

G51CSA Homework Answers for Digital Logic

1. Construct a truth table for the following Boolean expressions

a. $ABC + \overline{ABC}$

C	B	A	output
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

b. $ABC + \overline{ABC} + \overline{ABC}$

C	B	A	output
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

c. $(A+B)(A+C)(\overline{A}+\overline{B})$

C	B	A	output
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

2. Prove following (hint: use truth table)

a. $1 + A = 1$

A	Output
0	1
1	1

b. $\overline{A + B} = \overline{A} \overline{B}$

B	A	Output
0	0	1
0	1	0
1	0	0
1	1	0

c. $\overline{AB} = \overline{A} + \overline{B}$

B	A	Output
0	0	1
0	1	1
1	0	1
1	1	0

3. The problem is to construct 7 output functions.

Suppose D is the most significant bit and A is the least significant bit.

a. Develop a truth table for this circuit

Display 0 = {a b c d e f }

Display 1 = { b c }

Display 2 = {a b d e g}

Display 3 = {a b c d g}

Display 4 = { b c f g}

Display 5 = {a c d f g}

Display 6 = {a c d e f g}

Display 7 = {a b c }

Display 8 = {a b c d e f g}

Display 9 = {a b c d f g}

Fa={0, 2, 3, 5, 6, 7, 8, 9}

Fb=(0, 1, 2, 3, 4, 7, 8, 9)

Fc=(0, 1, 3, 4, 5, 6, 7, 8, 9)

Fd=(0, 2, 3, 5, 6, 8, 9)

Fe=(0, 2, 6, 8)

Ff=(0, 4, 5, 6, 8, 9)

Fg=(2, 3, 4, 5, 6, 8, 9)

D	C	B	A	Fa	Fb	Fc	Fd	Fe	Ff	Fg
0	0	0	0	1	1	1	1	1	1	
0	0	0	1		1	1				
0	0	1	0	1	1		1	1		1
0	0	1	1	1	1	1	1			1
0	1	0	0		1	1			1	1
0	1	0	1	1		1	1		1	1
0	1	1	0	1		1	1	1	1	1
0	1	1	1	1	1	1				
1	0	0	0	1	1	1	1	1	1	1
1	0	0	1	1	1	1	1		1	1
1	0	1	0							
1	0	1	1							
1	1	0	0							
1	1	0	1							
1	1	1	0							
1	1	1	1							
1	1	1	1							

b. Express the truth table sum of product form

$$F_a = \overline{D}\overline{C}\overline{B}\overline{A} + \overline{D}\overline{C}\overline{B}A + \overline{D}\overline{C}B\overline{A} + \overline{D}\overline{C}BA + \overline{D}C\overline{B}\overline{A} + \overline{D}C\overline{B}A + \overline{D}CB\overline{A} + \overline{D}CBA$$

$$F_b = \overline{D}\overline{C}\overline{B}\overline{A} + \overline{D}\overline{C}\overline{B}A + \overline{D}\overline{C}B\overline{A} + \overline{D}\overline{C}BA + \overline{D}C\overline{B}\overline{A} + \overline{D}C\overline{B}A + \overline{D}CB\overline{A} + \overline{D}CBA$$

$$F_c = \overline{D}\overline{C}\overline{B}\overline{A} + \overline{D}\overline{C}\overline{B}A + \overline{D}\overline{C}B\overline{A} + \overline{D}\overline{C}BA + \overline{D}C\overline{B}\overline{A} + \overline{D}C\overline{B}A + \overline{D}CB\overline{A} + \overline{D}CBA$$

$$F_d = \overline{D}\overline{C}\overline{B}\overline{A} + \overline{D}\overline{C}\overline{B}A + \overline{D}\overline{C}B\overline{A} + \overline{D}\overline{C}BA + \overline{D}C\overline{B}\overline{A} + \overline{D}C\overline{B}A + \overline{D}CB\overline{A} + \overline{D}CBA$$

$$F_e = \overline{D}\overline{C}\overline{B}\overline{A} + \overline{D}\overline{C}\overline{B}A + \overline{D}\overline{C}B\overline{A} + \overline{D}\overline{C}BA$$

$$F_f = \overline{D}\overline{C}\overline{B}\overline{A} + \overline{D}\overline{C}\overline{B}A + \overline{D}\overline{C}B\overline{A} + \overline{D}\overline{C}BA + \overline{D}C\overline{B}\overline{A} + \overline{D}C\overline{B}A$$

$$F_g = \overline{D}\overline{C}\overline{B}\overline{A} + \overline{D}\overline{C}\overline{B}A + \overline{D}\overline{C}B\overline{A} + \overline{D}\overline{C}BA + \overline{D}C\overline{B}\overline{A} + \overline{D}C\overline{B}A + \overline{D}CB\overline{A} + \overline{D}CBA$$

c. Provide a simplified expression
We will do it with Karnaugh Maps

Fa

	BA			
DC	00	01	11	10
00	1		1	1
01		1	1	1
11	x	x	x	x
10	1	1	x	x

$$F_a = \overline{C}\overline{A} + CA + D + B$$

Fb

BA				
DC	00	01	11	10
00	1	1	1	1
01	1		1	
11	x	x	x	x
10	1	1	x	x

$$F_b = \overline{C} + AB + \overline{A}\overline{B}$$

Fc

BA				
DC	00	01	11	10
00	1	1	1	
01	1	1	1	1
11	x	x	x	x
10	1	1	x	x

$$F_c = \overline{B} + A + C$$

Fd

BA				
DC	00	01	11	10
00	1		1	1
01		1		1
11	x	x	x	x
10	1	1	x	x

$$F_d = \overline{C}\overline{A} + D + B\overline{A} + \overline{C}B + C\overline{B}A$$

Fe

BA				
DC	00	01	11	10
00	1			1
01				1
11	x	x	x	x
10	1		x	x

$$F_e = \overline{C}\overline{A} + B\overline{A}$$

Ff

BA				
DC	00	01	11	10
00	1			
01	1	1		1
11	x	x	x	x
10	1	1	x	x

$F_f = D + \overline{B}\overline{A} + C\overline{B} + C\overline{A}$

Fg

BA				
DC	00	01	11	10
00			1	1
01	1	1		1
11	x	x	x	x
10	1	1	x	x

$F_g = D + C\overline{B} + C\overline{A} + \overline{C}B$