет ИТМО»

*Факультет программной инженерии и компьютерной техники*

**Курсовая работа**

по дисциплине

«Дискретная математика»

Вариант №94

Выполнил:

Студент группы P3113

Султанов А.Р.

Преподаватель:

Поляков В.И.

г. Санкт-Петербург

2022г.

# Оглавление

[**Оглавление**](#_7c4xf1yrz0jn) **2**

[**Часть 1**](#_jvas9qqul5qk) **3**

# Часть 1

Вариант: 94

Условия, при которых f=1:

Условия, при которых f=d:

| N |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 0 0 0 0 | 0 0 | 0 | 0 0 0 | 0 | 0 | 0 |
| 1 | 0 0 0 0 1 | 1 0 | 2 | 0 0 0 | 0 | 2 | 0 |
| 2 | 0 0 0 1 0 | 0 1 | 1 | 0 0 0 | 0 | 1 | 1 |
| 3 | 0 0 0 1 1 | 1 1 | 3 | 0 0 0 | 0 | 3 | D |
| 4 | 0 0 1 0 0 | 0 0 | 0 | 1 0 0 | 4 | 4 | 0 |
| 5 | 0 0 1 0 1 | 1 0 | 2 | 1 0 0 | 4 | 6 | 1 |
| 6 | 0 0 1 1 0 | 0 1 | 1 | 1 0 0 | 4 | 5 | 1 |
| 7 | 0 0 1 1 1 | 1 1 | 3 | 1 0 0 | 4 | 7 | 1 |
| 8 | 0 1 0 0 0 | 0 0 | 0 | 0 1 0 | 2 | 2 | 0 |
| 9 | 0 1 0 0 1 | 1 0 | 2 | 0 1 0 | 2 | 4 | 0 |
| 10 | 0 1 0 1 0 | 0 1 | 1 | 0 1 0 | 2 | 3 | D |
| 11 | 0 1 0 1 1 | 1 1 | 3 | 0 1 0 | 2 | 5 | 1 |
| 12 | 0 1 1 0 0 | 0 0 | 0 | 1 1 0 | 6 | 6 | 1 |
| 13 | 0 1 1 0 1 | 1 0 | 2 | 1 1 0 | 6 | 8 | 1 |
| 14 | 0 1 1 1 0 | 0 1 | 1 | 1 1 0 | 6 | 7 | 1 |
| 15 | 0 1 1 1 1 | 1 1 | 3 | 1 1 0 | 6 | 9 | 0 |
| 16 | 1 0 0 0 0 | 0 0 | 0 | 0 0 1 | 1 | 1 | 1 |
| 17 | 1 0 0 0 1 | 1 0 | 2 | 0 0 1 | 1 | 3 | D |
| 18 | 1 0 0 1 0 | 0 1 | 1 | 0 0 1 | 1 | 2 | 0 |
| 19 | 1 0 0 1 1 | 1 1 | 3 | 0 0 1 | 1 | 4 | 0 |
| 20 | 1 0 1 0 0 | 0 0 | 0 | 1 0 1 | 5 | 5 | 1 |
| 21 | 1 0 1 0 1 | 1 0 | 2 | 1 0 1 | 5 | 7 | 1 |
| 22 | 1 0 1 1 0 | 0 1 | 1 | 1 0 1 | 5 | 6 | 1 |
| 23 | 1 0 1 1 1 | 1 1 | 3 | 1 0 1 | 5 | 8 | 1 |
| 24 | 1 1 0 0 0 | 0 0 | 0 | 0 1 1 | 3 | 3 | D |
| 25 | 1 1 0 0 1 | 1 0 | 2 | 0 1 1 | 3 | 5 | 1 |
| 26 | 1 1 0 1 0 | 0 1 | 1 | 0 1 1 | 3 | 4 | 0 |
| 27 | 1 1 0 1 1 | 1 1 | 3 | 0 1 1 | 3 | 6 | 1 |
| 28 | 1 1 1 0 0 | 0 0 | 0 | 1 1 1 | 7 | 7 | 1 |
| 29 | 1 1 1 0 1 | 1 0 | 2 | 1 1 1 | 7 | 9 | 0 |
| 30 | 1 1 1 1 0 | 0 1 | 1 | 1 1 1 | 7 | 8 | 1 |
| 31 | 1 1 1 1 1 | 1 1 | 3 | 1 1 1 | 7 | 10 | 0 |

КДНФ:

ККНФ:

