

1. Zminimalizuj funkcję 4-zmiennych: $F^{(1)} = \{0, 3, 8, 10, 11, 12, 13\}$, $D^{(0)} = \{2, 4, 14\}$ za pomocą metody Karnough'a.

AB \ CD	00	01	11	10
00	1 ¹	0 ¹	1 ³	- ²
01	- ⁴	0 ⁵	0 ⁷	0 ⁶
11	1 ¹²	1 ¹³	0 ¹⁵	- ¹⁴
10	1 ⁸	0 ⁹	1 ¹¹	1 ¹⁰

Implikanty proste:

- 1) $\bar{C}\bar{D}$
- 2) $\bar{B}\bar{D}$
- 3) $A\bar{D}$
- 4) $\bar{B}C$ - istotny
- 5) $AB\bar{C}$ - istotny

AB \ CD	00	01	11	10
00	1 ¹	0 ¹	1 ³	- ²
01	- ⁴	0 ⁵	0 ⁷	0 ⁶
11	1 ¹²	1 ¹³	0 ¹⁵	- ¹⁴
10	1 ⁸	0 ⁹	1 ¹¹	1 ¹⁰

Implicenty proste:

- 1) $A + \bar{B}$
- 2) $\bar{B} + \bar{C}$ - istotny
- 3) $B + C + \bar{D}$ - istotny
- 4) $A + C + \bar{D}$
- 5) $A + \bar{C} + D$

Postacie minimalne:

dysjunkcyjne:

- 1) 1, 4, 5: $Y = \bar{C}\bar{D} + \bar{B}C + AB\bar{C}$
- 2) 2, 4, 5: $Y = \bar{B}\bar{D} + \bar{B}C + AB\bar{C}$

koniunkcyjne:

- 3) 1, 2, 3: $Y = (A + \bar{B})(\bar{B} + \bar{C})(B + C + \bar{D})$

2. Zminimalizuj funkcję 4-zmiennych: $F^{(1)} = \{3, 5, 7, 8, 14, 15\}$, $D^{(0)} = \{1, 4, 9, 10\}$ za pomocą metody Karnough'a.

AB \ CD	00	01	11	10
00	0 ₀	- ₁	1 ₃	0 ₂
01	- ₄	1 ₅	1 ₇	0 ₆
11	0 ₁₂	0 ₁₃	1 ₁₅	1 ₁₄
10	1 ₈	- ₉	0 ₁₁	- ₁₀

Diagram showing prime implicants for the function F(1) and don't care terms D(0) in a 4-variable Karnaugh map. The map is a 4x4 grid with rows AB (00, 01, 11, 10) and columns CD (00, 01, 11, 10). Prime implicants are circled: 1) (01, 11) in red; 2) (00, 01) in red; 3) (01, 11) in red; 4) (11, 10) in red; 5) (01, 11) in red; 6) (10, 10) in blue; 7) (10, 00) in blue. Don't care terms are marked with '-'.

Implikanty proste:

- 1) $\bar{A}D$ - istotny
- 2) $\bar{A}\bar{B}\bar{C}$
- 3) BCD
- 4) ABC
- 5) $AC\bar{D}$
- 6) $\bar{A}\bar{B}\bar{D}$
- 7) $\bar{A}\bar{B}\bar{C}$

AB \ CD	00	01	11	10
00	0 ₀	- ₁	1 ₃	0 ₂
01	- ₄	1 ₅	1 ₇	0 ₆
11	0 ₁₂	0 ₁₃	1 ₁₅	1 ₁₄
10	1 ₈	- ₉	0 ₁₁	- ₁₀

Diagram showing prime implicants for the function F(1) and don't care terms D(0) in a 4-variable Karnaugh map. The map is a 4x4 grid with rows AB (00, 01, 11, 10) and columns CD (00, 01, 11, 10). Prime implicants are circled: 1) (00, 01) in red; 2) (00, 01) in red; 3) (01, 11) in red; 4) (11, 10) in red; 5) (11, 10) in red; 6) (10, 10) in blue; 7) (10, 00) in blue. Don't care terms are marked with '-'.

Implicenty proste:

- 1) $A + D$ - istotny
- 2) $\bar{B} + \bar{C} + D$
- 3) $\bar{A} + \bar{B} + C$
- 4) $\bar{A} + C + \bar{D}$
- 5) $\bar{A} + B + \bar{D}$
- 6) $\bar{A} + B + \bar{C}$
- 7) $A + \bar{C} + D$

Postacie minimalne:

dysjunkcyjne:

- 1) 1, 4, 6: $Y = \bar{A}D + ABC + \bar{A}\bar{B}\bar{D}$
- 2) 1, 4, 7: $Y = \bar{A}D + ABC + \bar{A}\bar{B}\bar{C}$

koniunkcyjne:

- 3) 1, 3, 5: $Y = (A + D)(\bar{A} + \bar{B} + C)(\bar{A} + B + \bar{D})$
- 4) 1, 3, 6: $Y = (A + D)(\bar{A} + \bar{B} + C)(\bar{A} + B + \bar{C})$

3. Zminimalizuj funkcję 4-zmiennych: $F^{(1)} = \{3, 4, 6, 9, 13, 15\}$, $D^{(c)} = \{2, 7, 8, 12\}$ za pomocą metody Karnough'a.

