**Week 14-15 Boolean Functions**

1. What is the use of Boolean identities?  
a) Minimizing the Boolean expression  
b) Maximizing the Boolean expression  
c) To evaluate a logical identity  
d) Searching of an algebraic expression

Answer: a  
Explanation: Boolean identities are used for minimizing the Boolean expression and transforming into an equivalent expression.

2. \_\_\_\_\_\_\_\_\_ is used to implement the Boolean functions.  
a) Logical notations  
b) Arithmetic logics  
c) Logic gates  
d) Expressions

Answer: c  
Explanation: To implement a Boolean function logic gates are used. Basic logic gates are AND, OR and NOT.

3. Inversion of single bit input to a single bit output using \_\_\_\_\_\_\_\_\_  
a) NOT gate  
b) NOR gate  
c) AND gate  
d) NAND gate

Answer: a  
Explanation: A NOT gate is used to invert a single bit input (say A) to a single bit of output (~A).

4. There are \_\_\_\_\_\_\_\_\_ numbers of Boolean functions of degree n.  
a) n  
b) 2(2\*n)  
c) n3  
d) n(n\*2)

Answer: b  
Explanation: There are 2n different n-tuples of 0’s and 1’s. A Boolean function is an assignment of 0’s or 1’s to each of these 2 n different n-tuples. Hence, there are 2(2\*n) different Boolean functions.

5. A \_\_\_\_\_\_\_\_\_ is a Boolean variable.  
a) Literal  
b) String  
c) Keyword  
d) Identifier

Answer: a  
Explanation: A literal is a Boolean variable or its complement. A maxterm is a sum of n literals and a minterm is a product of n literals.

6. Minimization of function F(A,B,C) = A\*B\*(B+C) is \_\_\_\_\_\_\_\_\_  
a) AC  
b) B+C  
c) B`  
d) AB

Answer: d  
Explanation: AB(B+C)  
= ABB + ABC [Applying distributive rule]  
= AB + ABC [Applying Idempotent law]  
= AB (1+C)  
= AB\*1 [As, 1+C=1]  
= AB.

7. The set for which the Boolean function is functionally complete is \_\_\_\_\_\_\_\_\_\_  
a) {\*, %, /}  
b) {., +, -}  
c) {^, +, -}  
d) {%, +, \*}

Answer: b  
Explanation: A Boolean function is represented by using three operators ., +, -. We can ﬁnd a smaller set of functionally complete operators if one of the three operators of this set can be expressed in terms of the other two.

8. (X+Y`)(X+Z) can be represented by \_\_\_\_\_  
a) (X+Y`Z)  
b) (Y+X`)  
c) XY`  
d) (X+Z`)

Answer: a  
Explanation: (X+Y`) (X+Z)  
= XX + XZ + XY`+ Y`Z  
= X + XZ + XY`+ Y`Z  
= X (1+Z) + XY`+ Y`Z  
= X.1 + XY`+ Y`Z  
= X (1+Y`) + Y`Z  
= X + Y`Z.

9. \_\_\_\_\_\_\_\_\_\_ is a disjunctive normal form.  
a) product-of-sums  
b) product-of-subtractions  
c) sum-of-products  
d) sum-of-subtractions

Answer: c  
Explanation: The sum of minterms that represents the function is called the sum-of-products expansion or the disjunctive normal form. A Boolean sum of minterms has the value 1 when exactly one of the minterms in the sum has the value 1. It has the value 0 for all other combinations of values of the variables.

10. a ⊕ b = \_\_\_\_\_\_\_\_  
a) (a+b)(a`+b`)  
b) (a+b`)  
c) b`  
d) a` + b`

Answer: a  
Explanation: a ⊕ b  
= a`b + ab`  
= a`b+aa` + bb` + ab` [As, a\*a` = 0 and b\*b` = 0]  
= a`(a+b) + b`(a+b)  
= (a+b)(a`+b`).

**“Minimization of Boolean Functions”.**

1. Find the simplified expression A’BC’+AC’.  
a) B  
b) A+C  
c) (A+B)C’  
d) B’C

Answer: c  
Explanation: Given: A’BC’ + AC’  
= C’(A’B + A)  
= C’(A + B).

