Switching algebra

Rules for BCD addition

1. If the sum is smaller or equal to 9 the addition is done without correction.
2. If after addition illegal combination appears or carry out occurs the correction is 6 (0110).
3. Carry out which appears after correction is added to the next tetrad.

Switching Algebra

Switching algebra consist of :
1) A set of elements B= {0,1};
2) Logic operations AND, OR and NOT, that are defined as:

AND	OR	NOT
0*0=0	0+0=0	$\overline{0}$ =1
0*1=0	0+1=1	$\overline{1}$ =0
1*0=0	1+0=1	
1*1=1	1+1=1	

Single-variable Theorems (Axioms)

1. X+0=X	**X·1=X**	**- Identities**
2. X+1=1	**X·0=0**	**- Null element**
3. X+X=X	**X·X=X**	**- Idem potency**
4. (X`)`=X		**- Involution**
5. X+X`=1	**X·X`=0**	**- Complements**

No	Logic expressions		Theorem
1.	$x_1 + x_2 = x_2 + x_1$	$x_1 \cdot x_2 = x_2 \cdot x_1$	*Commutativity*
2.	$(x_1 + x_2) + x_3 = x_1 + (x_2 + x_3)$	$(x_1 \cdot x_2) \cdot x_3 = x_1 \cdot (x_2 \cdot x_3)$	*Associativity*
3.	$x_1x_2 + x_1x_3 = x_1 \cdot (x_2 + x_3)$	$(x_1 + x_2) \cdot (x_1 + x_3) = x_1 + (x_2 \cdot x_3)$	*Distributivity*
4.	$x_1 + x_1x_2 = x_1$	$x_1 \cdot (x_1 + x_2) = x_1$	*Covering*
	Proof: $x_1 + x_1x_2 = x_1 \cdot 1 + x_1x_2 = x_1(1 + x_2) = x_1 \cdot 1 = x_1$		
5.	$x_1x_2 + x_1\overline{x_2} = x_1$	$(x_1 + x_2) \cdot (x_1 + \overline{x_2}) = x_1$	*Combining*
	Proof: $x_1x_2 + x_1\overline{x_2} = x_1 \cdot (x_2 + \overline{x_2}) = x_1 \cdot 1 = x_1$		
6.	$\overline{x_1 \cdot x_2} = \overline{x_1} + \overline{x_2}$	$\overline{x_1 + x_2} = \overline{x_1} \cdot \overline{x_2}$	*De Morgan*

Minimize logic expressions

$$x_1x_2 + x_1x_2\bar{x}_3x_4 + x_1x_2x_4\bar{x}_5 + x_1x_2\bar{x}_3x_5 + \bar{x}_3x_4x_5$$

$$x_1x_2x_3x_4 \cdot (x_1x_2x_3\bar{x}_4 + x_1\bar{x}_2x_3x_4 + \bar{x}_1x_2x_3x_4 + x_1x_2\bar{x}_3x_4)$$

$$x_1x_2x_3 + x_3(\overline{\overline{x_1\bar{x}_2} \cdot \overline{\bar{x}_1x_3}})$$

Minimize logic expressions

$$(\bar{x}_1 + x_2)(x_3 \cdot (\bar{x}_4 + x_5)) + (\bar{x}_1 + x_2)(\overline{x_1 \cdot (\bar{x}_2 + x_3)})$$

$$x_1 x_2 x_3 + x_2(\overline{\overline{x_1 \bar{x}_2 x_3} \cdot \overline{\bar{x}_1 x_3}}) + \overline{\bar{x}_1 + \bar{x}_2 + \bar{x}_3 + x_4}$$

Write Truth tables

$$F = \bar{x}_1 x_2 + \bar{x}_1 \bar{x}_2 x_3$$

	x1	x2	x3	F
0				
1				
2				
3				
4				
5				
6				
7				

Write Truth tables

$$F = x_1 + \bar{x}_2(\bar{x}_3 + x_4)$$

	x1	x2	x3	F
0				
1				
2				
3				
4				
5				
6				
7				

Write Truth tables

$$F = \overline{\overline{x_1 + x_2 + x_3 + x_4}}$$

	x1	x2	x3	F
0				
1				
2				
3				
4				
5				
6				
7				

Write canonical sum and canonical product

$$F = \sum(2,4,6,7)$$

$$F = \prod(0,1,7)$$

$$F = x_1 + \bar{x}_2\bar{x}_3$$