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

Diagram Karnaugh showing prime implicants circled in various colors: 1) orange (1,3), 2) blue (1,4), 3) red (1,2,8,12), 4) green (1,5), 5) purple (1,15), 6) blue (6,14).

Implikanty proste:

- 1) $\overline{A}C$ - istotny
- 2) $A\overline{C}$ - istotny
- 3) $\overline{A}B\overline{D}$
- 4) $B\overline{C}D$
- 5) ABD
- 6) BCD

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

Diagram Karnaugh showing prime implicants circled in various colors: 1) red (1,2), 2) green (1,5), 3) blue (1,4), 4) red (5,7), 5) blue (14,15), 6) red (11,10).

Implicyty proste:

- 1) $B + D$
- 2) $\overline{A} + D$ - istotny
- 3) $A + B + C$
- 4) $A + B + \overline{D}$
- 5) $A + \overline{B} + \overline{D}$
- 6) $\overline{A} + B + \overline{C}$ - istotny

Postacie minimalne:

dysjunkcyjne:

1) 1, 2, 4, 5: $Y = \overline{A}C + A\overline{C} + B\overline{C}D + ABD$

2) 1, 2, 4, 6: $Y = \overline{A}C + A\overline{C} + B\overline{C}D + BCD$

3) 1, 2, 3, 6: $Y = \overline{A}C + A\overline{C} + \overline{A}B\overline{D} + BCD$

koniunkcyjne:

4) 2, 6, 1, 4: $Y = (\overline{A} + D)(\overline{A} + B + \overline{C})(B + D)(A + B + \overline{D})$

4. Zminimalizuj funkcję 4-zmiennych: $F^{(1)}=\{3, 4, 5, 7, 9, 13\}$, $D^{(c)}=\{6, 8, 10, 12\}$ za pomocą metody Karnough'a.

AB \ CD	00	01	11	10
00	0 ₀	0 ₁	1 ₃	0 ₂
01	1 ₄	1 ₅	1 ₇	- ₆
11	- ₁₂	1 ₁₃	0 ₁₅	0 ₁₄
10	- ₈	1 ₉	0 ₁₁	- ₁₀

Diagram showing groupings: (1) red box around cells (11,01), (11,11), (10,01), (10,11); (2) blue box around cell (00,11); (3) green box around cells (01,00), (01,01), (01,11), (01,10); (4) orange box around cells (01,00), (01,01), (11,00), (11,01).

Implikanty proste:

- 1) $A\bar{C}$ - istotny
- 2) $B\bar{C}$
- 3) $\bar{A}B$
- 4) $\bar{A}CD$ - istotny

Postacie minimalne:

dysjunkcyjne:

- 1) 1, 3, 4: $Y = A\bar{C} + \bar{A}B + \bar{A}CD$
- 2) 1, 2, 4: $Y = A\bar{C} + B\bar{C} + \bar{A}CD$

5. Zminimalizuj funkcję 4-zmiennych: $F^{(1)}=\{3, 4, 5, 7, 9, 13\}$, $D^{(c)}=\{6, 12\}$ za pomocą metody Karnough'a.

AB \ CD	00	01	11	10
00	0 ₀	0 ₁	1 ₃	0 ₂
01	1 ₄	1 ₅	1 ₇	- ₆
11	- ₁₂	1 ₁₃	0 ₁₅	0 ₁₄
10	0 ₈	1 ₉	0 ₁₁	0 ₁₀

Diagram showing groupings: (1) blue box around cells (01,00), (01,01), (01,11), (01,10); (2) red box around cells (11,00), (11,01), (10,00), (10,01); (3) green box around cell (00,11); (4) orange box around cells (11,01), (10,01).

Implikanty proste:

- 1) $\bar{A}B$
- 2) $B\bar{C}$
- 3) $\bar{A}CD$ - istotny
- 4) $\bar{A}\bar{C}D$ - istotny

Postacie minimalne:

dysjunkcyjne:

- 3) 1, 3, 4: $Y = \bar{A}B + \bar{A}CD + \bar{A}\bar{C}D$
- 4) 2, 3, 4: $Y = B\bar{C} + \bar{A}CD + \bar{A}\bar{C}D$

6. Zminimalizuj funkcję 4-zmiennych: $F^{(1)}=\{0, 1, 2, 10, 11, 12, 14, 15\}$, $D^{(-)}=\{6, 8, 13\}$ za pomocą metody Karnough'a.