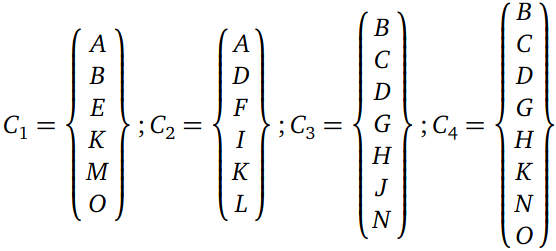
|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 0 0 0 1 0 | v | 1 | 0 0 0 1 X | 1 - 2 | v | 1 | 0 0 X 1 X | 1 - 9, 2 - 4 | 1 | 0 X 1 0 1 |
| 2 | 0 0 0 1 1 | v | 2 | 0 0 X 1 0 | 1 - 4 | v | 2 | 0 X 0 1 X | 1 - 13, 3 - 5 | 2 | X 1 0 1 1 |
| 3 | 0 0 1 0 1 | v | 3 | 0 X 0 1 0 | 1 - 6 | v | 3 | 0 X X 1 0 | 2 - 14, 3 - 10 | 3 | 0 1 1 0 X |
| 4 | 0 0 1 1 0 | v | 4 | 0 0 X 1 1 | 2 - 5 | v | 4 | X 0 1 X 1 | 6 - 28, 8 - 12 | 4 | 1 1 0 X 1 |
| 5 | 0 0 1 1 1 | v | 5 | 0 X 0 1 1 | 2 - 7 | v | 5 | X 0 1 1 X | 9 - 29, 11 - 12 | 5 | 0 0 X 1 X |
| 6 | 0 1 0 1 0 | v | 6 | 0 0 1 X 1 | 3 - 5 | v | 6 | X X 1 1 0 | 10 - 30, 11 - 19 | 6 | 0 X 0 1 X |
| 7 | 0 1 0 1 1 | v | **7** | **0 X 1 0 1** | 3 - 9 |  | 7 | X 1 1 X 0 | 17 - 34, 18 - 19 | 7 | 0 X X 1 0 |
| 8 | 0 1 1 0 0 | v | 8 | X 0 1 0 1 | 3 - 14 | v | 8 | 1 0 X 0 X | 20 - 25, 21 - 23 | 8 | X 0 1 X 1 |
| 9 | 0 1 1 0 1 | v | 9 | 0 0 1 1 X | 4 - 5 | v | 9 | 1 X 0 0 X | 20 - 31, 22 - 24 | 9 | X 0 1 1 X |
| 10 | 0 1 1 1 0 | v | 10 | 0 X 1 1 0 | 4 - 10 | v | 10 | 1 X X 0 0 | 21 - 32, 22 - 27 | 10 | X X 1 1 0 |
| 11 | 1 0 0 0 0 | v | 11 | X 0 1 1 0 | 4 - 15 | v | 11 | 1 0 1 X X | 25 - 29, 26 - 28 | 11 | X 1 1 X 0 |
| 12 | 1 0 0 0 1 | v | 12 | X 0 1 1 1 | 5 - 16 | v | 12 | 1 X 1 X 0 | 26 - 34, 27 - 30 | 12 | 1 0 X 0 X |
| 13 | 1 0 1 0 0 | v | 13 | 0 1 0 1 X | 6 - 7 | v |  |  |  | 13 | 1 X 0 0 X |
| 14 | 1 0 1 0 1 | v | 14 | 0 1 X 1 0 | 6 - 10 | v |  |  |  | 14 | 1 X X 0 0 |
| 15 | 1 0 1 1 0 | v | **15** | **X 1 0 1 1** | 7 - 19 |  |  |  |  | 15 | 1 0 1 X X |
| 16 | 1 0 1 1 1 | v | **16** | **0 1 1 0 X** | 8 - 9 |  |  |  |  | 16 | 1 X 1 X 0 |
| 17 | 1 1 0 0 0 | v | 17 | 0 1 1 X 0 | 8 - 10 | v |  |  |  |  |  |
| 18 | 1 1 0 0 1 | v | 18 | X 1 1 0 0 | 8 - 20 | v |  |  |  |  |  |
| 19 | 1 1 0 1 1 | v | 19 | X 1 1 1 0 | 10 - 21 | v |  |  |  |  |  |
| 20 | 1 1 1 0 0 | v | 20 | 1 0 0 0 X | 11 - 12 | v |  |  |  |  |  |
| 21 | 1 1 1 1 0 | v | 21 | 1 0 X 0 0 | 11 - 13 | v |  |  |  |  |  |
|  |  |  | 22 | 1 X 0 0 0 | 11 - 17 | v |  |  |  |  |  |
|  |  |  | 23 | 1 0 X 0 1 | 12 - 14 | v |  |  |  |  |  |
|  |  |  | 24 | 1 X 0 0 1 | 12 - 18 | v |  |  |  |  |  |
|  |  |  | 25 | 1 0 1 0 X | 13 - 14 | v |  |  |  |  |  |
|  |  |  | 26 | 1 0 1 X 0 | 13 - 15 | v |  |  |  |  |  |
|  |  |  | 27 | 1 X 1 0 0 | 13 - 20 | v |  |  |  |  |  |
|  |  |  | 28 | 1 0 1 X 1 | 14 - 16 | v |  |  |  |  |  |
|  |  |  | 29 | 1 0 1 1 X | 15 - 16 | v |  |  |  |  |  |
|  |  |  | 30 | 1 X 1 1 0 | 15 - 21 | v |  |  |  |  |  |
|  |  |  | 31 | 1 1 0 0 X | 17 - 18 | v |  |  |  |  |  |
|  |  |  | 32 | 1 1 X 0 0 | 17 - 20 | v |  |  |  |  |  |
|  |  |  | **33** | **1 1 0 X 1** | 18 - 19 |  |  |  |  |  |  |
|  |  |  | 34 | 1 1 1 X 0 | 20 - 21 | v |  |  |  |  |  |

