



National Institute of Technology Patna

Department of Electronics and Communication Engineering

Digital Design (EC-14102)

Practice Sheet-2

B.Tech.: Semester-1 CSE-I and CSE-II

Session: Jul-Dec 2024

Unit: I

Topic: Boolean Algebra

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PROBLEMS

- Using Boolean notation, write an expression that is a 1 whenever one or more of its variables (A, B, C , and D) are 1s.
- Simplify the Boolean expression $A + B(C + D)$. What if only one input state is HIGH.
- An entry light at the colony's main gate is controlled by two switches one at the left end of the gate and the other at the right end of the gate.
 - Make a truth table for this system.
 - Write the logic equation in SOP form.
- Prove that $((AB)' + A' + AB)' = 0$.
- Apply DeMorgan's theorems to the following:
 - $\overline{(A + \overline{BC} + CD)} + \overline{BC}$
 - $\overline{(A + B)(C + D)(E + F)(G + H)}$
- Using Boolean algebra, simplify the following expressions:
 - $A(A + B)$
 - $BC + \overline{BC}$
 - $A\overline{B}C + \overline{A}BC + \overline{A}\overline{B}C$
 - $(A + \overline{B})(A + C)$
 - $(A + \overline{A})(AB + AB\overline{C})$
 - $\overline{A}\overline{B}C + (A + B + \overline{C}) + \overline{A}\overline{B}\overline{C}D$
 - $(B + BC)(B + \overline{B}C)(B + D)$
 - $ABC[AB + \overline{C}(BC + AC)]$
- Convert the following expressions to sum-of-product (SOP) forms and convert the expression to standard SOP form:
 - $(A + B)(C + \overline{B})$
 - $AB + CD(A\overline{B} + CD)$
 - $A + B[AC + (B + \overline{C})D]$
- Write the expression for Boolean function $F(A, B, C) = \sum m(1, 4, 5, 6, 7)$ in POS form.
- Use a Karnaugh map to simplify following expressions in a minimum SOP form:
 - $\overline{A}\overline{B}\overline{C} + \overline{A}\overline{B}C + A\overline{B}C$
 - $\overline{A}(BC + B\overline{C}) + A(BC + B\overline{C})$
 - $\overline{A}\overline{B}\overline{C} + A\overline{B}\overline{C} + \overline{A}B\overline{C} + ABC$
 - $AC[\overline{B} + B(B + \overline{C})]$
 - $DE\overline{F} + \overline{D}E\overline{F} + \overline{D}\overline{E}\overline{F}$
 - $BC' + A'B + BCD' + A'B'D + AB'C'D$
 - $A + B\overline{C} + CD$
 - $AB(\overline{C}\overline{D} + \overline{C}D) + AB(\overline{C}\overline{D} + \overline{C}D) + A\overline{B}\overline{C}D$
- Use a Karnaugh map to reduce following expressions in a minimum POS form:
 - $(A + B + C)(\overline{A} + \overline{B} + \overline{C})(A + \overline{B} + C)$



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- (ii) $(X + \bar{Y})(\bar{X} + Z)(X + \bar{Y} + \bar{Z})(\bar{X} + \bar{Y} + Z)$
(iii) $A(B + \bar{C})(\bar{A} + C)(A + \bar{B} + C)(\bar{A} + B + \bar{C})$
11. Simplify the given function $F = \prod m(0, 1, 2, 3, 4, 6, 10, 11, 13)$ to SOP and POS form.
12. Apply K-map to simplify the following functions:
- (i) $\sum m(0, 4)$ while don't care terms are $(1, 2, 7)$.
(ii) $\sum m(1, 7, 15)$ while don't care terms are $(3, 11, 13)$.
13. Simplify the following expression by using Quine McClusky method.
- $$F(A, B, C, D) = \sum m(0, 2, 3, 6, 7, 8, 10, 12, 13)$$