

Question 1

a.

X	Y	Z	A	B	C	D	E	F
0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	1
0	1	0	0	0	0	1	0	0
0	1	1	0	0	1	0	0	1
1	0	0	0	1	0	0	0	0
1	0	1	0	1	1	0	0	1
1	1	0	1	0	0	1	0	0
1	1	1	1	1	0	0	0	1

b.

$$A(x,y,z) = \sum_m (6,7) = xyz' + xyz = xy(z+z') = \mathbf{xy}$$

$$B(x,y,z) = \sum_m (4,5,7) = xy'z' + xy'z + xyz$$

$$xy'(z+z') + xy'z = xy' + xyz = x(y' + yz) = x(y + y' \cdot y' + z) = \mathbf{x \cdot (y' + z)}$$

$$C(x,y,z) = \sum_m (3,5) = x'yz + xy'z = z(x'y + xy') = z((x' + x) \cdot (x' + y') \cdot (y + y') \cdot (y + x))$$

$$= z(x' + y') \cdot (x + y) = \mathbf{z(x \oplus y)}$$

$$D(x,y,z) = \sum_m (2,6) = x'yz' + xyz' = yz'(x + x') = \mathbf{yz'}$$

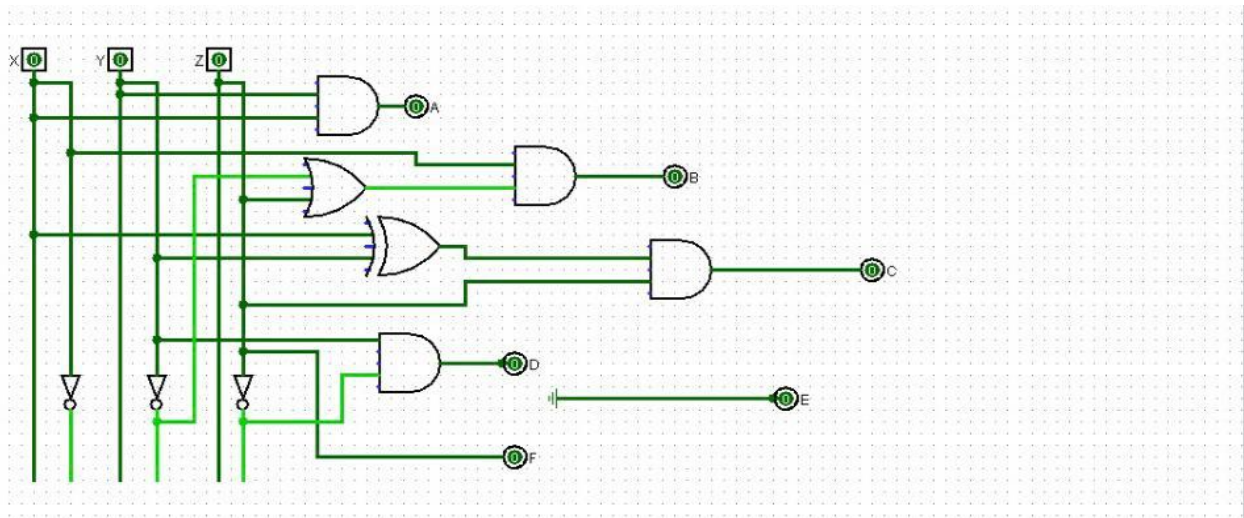
$$E(x,y,z) = \mathbf{0}$$

$$F(x,y,z) = \sum_m (1,3,5,7) = x'y'z + xy'z + x'yz + xyz$$

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

$$= y'z + yz = z(y + y') = \mathbf{z}$$

C.



Question 2

a.

A	B	C	D	X	W	Y	Z
0	0	0	0	1	0	0	1
0	0	0	1	1	0	0	0
0	0	1	0	0	1	1	1
0	0	1	1	0	1	1	0
0	1	0	0	0	1	0	1
0	1	0	1	0	1	0	0
0	1	1	0	0	0	1	1
0	1	1	1	0	0	1	0
1	0	0	0	0	0	0	1
1	0	0	1	0	0	0	0
1	0	1	0	X	X	X	X
1	0	1	1	X	X	X	X
1	1	0	0	X	X	X	X
1	1	0	1	X	X	X	X
1	1	1	0	X	X	X	X
1	1	1	1	X	X	X	X

