Solution to Assignment 1:

2.2

(a) $xy + xy' = x(y + y') = x$

(b) $(x + y)(x + y') = x + yy' = x(x + y') + y(x + y') = xx + xy' + xy + yy' = x$

(c) $xyz + x'y + xyz' = xy(z + z') + x'y = xy + x'y = y$

(d) $(A + B)'(A' + B')' = (A'B')(A\ B) = (A'B')(BA) = A'(B'B)A = 0$

(e) $(a + b + c')(a'b' + c) = aa'b' + ac + ba'b' + bc + c'a'b' + c'c = ac + bc + a'b'c'$

(f) $a'bc + abc' + abc + a'bc' = a'b(c + c') + ab(c + c') = a'b + ab = (a' + a)b = b$

2.3

(a) $ABC + A'B + ABC' = AB + A'B = B$

(b) $x'yz + xz = (x'y + x)z = z(x + x')(x + y) = z(x + y)$

(c) $(x + y)'(x' + y') = x'y'(x' + y') = x'y'$

(d) $xy + x(wz + wz') = x(y + wz + wz') = x(w + y)$

(e) $(BC' + A'D)(AB' + CD') = BC'AB' + BC'CD' + A'DAB' + A'DCD' = 0$

(f) $(a' + c')(a + b' + c') = a'a + a'b' + a'c' + c'a + c'b' + c'c = a'b' + a'c' + ac' + b'c' = c' + b'(a' + c')$
$= c' + b'c' + a'b' = c' + a'b'$

2.4

(a) $A'C' + ABC + AC' = C' + ABC = (C + C')(C' + AB) = AB + C'$

(b) $(x'y' + z)' + z + xy + wz = (x'y')'z' + z + xy + wz = [(x + y)z' + z] + xy + wz =$
$= (z + z')(z + x + y) + xy + wz = z + wz + x + xy + y = z(1 + w) + x(1 + y) + y = x + y + z$

(c) $A'B(D' + C'D) + B(A + A'CD) = B(A'D' + A'C'D + A + A'CD)$
$= B(A'D' + A + A'D(C + C') = B(A + A'(D' + D)) = B(A + A') = B$

(d) $(A' + C)(A' + C')(A + B + C'D) = (A' + CC')(A + B + C'D) = A'(A + B + C'D)$
$= AA' + A'B + A'C'D = A'(B + C'D)$

(e) $ABC'D + A'BD + ABCD = AB(C + C')D + A'BD = ABD + A'BD = BD$

2.9

(a) $F' = (xy' + x'y)' = (xy')'(x'y)' = (x' + y)(x + y') = xy + x'y'$

(b) $F' = [(a + c)\ (a + b')(a' + b + c')]' = (a + c)' + (a + b')' + (a' + b + c')'$
$= a'c' + a'b + ab'c$

(c) $F' = [z + z'(v'w + xy)]' = z'[z'(v'w + xy)]' = z'[zv'w + xyz']'$
$= z'[(zv'w)'(xyz')'] = z'[(z + v + w') + (x' + y' + z)]$
$= z'z + z'v + z'w' + z'x' + z'y' + z'z = z'(v + w' + x' + y')$

2.11

(a) $F(x, y, z) = \Sigma(1, 4, 5, 6, 7)$

(b) $F(a, b, c) = \Sigma(0, 2, 3, 7)$

$F = xy + xy' + y'z$		
x y z		F

x y z	F
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	1

$F = bc + a'c'$	
a b c	F
0 0 0	1
0 0 1	0
0 1 0	1
0 1 1	1
1 0 0	0
1 0 1	0
1 1 0	0
1 1 1	1

2.17   (a) $F = (b + cd)(c + bd)$ $bc + bd + cd + bcd = \Sigma(3, 5, 6, 7, 11, 14, 15)$
$F' = \Sigma(0, 1, 2, 4, 8, 9, 10, 12, 13)$
$F = \Pi(0, 1, 2, 4, 8, 9, 10, 12, 13)$

abcd	F
0000	0
0001	0
0010	0
0011	1
0100	0
0101	1
0110	1
0111	1
1000	0
1001	0
1010	0
1011	1
1100	0
1101	1
1110	1
1111	1

(b) $(cd + b'c + bd')(b + d) = bcd + bd' + cd + b'cd = cd + bd'$
$= \Sigma (3, 4, 7, 11, 12, 14, 15)$
$= \Pi (0, 1, 2, 5, 6, 8, 9, 10, 13)$

abcd	F
0000	0
0001	0
0010	0
0011	1
0100	1
0101	0
0110	0
0111	1
1000	0
1001	0
1010	0
1011	1
1100	1
1101	0
1110	1
1111	1

(c) $(c' + d)(b + c') = bc' + c' + bd + c'd = (c' + bd)$
$= \Sigma(0, 1, 4, 5, 7, 8, 12, 13, 15)$
$F = \Pi (2, 3, 6, 9, 10, 11, 14)$