

ZAVRŠNI ISPIT 2008./2009.

1. $F(A, B, C) = A\bar{B} + \bar{B}\bar{C}$

	A	B	C	F
0	0	0	0	1
1	0	0	1	0
2	0	1	0	0
3	0	1	1	0
4	1	0	0	1
5	1	0	1	1
6	1	1	0	0
7	1	1	1	0

4 0 0 4 1 0 0
5 1 0 1 0 0 0 0

+5V → 0
-5V → 1

2

3

2. $F(A, B, C, D, E) = A(\bar{B}\bar{C} + D\bar{E})$

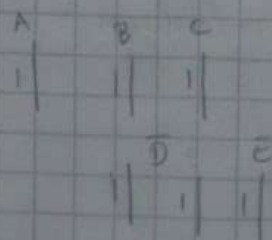
n-terminal → pull-down

$\bar{F} = 1$

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

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

↓ ↓ ↓ ↓ ↓
1 1 1 2 1



6

3.

00
k=2

n=5

2 ⁰	2 ¹	2 ²	
1	2	3	4
2	2	P	2
0	0	0	1
0	1	1	0
1	0	1	0
0	1	0	0

$2^1 \geq 1 + k + 1$

$2^1 \geq 1 + 3$

$2^3 \geq 6$

$1 + 3$

00000

19	1	↑
9	1	
4	0	
2	0	
1	1	
0	1	

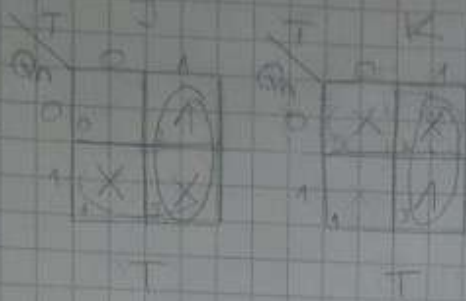
5.

6.

7.



T	Q	Q _{new}	J	K
0	0	0	0	X
0	1	1	X	0
1	0	1	1	X
1	1	0	X	1



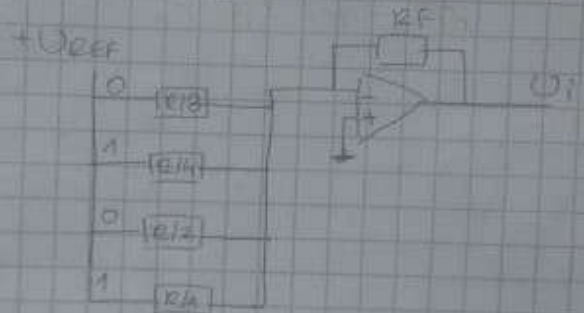
J	K	Q	Q _{new}
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

8.

$R_F = 15 \text{ k}\Omega$
 $R = 10 \text{ k}\Omega$
 binary 5 \rightarrow 0101
 $U_i = -2 \text{ V}$
 $U_{REF}?$

0

teilen in 4



$$\frac{U_i}{R_F} = \frac{U_{REF}}{R_{eq}}$$

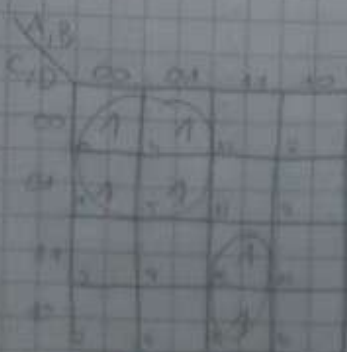
$$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{R} = \frac{1}{R} + \frac{4}{R} = \frac{5}{R}$$

$$\frac{U_i}{R_F} = U_{REF} \cdot \frac{5}{R} \rightarrow U_{REF} = \frac{U_i}{R_F} \cdot \frac{R}{5} = \frac{-2}{10^3} \cdot \frac{10^4}{5} = -4 \text{ V}$$

9.