$$b.X(A,B,C,D) = \sum_m(0,1) = A'B'C'D' + A'B'C'D = A'B'C'(D+D') = A'B'C'$$

$$W(A,B,C,D) = \sum_m(2,3,4,5) =$$

$$A'B'CD' + A'B'CD + AB'CD + AB'CD + A'BC'D' + A'BC'D + ABC'D' + ABC'D$$

$$= A'BC(D+D') + AB'C(D+D') + A'BC'(D+D') + ABC'(D+D')$$

$$= A'B'C + AB'C + A'BC' + ABC'$$

$$= B'C(A+A') + BC'(A+A')$$

$$= B'C + BC'$$

$$B \oplus C$$

$$Y(A,B,C,D) = \sum_m(2,3,6,7) =$$

$$A'B'CD' + A'B'CD + A'BCD' + A'BCD + AB'CD' + AB'CD + ABCD' + ABCD$$

$$= A'B'C + A'BC + AB'C + ABC$$

$$= A'C(B+B') + AC(B+B')$$

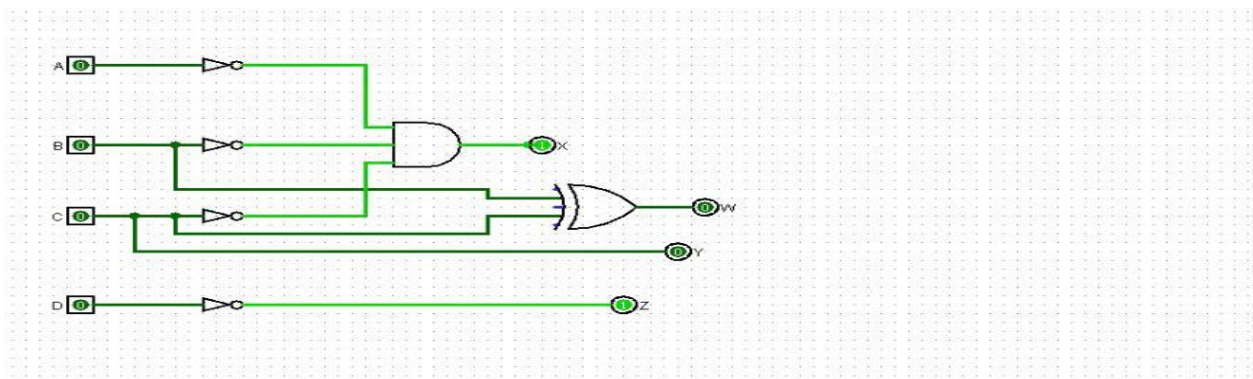
$$A'C + AC = C(A+A') = C$$

$$Z(A,B,C,D) = \sum_m(0,2,4,6,8) =$$

$$= A'B'C'D' + A'BC'D' + AB'C'D' + ABC'D' + A'B'CD' + A'BCD' + AB'CD' + ABCD'$$

$$= A'C'D'(B+B') + AC'D'(B+B') + A'CD'(B+B') + ACD'(B+B')$$

$$A'C'D' + AC'D' + A'CD' + ACD' = C'D'(A'+A) + CD'(A+A') = D'(C+C') = D$$



Question 3

A	B	C	D	S1	S2	S3	S4
0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1
0	0	1	0	1	1	1	0
0	0	1	1	1	1	0	1
0	1	0	0	1	1	0	0
0	1	0	1	1	0	1	1
0	1	1	0	1	0	1	0
0	1	1	1	1	0	0	1
1	0	0	0	1	0	0	0
1	0	0	1	0	1	1	1
1	0	1	0	0	1	1	0
1	0	1	1	0	1	0	1
1	1	0	0	0	1	0	0
1	1	0	1	0	0	1	1
1	1	1	0	0	0	1	0
1	1	1	1	0	0	0	1