AB \ CD	00	01	11	10
00	1 ⁰	1 ¹	0 ³	1 ²
01	0 ⁴	0 ⁵	0 ⁷	- ⁶
11	1 ¹²	- ¹³	1 ¹⁵	1 ¹⁴
10	- ⁸	0 ⁹	1 ¹¹	1 ¹⁰

Implikanty proste:

- 1) $\overline{A}\overline{B}\overline{C}$ - istotny
- 2) $\overline{B}\overline{D}$
- 3) $\overline{C}\overline{D}$
- 4) $\overline{A}\overline{D}$
- 5) AC - istotny
- 6) AB

Postacie minimalne:

dysjunkcyjne:

- 1) 1, 5, 2, 4: $Y = \overline{A}\overline{B}\overline{C} + AC + \overline{B}\overline{D} + \overline{A}\overline{D}$
- 2) 1, 5, 2, 6: $Y = \overline{A}\overline{B}\overline{C} + AC + \overline{B}\overline{D} + AB$
- 3) 1, 5, 3, 4: $Y = \overline{A}\overline{B}\overline{C} + AC + \overline{C}\overline{D} + \overline{A}\overline{D}$
- 4) 1, 5, 3, 6: $Y = \overline{A}\overline{B}\overline{C} + AC + \overline{C}\overline{D} + AB$

7. Zminimalizuj funkcję 4-zmiennych: $F^{(1)}=\{0, 1, 2, 10, 11, 12, 14, 15\}$, $D^{(-)}=\{6, 8, 13\}$ za pomocą metody Karnough'a.

AB \ CD	00	01	11	10
00	1 ⁰	- ¹	0 ³	1 ²
01	0 ⁴	0 ⁵	0 ⁷	- ⁶
11	1 ¹²	1 ¹³	1 ¹⁵	1 ¹⁴
10	1 ⁸	1 ⁹	0 ¹¹	1 ¹⁰

Implikanty proste:

- 1) $\overline{A}\overline{B}\overline{D}$
- 2) $\overline{A}\overline{B}\overline{C}$
- 3) $\overline{C}\overline{D}$ - istotny
- 4) AB - istotny
- 5) $\overline{A}\overline{C}$ - istotny

Postacie minimalne:

dysjunkcyjne:

- 1) 3, 4, 5, 1: $Y = \overline{C}\overline{D} + AB + \overline{A}\overline{C} + \overline{A}\overline{B}\overline{D}$
- 2) 3, 4, 5, 2: $Y = \overline{C}\overline{D} + AB + \overline{A}\overline{C} + \overline{A}\overline{B}\overline{C}$

8. Zminimalizuj funkcję 4-zmiennych: $F^{(1)} = \{0, 1, 2, 10, 11, 12, 14, 15\}$, $D^{(-)} = \{6, 8, 13\}$ za pomocą metody Karnough'a.

AB \ CD	00	01	11	10
00	0 ₀	0 ₁	1 ₃	0 ₂
01	0 ₄	0 ₅	1 ₇	0 ₆
11	1 ₁₂	- ₁₃	1 ₁₅	- ₁₄
10	- ₈	0 ₉	1 ₁₁	0 ₁₀

Diagram showing groupings in the Karnaugh map:

- Group 1 (green): CD (cells 3, 7, 11, 15)
- Group 2 (blue): AB (cells 12, 13, 14, 15)
- Group 3 (red): $ABC\bar{C}$ (cells 12, 13)
- Group 4 (yellow): $A\bar{C}\bar{D}$ (cells 8, 12)

Implikanty proste:

1) CD - istotny

2) AB - istotny

Implikanty (nie są prostymi)

3) $ABC\bar{C}$

4) $A\bar{C}\bar{D}$

Postacie minimalne:

dysjunkcyjne:

1) 1, 2: $Y = CD + AB$

Postacie nie minimalne:

1) 1, 3: $Y = CD + ABC\bar{C}$

2) 1, 4: $Y = CD + A\bar{C}\bar{D}$

9. Zminimalizuj funkcję 4-zmiennych: $F^{(1)} = \{6, 8, 10, 13, 14, 15\}$, $D^{(c)} = \{2, 7, 9, 12\}$ za pomocą metody Karnough'a.

AB \ CD	00	01	11	10
00	0 ₀	0 ₁	0 ₃	- ₂
01	0 ₄	0 ₅	- ₇	1 ₆
11	- ₁₂	1 ₁₃	1 ₁₅	1 ₁₄
10	1 ₈	- ₉	0 ₁₁	1 ₁₀

Implikanty proste:

- 1) $C\bar{D}$
- 2) BC
- 3) $A\bar{D}$
- 4) AB
- 5) $A\bar{C}$

Postacie minimalne:

dysjunkcyjne:

1) 1, 2, 5: $Y = C\bar{D} + BC + A\bar{C}$

2) 1, 4, 5: $Y = C\bar{D} + AB + A\bar{C}$

3) 1, 3, 4: $Y = C\bar{D} + A\bar{D} + AB$

4) 2, 3, 4: $Y = BC + A\bar{D} + AB$

5) 2, 3, 5: $Y = BC + A\bar{D} + A\bar{C}$