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

$$F(A, B, C, D) = (A + B \cdot C) \cdot (\bar{C} + A \cdot B) = \overbrace{AC} + \overbrace{ABBC} + \overbrace{BCC} + \overbrace{ABBC} = AC + ABC$$



$$AC + ABC$$

0	0	0	0	0	1	1	1	0
1	0	0	0	1	0	1	1	1
2	0	1	0	0				
3	0	1	0	1				

10.

$$U_{GS} = U_{Hmax} - U_{OHmax} = 0,5 - 0,2 = 0,3V$$

$$U_{GS} = U_{OHmin} - U_{Hmin} = 4,4 - 4,2 = 0,2V$$

$$U_{GS} = \min(0,3, 0,2) = 0,2V$$

11. $F(A, B, C, D) = \sum m(3, 5, 6, 7, 9, 10, 12, 13, 15)$

4/1



	A	B	C	D	F	
0	0	0	0	0	0	
1	0	0	0	1	0	
2	0	0	1	0	0	d0
3	0	0	1	1	1	
4	0	1	0	0	0	
5	0	1	0	1	1	
6	0	1	1	0	1	d1
7	0	1	1	1	1	
8	1	0	0	0	0	
9	1	0	0	1	1	
10	1	0	1	0	1	d2
11	1	0	1	1	0	
12	1	1	0	0	1	
13	1	1	0	1	1	A3
14	1	1	1	0	0	
15	1	1	1	1	1	

C \ D	0	1
0	0	1
1	1	0

$$C\bar{D} + C D = C \oplus D$$

12.

Kombinacijski sklop → izlaz (a) koji ima 0 ulazima (2 → ili 0 ili 1 de bita)

13.

$$N = 2^N \text{ stanja} \quad G = 2^N \quad N = 2 \text{ bistabiln}$$

	Trenutno stanje		Potica	Sledeće stanje		Bistabiln				izlaz	
	Q ₁	Q ₀	U	Q ₁	Q ₀	J ₁	K ₁	J ₀	K ₀	Q ₁	Q ₀
S ₀	0	0	0	0	1	0	X	1	X	0	0
	0	0	1	1	1	1	X	1	X	0	0
	0	1	0	1	0	1	X	X	1	0	0
S ₁	0	1	1	0	0	0	X	X	1	0	0
	1	0	0	1	1	X	0	1	X	1	1
S ₂	1	0	1	0	1	X	1	1	X	0	1
	1	1	0	1	0	X	0	X	1	1	1
S ₃	1	1	1	0	1	X	1	X	0	1	1

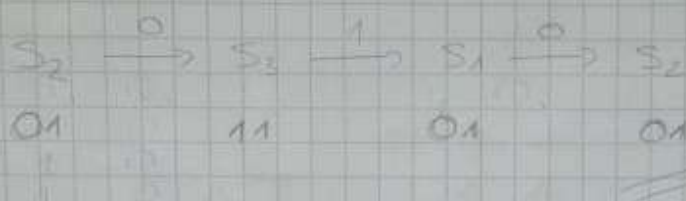
Q_1	Q_0	Q_{n+1}
0	0	0
0	1	1
1	0	0
1	1	1
0	0	0
0	1	1
1	0	1
1	1	1
1	0	1
1	1	0

Q_1	Q_0	Q_{n+1}
0	0	0
0	1	1
1	0	0
1	1	1
0	0	0
0	1	1
1	0	1
1	1	1
1	0	1
1	1	0

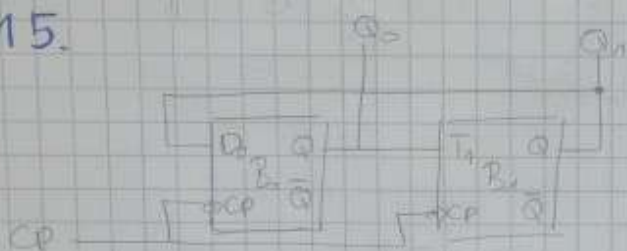
$$J_1 = Q_0 \bar{Q}_1 + \bar{Q}_0 Q_1$$

$$= Q_0 \oplus Q_1$$

14.



