

Задание 1

$$f_1 = x \leftrightarrow (y \downarrow \bar{z})$$

| | x | y | z | \bar{z} | $y \downarrow \bar{z}$ | $x \leftrightarrow (y \downarrow \bar{z})$ |
|---|---|---|---|-----------|------------------------|--|
| 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| 2 | 0 | 1 | 0 | 1 | 0 | 1 |
| 3 | 0 | 1 | 1 | 0 | 0 | 1 |
| 4 | 1 | 0 | 0 | 1 | 0 | 0 |
| 5 | 1 | 0 | 1 | 0 | 1 | 1 |
| 6 | 1 | 1 | 0 | 1 | 0 | 0 |
| 7 | 1 | 1 | 1 | 0 | 0 | 0 |

СДНФ: $f = m_0 + m_2 + m_3 + m_5 = f(0, 2, 3, 5)$

$$f = (\bar{x}\bar{y}\bar{z}) + (\bar{x}y\bar{z}) + (\bar{x}yz) + (x\bar{y}z)$$

СКНФ: $f = M_1 \cdot M_4 \cdot M_6 \cdot M_7 = f(1, 4, 6, 7)$

$$f = (x + y + \bar{z}) \cdot (\bar{x} + \bar{y} + \bar{z}) \cdot (\bar{x} + \bar{y} + z) \cdot (\bar{x} + y + \bar{z})$$

Задача 2

$$f_2 = (10101001)$$

| | A | B | C | f_2 |
|---|---|---|---|-------|
| 0 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 |
| 2 | 0 | 1 | 0 | 1 |
| 3 | 0 | 1 | 1 | 0 |
| 4 | 1 | 0 | 0 | 1 |
| 5 | 1 | 0 | 1 | 0 |
| 6 | 1 | 1 | 0 | 0 |
| 7 | 1 | 1 | 1 | 1 |

СДНФ: $f = m_0 + m_2 + m_4 + m_7 = f(0, 2, 4, 7)$

$$f = (\bar{A}\bar{B}\bar{C}) + (\bar{A}B\bar{C}) + (A\bar{B}C) + (ABC)$$

СКНФ: $f = M_1 \cdot M_3 \cdot M_5 \cdot M_6 = f(1, 3, 5, 6)$

$$f = (A + B + \bar{C}) \cdot (A + \bar{B} + \bar{C}) \cdot (\bar{A} + B + \bar{C}) \cdot (\bar{A} + \bar{B} + C)$$

$$f_3(A, B, C, D) = A + BC + D$$

| | A | B | C | D | f_3 |
|----|---|---|---|---|-------|
| 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 1 |
| 2 | 0 | 0 | 1 | 0 | 0 |
| 3 | 0 | 0 | 1 | 1 | 1 |
| 4 | 0 | 1 | 0 | 0 | 0 |
| 5 | 0 | 1 | 0 | 1 | 1 |
| 6 | 0 | 1 | 1 | 0 | 1 |
| 7 | 0 | 1 | 1 | 1 | 1 |
| 8 | 1 | 0 | 0 | 0 | 1 |
| 9 | 1 | 0 | 0 | 1 | 1 |
| 10 | 1 | 0 | 1 | 0 | 1 |
| 11 | 1 | 0 | 1 | 1 | 1 |
| 12 | 1 | 1 | 0 | 0 | 1 |
| 13 | 1 | 1 | 0 | 1 | 1 |
| 14 | 1 | 1 | 1 | 0 | 1 |
| 15 | 1 | 1 | 1 | 1 | 1 |

СДНФ: $f = m_1 + m_3 + m_5 + m_6 + m_7 + m_8 + m_9 + m_{10} +$

$$+ m_{11} + m_{12} + m_{13} + m_{14} + m_{15} = f(1, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15)$$

$$f = (\bar{A}\bar{B}\bar{C}D) + (\bar{A}\bar{B}C\bar{D}) + (\bar{A}\bar{B}C\bar{D}) + (\bar{A}\bar{B}C\bar{D}) + (\bar{A}\bar{B}C\bar{D}) + (\bar{A}\bar{B}\bar{C}\bar{D}) + (\bar{A}\bar{B}\bar{C}\bar{D}) + (\bar{A}\bar{B}\bar{C}\bar{D}) + (\bar{A}\bar{B}\bar{C}\bar{D}) + (\bar{A}\bar{B}\bar{C}\bar{D}) + (\bar{A}\bar{B}\bar{C}\bar{D}) + (\bar{A}\bar{B}\bar{C}\bar{D}) + (\bar{A}\bar{B}\bar{C}\bar{D}) + (\bar{A}\bar{B}\bar{C}\bar{D}) + (\bar{A}\bar{B}\bar{C}\bar{D})$$