2. Evaluate the expression: (X + Z)(X + XZ’) + XY + Y.  
a) XY+Z’  
b) Y+XZ’+Y’Z  
c) X’Z+Y  
d) X+Y

Answer: d  
Explanation: (X + Z)(X + XZ’) + XY + Y [Original Expression]  
= (x + z)X(1 + Z’) + XY + Y [Distributive]  
= (X + Z)X + XY + Y [Complement, Identity]  
= (X+Z)X + Y(X+1) [ Distributive]  
= (X+Z)X + Y [Idempotent]  
= XX + XZ + Y [Distributive]  
= X + XZ + Y [Identity]  
= X(1+Z) + Y  
= X + Y [Idempotent].

3. Simplify the expression: A’(A + BC) + (AC + B’C).  
a) (AB’C+BC’)  
b) (A’B+C’)  
c) (A+ BC)  
d) AC

Answer: b  
Explanation: Given: A’(A + BC) + (AC + B’C)  
= A’A + A’BC + AC + B’C  
= A’BC + C(A + B’)  
= C(A’B + A + B’)  
= C(A + B + B’)  
= C(A + 1)  
= AC.

4. What is the simplification value of MN(M + N’) + M(N + N’)?  
a) M  
b) MN+M’N’  
c) (1+M)  
d) M+N’

Answer: b  
Explanation: Given: MN(M + N’) + M(N + N’)  
= MN(M+N’) + M.1  
= MNM + MNN’ + M  
= MN + 0 +M  
= M(N + 1)  
= M.

5. Simplify the expression XZ’ + (Y + Y’Z) + XY.  
a) (1+XY’)  
b) YZ + XY’ + Z’  
c) (X + Y +Z)  
d) XY’+ Z’

Answer: c  
Explanation: Given: X Z’ + (Y + Y’Z) + XY  
= XZ’ + (Y + Z) + XY  
= XZ’ + Y + Z + XY  
= (XZ’ + Z) + (Y + XY)  
= (X + Z) + Y (1 + X)  
= X + Y + Z.

6. Find the simplified term Y’ (X’ + Y’) (X + X’Y)?  
a) XY’  
b) X’Y  
c) X + Y  
d) X’Y’

Answer: a  
Explanation: Given: Y’ (X’ + Y’) (X + X’Y)  
= Y’(X’ + Y’)(X + Y)  
= (X’Y’ + Y’)(X + Y)  
= (XX’Y’ + X’Y’Y + XY’ + YY’)  
= XY’.

7. If an expression is given that x+x’y’z=x+y’z, find the minimal expression of the function F(x,y,z) = x+x’y’z+yz?  
a) y’ + z  
b) xz + y’  
c) x + z  
d) x’ + y

Answer: c  
Explanation: We have, x+x’y’z+yz  
= x+y’z+yz [since, x+x’y’z=x+y’z]  
= x+z(y’+y)  
= x + z.

8. Simplify the expression: XY’ + X’ + Y’X’.  
a) X’ + Y  
b) XY’  
c) (XY)’  
d) Y’ + X

Answer: c  
Explanation: Given XY’+X’+Y’X’ = Y’(X+X’) + X’ = Y’.1 + X’ = X’ + Y’ = (XY)’ [De Morgan’s law].

9. Minimize the Boolean expression using Boolean identities: A′B+ABC′+BC’+AB′C′.  
a) B(AC)’ + AC’  
b) AC’ + B’  
c) ABC + B’ + C  
d) BC’ + A’B

Answer: a  
Explanation: Given: A′B+ABC′+BC’+AB′C′  
= A’B + BC’ (1 + A) + AB’C”  
= A’B + BC’ + AB’C’  
= A’B + BC’ + BC’ + AB’C’  
= B(A’ + C’) + C’(A + AB’)  
= B(AC)’ + C’ A(1 + B’)  
= B(AC)’ + AC’.

10. Minimize the following Boolean expression using Boolean identities.  
F(A,B,C) = (A+BC’)(AB’+C)  
a) A + B + C’  
b) AC’ + B  
c) B + AC  
d) A(B’ + C)

Answer: d  
Explanation: Given, F(A,B,C) = (A+BC’)(AB’+C)  
= (AAB’ + BC’AB’ + AC + BC’C)  
= (AB’ + 0 + AC + 0)  
= A(B’ + C).