Chapter 2: Boolean Algebra & Logic Gates
Solutions of Problems: [18, 21, 23]

Problem 18:

Convert the following to the other canonical form:

(a) F(x, y, z)= ∑(1,3,7)   (b) F(A,B,C,D)= ∏(0,1,2,3,4,6,12)

Solution:

(a) F(x, y, z)= ∑(1,3,7) = ∏(0,2,4,5,6)

F(x, y, z)= $(x+y+z)\bullet(x+\overline{y}+z)\bullet(\overline{x}+y+z)\bullet(\overline{x}+y+\overline{z})\bullet(\overline{x}+\overline{y}+z)$

(b) F(A,B,C,D)= ∏(0,1,2,3,4,6,12)= ∑(5,7,8,9,10,11,13,14,15)

F(A,B,C,D)=

$(\overline{A}B\overline{C}D)+(\overline{A}BCD)+(A\overline{B}\,\overline{C}\,\overline{D})+(A\overline{B}\,\overline{C}D)+(A\overline{B}C\overline{D})+(A\overline{B}CD)+(AB\overline{C}D)+(ABC\overline{D})+(ABCD)$

Problem 21:

Show that the dual of the exclusive-OR is equal to its complement.

Solution:

XOR: X⊕Y = XY′ + X′Y

Dual of XOR: = (X +Y′)•(X′+Y)
= XX′+ XY +X′Y′ +YY′
= XY + X′Y′

Complement of XOR (XNOR)= (X⊕Y)′
= (XY′ + X′Y)′
= (X′+Y)•(X +Y′)
= XX′+ XY + X′Y′+ YY′
= XY + X′Y′

Problem 23:
Show that a positive logic NAND gate is a negative logic NOR gate and vice versa.

Solution:

Truth table for a NAND gate:

X	Y	Z
0	0	1
0	1	1
1	0	1
1	1	0

Truth table for positive logic NAND gate (L = 0 H = 1) with H and L:

X	Y	Z
L	L	H
L	H	H
H	L	H
H	H	L

Truth table for negative logic let L = 1, H = 0

X	Y	Z
1	1	0
1	0	0
0	1	0
0	0	1

This resulting truth table is that of the NOR gate using negative logic.