**Составление импликантной таблицы**

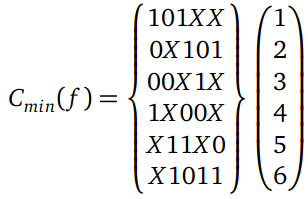
| Простые импликанты (максимальные кубы) | | 0-кубы | | | | | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 0 0 1 0 | 0 0 1 0 1 | 0 0 1 1 0 | 0 0 1 1 1 | 0 1 0 1 1 | 0 1 1 0 0 | 0 1 1 0 1 | 0 1 1 1 0 | 1 0 0 0 0 | 1 0 1 0 0 | 1 0 1 0 1 | 1 0 1 1 0 | 1 0 1 1 1 | 1 1 0 0 1 | 1 1 0 1 1 | 1 1 1 0 0 | 1 1 1 1 0 |
| a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p | r |
| A | 0 X 1 0 1 |  | \* |  |  |  |  | \* |  |  |  |  |  |  |  |  |  |  |
| B | X 1 0 1 1 |  |  |  |  | \* |  |  |  |  |  |  |  |  |  | \* |  |  |
| C | 0 1 1 0 X |  |  |  |  |  | \* | \* |  |  |  |  |  |  |  |  |  |  |
| D | 1 1 0 X 1 |  |  |  |  |  |  |  |  |  |  |  |  |  | \* | \* |  |  |
| E | 0 0 X 1 X | \* |  | \* | \* |  |  |  |  |  |  |  |  |  |  |  |  |  |
| F | 0 X 0 1 X | \* |  |  |  | \* |  |  |  |  |  |  |  |  |  |  |  |  |
| G | 0 X X 1 0 | \* |  | \* |  |  |  |  | \* |  |  |  |  |  |  |  |  |  |
| H | X 0 1 X 1 |  | \* |  | \* |  |  |  |  |  |  | \* |  | \* |  |  |  |  |
| I | X 0 1 1 X |  |  | \* | \* |  |  |  |  |  |  |  | \* | \* |  |  |  |  |
| J | X X 1 1 0 |  |  | \* |  |  |  |  | \* |  |  |  | \* |  |  |  |  | \* |
| K | X 1 1 X 0 |  |  |  |  |  | \* |  | \* |  |  |  |  |  |  |  | \* | \* |
| L | 1 0 X 0 X |  |  |  |  |  |  |  |  | \* | \* | \* |  |  |  |  |  |  |
| M | 1 X 0 0 X |  |  |  |  |  |  |  |  | \* |  |  |  |  | \* |  |  |  |
| N | 1 X X 0 0 |  |  |  |  |  |  |  |  | \* | \* |  |  |  |  |  | \* |  |
| O | 1 0 1 X X |  |  |  |  |  |  |  |  |  | \* | \* | \* | \* |  |  |  |  |
| P | 1 X 1 X 0 |  |  |  |  |  |  |  |  |  | \* |  | \* |  |  |  | \* | \* |

**Метод Петрика**

(для удобства опущено большое количество термов, приведены несколько)



Минимальное покрытие функции -



**Минимизация булевой функции на картах Карно**

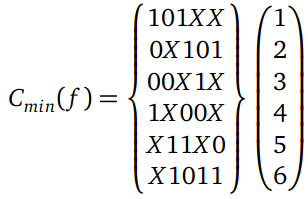
**Определение МДНФ**

:

| **x2x3/x4x5** | **00** | **01** | **11** | **10** |
| --- | --- | --- | --- | --- |
| **00** | 0 | 0 | **d** | **1** |
| **01** | 0 | **1** | **1** | **1** |
| **11** | **1** | **1** | 0 | **1** |
| **10** | 0 | 0 | **1** | **d** |