15.



$$t_{ab} = 15ns$$

$$t_{setup} = 10ns$$

$$t_{hold} = 10ns$$

Ukazi su su veličine prekrivanja → paralelni prijenos

$$f_{max} = \frac{1}{t_{setup} + t_{ab} + n \cdot t_{clk}} = \frac{1}{10ns + 15ns + 2 \cdot 0} =$$

$$\frac{1}{25 \cdot 10^{-9}} = 0,04 \cdot 10^9 = 40 \cdot 10^6 = 40MHz$$

transition state

steady state

bistabili:

Q_1 Q_0

Q_1 Q_0

Q_1 Q_0

Q_1	Q_0	Q_{n+1}
0	0	0
0	1	1
1	0	1
1	1	0

Q_1	Q_0	Q_{n+1}
0	0	0
0	1	0
1	0	1
1	1	1

0 → 0

1 → 2 → 3

2 celula → NESIGURAN START

16.

$$Q_{n+1} = \bar{A} Q_n + B$$

A	B	Q_n	Q_{n+1}
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

J	K
0	X
X	0
1	X
X	1
0	X
X	0
1	X
X	1

J	K	Q_n	Q_{n+1}
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

A \ B	00	01	11	10
0	X	X	X	X
1				1

$\Delta \bar{B}$

17.

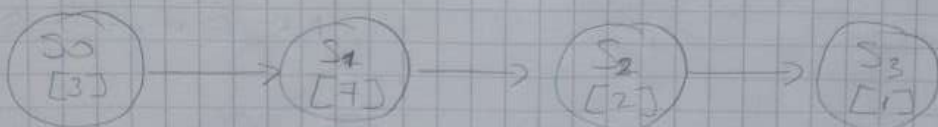
000000
010101
111111

$$d_1 = 3, d_2 = 3$$

$$d_{\min} = 3$$

$$\begin{aligned} d_{\min} &\geq 2t + 1 \\ 3 &\geq 2t + 1 \\ 2 &\geq 2t \\ 1 &\geq t \\ t &= 1 \end{aligned}$$

18.



Transition stage

Q_1	Q_0
0	0
0	1
1	0
1	1

Shifted stage

Q_1	Q_0
0	1
1	0
1	1
0	0

izlaz

Q_2	Q_1	Q_0
0	1	1
1	1	1
0	1	1
0	0	0

bistabil

Q_1	Q_0
0	1
1	0
1	1
0	0

1110

D	Q_n	Q_{n+1}
0	0	0
1	1	1
1	0	1
1	1	1

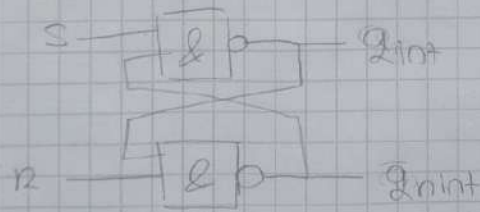
19.

		n_3	n_2	n_1	n_0	f
0		0	0	0	0	0
1		0	0	0	1	0
2		0	0	1	0	0
3	0	0	0	1	1	1
4	1	0	1	0	0	1
5	2	0	1	0	1	1
6	3	0	1	1	0	1
7	4	0	1	1	1	1
8	5	1	0	0	0	1
9	6	1	0	0	1	1
10	7	1	0	1	0	1
11	8	1	0	1	1	1
12	9	1	1	0	0	1
13		1	1	0	1	0
14		1	1	1	0	0
15		1	1	1	1	0

$n_3 \backslash n_2 n_1 n_0$	00	01	11	10
00	0	1	1	1
01	1	1	1	1
11	1	1	1	1
10	1	1	1	1

$$\overline{n_3} n_2 + n_3 \overline{n_2} + n_3 \overline{n_1} \overline{n_0} + \overline{n_3} \cdot n_1 \cdot n_0$$

20.



$$\begin{aligned} r, q_{int} &= ulaz \\ q_{int} &= izlaz \end{aligned}$$