СКНФ: $f = M_0 \cdot M_2 \cdot M_4 = f(0, 2, 4)$

$$f = (A + B + C + D) \cdot (A + B + \bar{C} + D) \cdot (A + \bar{B} + C + D)$$

$f_4 = f_{47541}^{(4)} = \mathbb{Z}(1011100110110101)$

| | A | B | C | D | f |
|----|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 |
| 2 | 0 | 0 | 1 | 0 | 1 |
| 3 | 0 | 0 | 1 | 1 | 1 |
| 4 | 0 | 1 | 0 | 0 | 1 |
| 5 | 0 | 1 | 0 | 1 | 0 |
| 6 | 0 | 1 | 1 | 0 | 0 |
| 7 | 0 | 1 | 1 | 1 | 1 |
| 8 | 1 | 0 | 0 | 0 | 1 |
| 9 | 1 | 0 | 0 | 1 | 0 |
| 10 | 1 | 0 | 1 | 0 | 1 |
| 11 | 1 | 0 | 1 | 1 | 1 |
| 12 | 1 | 1 | 0 | 0 | 0 |
| 13 | 1 | 1 | 0 | 1 | 1 |
| 14 | 1 | 1 | 1 | 0 | 0 |
| 15 | 1 | 1 | 1 | 1 | 1 |

СДНФ: $f = m_0 + m_2 + m_3 + m_4 + m_7 + m_8 + m_{10} + m_{11} + m_{13} + m_{15} = f(0, 2, 3, 4, 7, 8, 10, 11, 13, 15)$

$$f = (\bar{A}\bar{B}\bar{C}\bar{D}) + (\bar{A}\bar{B}C\bar{D}) + (\bar{A}\bar{B}CD) + (A\bar{B}\bar{C}\bar{D}) + (A\bar{B}CD) + (A\bar{B}C\bar{D}) + (A\bar{B}CD) + (AB\bar{C}\bar{D}) + (AB\bar{C}D)$$

СКНФ: $f = M_1 \cdot M_5 \cdot M_6 \cdot M_9 \cdot M_{12} \cdot M_{14} = f(1, 5, 6, 9, 12, 14)$

$$f = (A+B+C+\bar{D}) \cdot (A+\bar{B}+\bar{C}+\bar{D}) \cdot (A+\bar{B}+C+\bar{D}) \cdot (A+\bar{B}+\bar{C}+D) \cdot (\bar{A}+B+C+\bar{D}) \cdot (\bar{A}+B+C+D)$$

Задача 2

$$f_1(A, B, C, D) = A\bar{C} + A\bar{B} + \bar{A}C + D$$

(A): $f_1(A, B, C, D) = A \cdot (\bar{C} + \bar{B} + D) + \bar{A}(\bar{C} + D) = A\bar{C} + A\bar{B} + AD + \bar{A}\bar{C} + \bar{A}D =$
 $= A\bar{B} + D + \bar{A}\bar{C} + A\bar{C}$

(B): $f_1(A, B, C, D) = B \cdot (A\bar{C} + \bar{A}C + D) + \bar{B}(A\bar{C} + A + \bar{A}C + D) =$
 $= AB\bar{C} + \bar{A}BC + BD + \bar{B}A\bar{C} + \bar{B}A + \bar{B}\bar{A}C + \bar{B}D = AB\bar{C} + \bar{B} + D + \bar{A}C$

(C): $f_1(A, B, C, D) = C(\bar{A} + A\bar{B} + \bar{A} + D) + \bar{C}(A + A\bar{B} + D) =$
 $= A\bar{B}C + \bar{A}C + CD + \bar{A}\bar{C} + \bar{C}D = A\bar{B}C + \bar{A}C + A\bar{C} + D$

(D): $f_1(A, B, C, D) = D(A\bar{C} + A\bar{B} + \bar{A}C + 1) + \bar{D}(A\bar{C} + A\bar{B} + \bar{A}C) =$
 $= D + A\bar{C}\bar{D} + A\bar{B}\bar{D} + \bar{A}C\bar{D}$

$$f_1(A, B, C, D) = (1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15)$$

$$f_2(A, B, C, D) = (A + \bar{C}) \cdot (A + \bar{B}) \cdot (\bar{A} + C) \cdot D$$

$$\begin{aligned} \textcircled{A}: f_2(A, B, C, D) &= (A + (\bar{C} \cdot \bar{B} \cdot D)) \cdot (\bar{A} + (C \cdot D)) = \\ &= (A + \bar{B} \bar{C} D) \cdot (\bar{A} + C D) = \bar{A} \bar{B} \bar{C} D + A C D \end{aligned}$$