b. S1 = $\sum_m(1,2,3,4,5,6,7,8)$

$$A'B'C'D + A'B'CD + A'BC'D + A'BCD + A'B'CD' + A'B'CD + A'BCD' + A'BCD + A'BC'D' + A'BC'D + A'BCD' + A'BCD + AB'C'D'$$

$$= A'B'D(C+C') + A'BD(C+C') + A'B'C(D+D') + A'BC(D+D') + A'BC'(D+D') + A'BC(D+D') +$$

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

$$= A'D + A'C + A'B + AB'C'D'$$

$$= A'(B+C+D) + A(B.C.D)'$$

$$= A \oplus (B+C+D)$$

S2 = $\sum_m(1,2,3,4,9,10,11,12)$

$$A'BC'D' + ABC'D' + A'B'C'D + AB'C'D + A'B'CD + AB'CD + A'B'CD' + A'B'CD + AB'CD' + AB'CD$$

$$= BC'D'(A+A') + B'C'D(A+A') + B'CD(A+A') + A'B'C(D+D') + AB'C(D+D')$$

$$= BC'D' + B'C'D + B'CD + A'B'C + AB'C$$

$$= BC'D' + B'D(C+C') + B'C(A+A')$$

$$= BC'D' + B'D + B'C$$

$$= BC'D' + B'(C+D) = B \oplus (C+D)$$

$$\mathbf{S3} = \sum_m(1,2,5,6,9,10,13,14)$$

$$A'B'C'D + A'BC'D + AB'C'D + ABC'D + A'B'CD' + A'BCD' + AB'CD' + ABCD'$$

$$= A'C'D(B+B') + AC'D(B+B') + A'CD'(B+B') + ACD'(B+B')$$

$$= A'C'D + AC'D + A'CD' + ACD'$$

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

$$= C'D + CD'$$

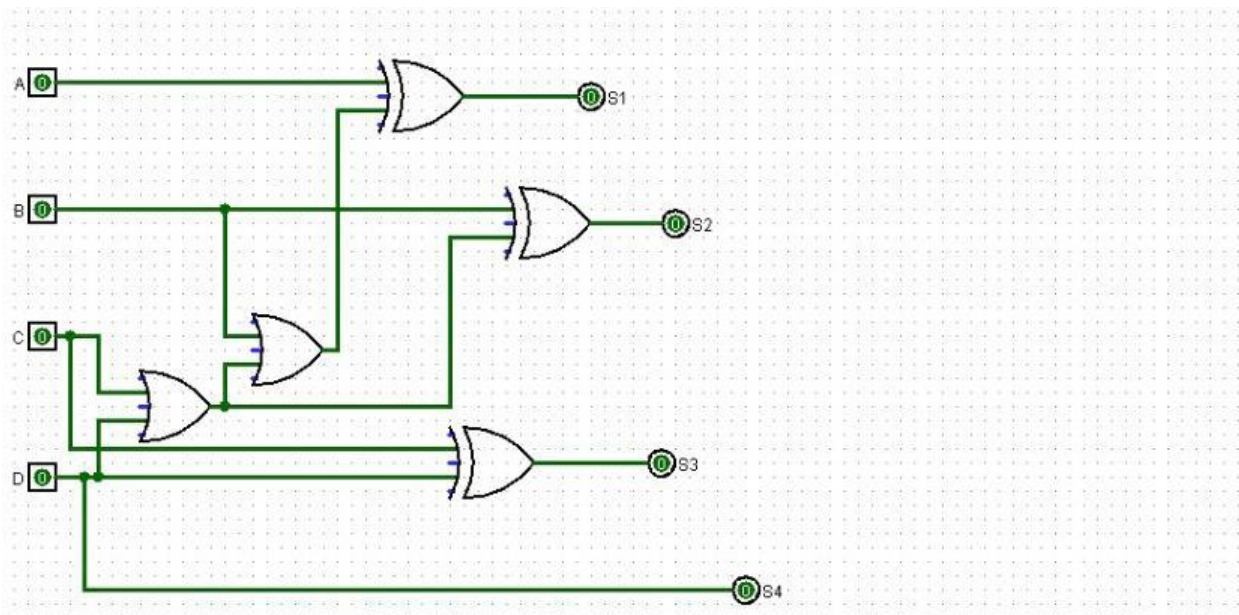
$$C \oplus D$$

$$\mathbf{S4} = \sum_m(1,3,5,7,9,11,13,15)$$

$$A'B'C'D + A'B'CD + A'BC'D + A'BCD + AB'C'D + AB'CD + ABC'D + ABCD$$

$$= A'B'D(C+C') + A'BD(C+C') + AB'D(C+C') + ABD(C+C')$$

$$= A'B'D + A'BD + AB'D + ABD = A'D(B+B') + AD(B+B') = A'D + AD = D(A+A') = D$$



Question 4

a.

A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

b. $F(A,B,C) = \sum_m(1,2,4,7)$

$$A'B'C + A'BC' + AB'C' + ABC$$

$$A'(B'C + BC) + A(B'C' + BC)$$

$$A'(B \oplus C) + A(B'C' + BC)''$$

$$A'(B \oplus C) + A((B+C) \cdot (B'+C')) = A'(B \oplus C) + A((B \cdot B') + (B' \cdot C) + (B \cdot C') + (C \cdot C'))'$$

$$= A'(B \oplus C) + A(B'C + BC')$$

$$A'(B \oplus C) + A(B \oplus C)'$$

$$A \oplus B \oplus C$$

c.

