Sardar Vallabhbhai Patel Institute of Technology, Vasad

Digital Fundamentals

Assignment 2

Boolean algebra and Logic Gates

1. What is Boolean algebra? What is its utility?
2. State and prove De-Morgan's theorem.
3. Show that the dual of the exclusive OR is equal to its complement.
4. Differentiate between positive and negative logic systems.
5. Show that a positive logic NAND gate is a negative logic NOR gate, and vice versa.
6. Define the following: (a) minterm (b)maxterm (c) duality principle (d) logic gate.
7. Differentiate between Canonical form and Standard form. Which form is preferable when implementing a Boolean function with gate? why?
8. Given two Boolean function F1 and F2.
   (a) Show that the Boolean function E=F1+F2, obtained by ORing the two function, contain the sum of all the minterms in F1 and F2.
   (b) Show that the Boolean function E=F1.F2, obtained by ANDing the two function, contain those minterm common to both F1 and F2.
9. Simplify the following Boolean function to a minimum no of literal.
   (a) ABC+A'BC+A'B'C+ABC'+A'B'C' (to five literals)
   (b) xy'+y'z'+x'z'
   (c) (A'+C)(A'+C')(A+B+C'D)
   (d) (x'y'+z)'+z+xy+wz
   (e) (A+C+D)(A+C+D')(A+C'+D)(A+B') (to four literals)
   (f) A'B(D'+C'D)+B(A+A'CD)
   (g) BC+AC'+AB+BCD (to four literals)
   (h) [(CD)'+A]'+A+CD+AB (to three literals)
   (i) y(wz'+wz)+xy
   (j) zx+zx'y

10. Prove the following.
    (a) AB+ABC+AB'=A
    (b) AB+CD=[(AB)'(CD)']'
    (c) (A+B)(A'+C)=AC+A'B
    (d) (B+BC)(B+B'C)(B+D)=B
    (e) xyz+x'y+xyz'=y
    (f) AB+A'C+BC=AB+A'C
    (g) A+B[AC+(B+C')D]=A+BD
    (h) AB'C+B+BD'+ABD'+A'C=B+C
11. Find the complement of the following Boolean function and reduce them into minimum no of literals.
    (a) [(AB)'A][(AB)'B]=
    (b) (AB'+C)D'+E
    (c) AB(C'D+CD')+A'B'(C'+D)(C+D')
    (d) (x+y'+z)(x'+z')(x+y)
    (e) (BC'+A'D)(AB'+CD')
12. Find the complement of F=x+yz then show that FF'=0 and F+F'=1.
13. Given the Boolean function F=(y+z')(x+y)(y'+z)
    (a) Implement it with only OR and NOT gate.

    F'= ((y+z')(x+y)(y'+z))'

    (F')'=((y+z')'+(x+y)'+(y'+z)')'

    (b) Implement it with only AND and NOT gate.

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

    (F')'= (y'z+x'y'+yz')' = (y'z)'(x'y')'(yz')'
14. Express the following function in (i) S.O. minterm (ii) P.O maxterm
    (a) F (A, B, C)=1
    (b) F (A, B, C)=(A'+B)(B'+C)
    (c) F (x, y, z)=(xy+z)(y+xz)
    (d) F (A, B, C, D)=D (A'+B)+B'D
    (e) F (A, B, C, D)=A+BC'+ABD'+ABCD
    (f) F (A, B, C, D)=(AB+C)(B+C'D)
    (g) F (A, B, C, D)=(A+B'+C)(A+B')(A+C'+D')(A'+B+C+D')(B+C'+D')

15. Simplify the function T1 and T2 to a minimum number of literal. Prove that T1=T2'.

A	B	C	T1	T2
0	0	0	0	1
0	0	1	0	1
0	1	0	0	1
0	1	1	0	1
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	0

16. A majority gate in a digital circuit whose output is equal to 1 if the majority inputs are 1's. The output is 0 otherwise. By means of a truth table, find the Boolean function implemented by a 3 input majority gate. Simplify the function.