:

| **x2x3/x4x5** | **00** | **01** | **11** | **10** |
| --- | --- | --- | --- | --- |
| **00** | **1** | **d** | 0 | 0 |
| **01** | **1** | **1** | **1** | **1** |
| **11** | **1** | 0 | 0 | **1** |
| **10** | **d** | **1** | **1** | 0 |



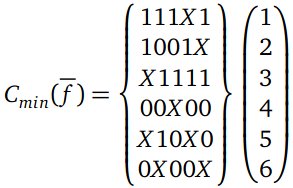
**Определение МКНФ**

:

| x2x3/x4x5 | **00** | **01** | **11** | **10** |
| --- | --- | --- | --- | --- |
| **00** | **0** | **0** | **d** | 1 |
| **01** | **0** | 1 | 1 | 1 |
| **11** | 1 | 1 | **0** | 1 |
| **10** | **0** | **0** | 1 | **d** |

:

| x2x3/x4x5 | **00** | **01** | **11** | **10** |
| --- | --- | --- | --- | --- |
| **00** | 1 | **d** | **0** | **0** |
| **01** | 1 | 1 | 1 | 1 |
| **11** | 1 | **0** | **0** | 1 |
| **10** | **d** | 1 | 1 | **0** |



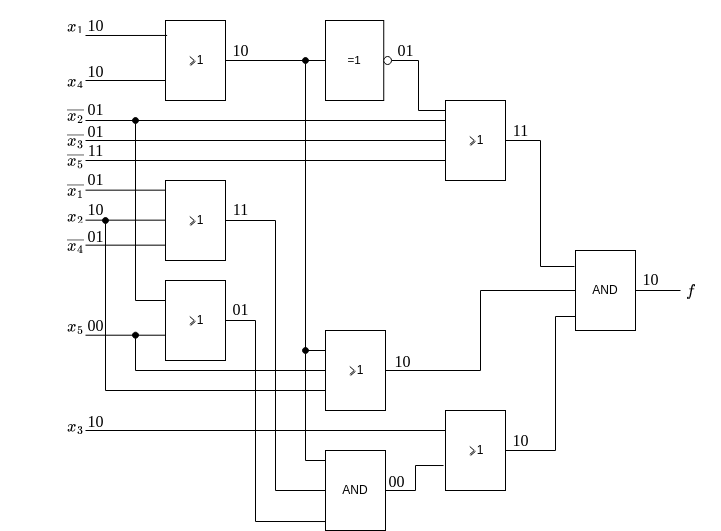
**Преобразование минимальных форм булевой функции**

**Факторное преобразование для МДНФ**

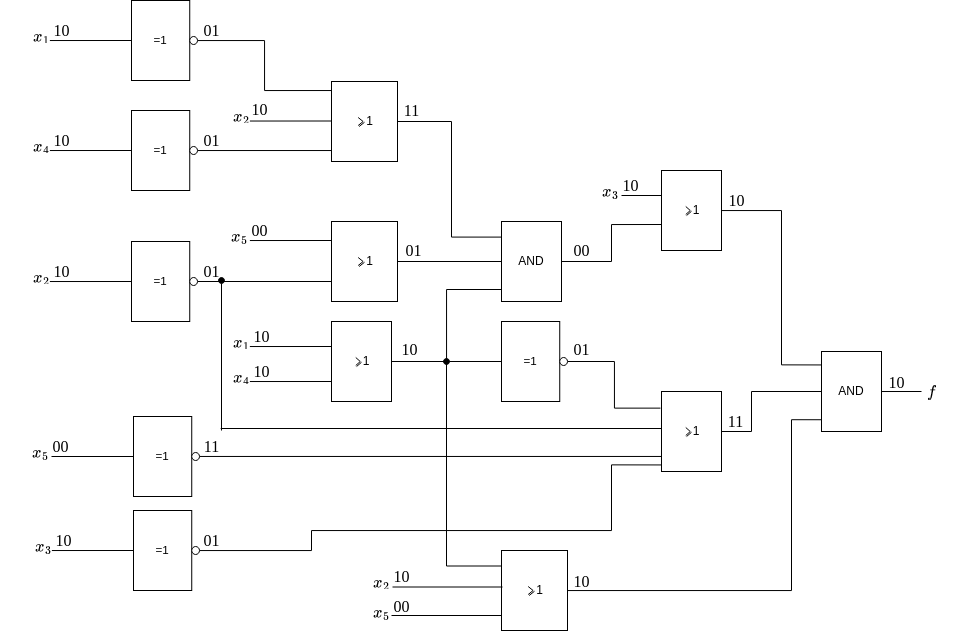
Различные преобразования методом факторизации и декомпозиции также не принесли успеха.

**Факторное преобразование для МКНФ**

**Булевый базис с парафазными входами**

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**Булевый базис с однофазными входами**

****

**Универсальный базис И-НЕ**