$$\begin{aligned} \textcircled{B}: f_2(A, B, C, D) &= (B + ((A + \bar{C})(\bar{A} + C)D)) \cdot (\bar{B} + ((A + \bar{C})A \cdot (\bar{A} + C) \cdot D)) = \\ &= (B + (A + \bar{C})(\bar{A} + C)D) \cdot (\bar{B} + (A + \bar{C}) \cdot A \cdot C \cdot D) = \cancel{(B + D)} \cdot \cancel{(A + C)} = \\ &= (B + D) \cdot (A + A C D) = (B + (A C + \bar{A} \bar{C})D) \cdot (\bar{B} + A C D) = \\ &= (B + A C D + \bar{A} \bar{C} D) (\bar{B} + A C D) = \bar{A} \bar{B} C D + \bar{A} \bar{B} \bar{C} D + A B C D + A C D \end{aligned}$$

$$\begin{aligned} \textcircled{C}: f_2(A, B, C, D) &= (C + ((A + \bar{B}) \cdot \bar{A} \cdot D)) \cdot (\bar{C} + (A \cdot (A + \bar{B}) \cdot D)) = \\ &= (C + \bar{A} \bar{B} D) \cdot (\bar{C} + A D + A \bar{B} D) = \bar{A} \bar{C} D + A \bar{B} C D + \bar{A} \bar{B} \bar{C} D + \end{aligned}$$

$$\begin{aligned} \textcircled{D}: f_2(A, B, C, D) &= (D + ((A + \bar{C}) \cdot (A + \bar{B}) \cdot (\bar{A} + C) \cdot D)) \cdot (\bar{D} + ((A + \bar{C}) \cdot (A + \bar{B}) \cdot (\bar{A} + C))) = \\ &= D \cdot (\bar{D} + (A + \bar{A} \bar{B} + A \bar{C} + \bar{B} \bar{C}) \cdot (\bar{A} + \bar{C})) = D \cdot (\bar{D} + \bar{A} \bar{B} \bar{C} + A \bar{C} + A \bar{B} \bar{C} + A \bar{C} + \bar{B} \bar{C}) = \\ &= D \cdot (\bar{D} + \bar{A} \bar{B} \bar{C} + A \bar{C} + A \bar{B} \bar{C} + \bar{B} \bar{C}) = \bar{A} \bar{B} \bar{C} D + A \bar{C} D + A \bar{B} \bar{C} D + \bar{B} \bar{C} D \end{aligned}$$

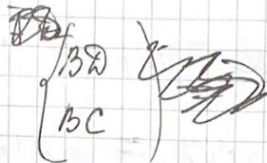
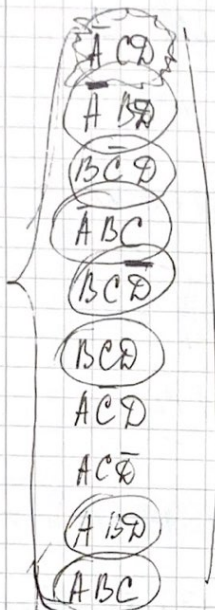
$$f_2(A, B, C, D) = \{0, 2, 3, 4, 5, 6, 7, 8, 11, 12, 14, 15\}$$

Задача 3

$$f(A, B, C, D) = (0, 3, 5, 6, 7, 9, 10, 13, 14, 15)$$

$$f = (\bar{A}\bar{B}\bar{C}\bar{D}) + (\bar{A}B\bar{C}\bar{D}) + (\bar{A}B\bar{C}D) + (\bar{A}B\bar{C}\bar{D}) + (\bar{A}B\bar{C}D) + A\bar{B}\bar{C}\bar{D} +$$

$$+ A\bar{B}\bar{C}D + A\bar{B}C\bar{D} + A\bar{B}CD + ABC\bar{D} + ABCD$$



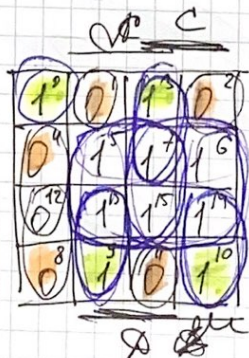
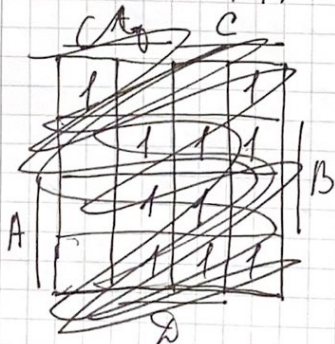
$$\bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}CD + \bar{A}C\bar{D} + \bar{A}C\bar{D} + \bar{A}C\bar{D} + B\bar{D} + BC$$

$$f = \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}CD + \bar{A}C\bar{D} + \bar{A}C\bar{D} + B\bar{D} + BC$$

6 простых множителей

$$A: 4, B: 3, C: 5, D: 5$$

Всего: 17



мин. КНФ:

$$(\bar{A} + \bar{C} + \bar{D}) \cdot (B + C + D)$$

$$(\bar{A} + C + D) \cdot (B + C + D)$$

$$(A + B + C + D) \cdot (A + B + C + D)$$

$$(A + B + C + D)$$

бульеновое ДНФ:

$$\bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}B\bar{C}\bar{D} + A\bar{B}\bar{C}\bar{D} + A\bar{B}C\bar{D}$$

Принципальная ДНФ:

$$F = (\bar{A} + B + C + D) \cdot (A + \bar{B} + C + D) \cdot (A + B + C + \bar{D}) \cdot (A + B + \bar{C} + D) + (\bar{A} + B + \bar{C} + \bar{D})$$

Задание 4

| | | | | | |
|----|----|----|----|----|----|
| | | CD | | | |
| | | 00 | 01 | 11 | 10 |
| AB | 00 | 1 | 0 | 1 | 1 |
| | 01 | 1 | 1 | 1 | 1 |
| | 11 | 1 | 1 | 0 | 1 |
| | 10 | 1 | 1 | 0 | 1 |

СДНФ:

$$f = m_0 + m_2 + m_3 + m_4 + m_5 + m_6 + m_7 + m_8 + m_9 + m_{10} + m_{12} + m_{13} + m_{14}$$

$$f = (\bar{A}\bar{B}\bar{C}\bar{D}) + (\bar{A}\bar{B}C\bar{D}) + (\bar{A}\bar{B}C\bar{D}) + (\bar{A}\bar{B}\bar{C}D) + (\bar{A}B\bar{C}\bar{D}) + (\bar{A}B\bar{C}\bar{D}) + (\bar{A}B\bar{C}\bar{D}) + (\bar{A}B\bar{C}\bar{D}) + (A\bar{B}\bar{C}\bar{D}) + (A\bar{B}\bar{C}\bar{D}) + (A\bar{B}\bar{C}\bar{D}) + (A\bar{B}\bar{C}\bar{D}) + (A\bar{B}\bar{C}\bar{D}) + (A\bar{B}\bar{C}\bar{D}) + (A\bar{B}\bar{C}\bar{D})$$

СКНФ:

$$f = M_1 \cdot M_{11} \cdot M_{15}$$

$$f = (A+B+C+\bar{D}) \cdot (\bar{A}+B+\bar{C}+\bar{D}) \cdot (\bar{A}+\bar{B}+\bar{C}+\bar{D})$$

мин. ДНФ:

$$f = (\bar{A}\bar{C}\bar{D}) + (\bar{A}C) + (B\bar{C}) + (\bar{A}B\bar{D}) + (B\bar{C}\bar{D}) + (A\bar{C}) + (A\bar{C}\bar{D})$$

мин. КНФ:

$$f = (A+B+C+\bar{D}) \cdot (\bar{A}+\bar{C}+\bar{D})$$

Тупиковые:

ДНФ:

$$f = (\bar{A}\bar{B}\bar{C}\bar{D}) + (\bar{A}\bar{B}C\bar{D}) + (\bar{A}\bar{B}C\bar{D}) + (\bar{A}\bar{B}\bar{C}\bar{D}) + (\bar{A}\bar{B}\bar{C}\bar{D}) + (\bar{A}\bar{B}\bar{C}\bar{D})$$

КНФ:

$$f = (A+B+C+\bar{D}) \cdot (\bar{A}+B+\bar{C}+\bar{D}) \cdot (\bar{A}+\bar{B}+\bar{C}+\bar{D})$$

Задача 5:

$$f = (1011010110110101)$$

| | A | B | C | D | f |
|----|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 |
| 2 | 0 | 0 | 1 | 0 | 1 |
| 3 | 0 | 0 | 1 | 1 | 1 |
| 4 | 0 | 1 | 0 | 0 | 0 |
| 5 | 0 | 1 | 0 | 1 | 1 |
| 6 | 0 | 1 | 1 | 0 | 0 |
| 7 | 0 | 1 | 1 | 1 | 1 |
| 8 | 1 | 0 | 0 | 0 | 1 |
| 9 | 1 | 0 | 0 | 1 | 0 |
| 10 | 1 | 0 | 1 | 0 | 1 |
| 11 | 1 | 0 | 1 | 1 | 1 |
| 12 | 1 | 1 | 0 | 0 | 0 |
| 13 | 1 | 1 | 0 | 1 | 1 |
| 14 | 1 | 1 | 1 | 0 | 0 |
| 15 | 1 | 1 | 1 | 1 | 1 |

A - отрицательная

C - существенная

B - существенная

D - существенная

Ответ: C, B, D - существенные
A - отрицательная