ISTANBUL TECHNICAL UNIVERSITY
COMPUTER ENGINEERING DEPARTMENT

BLG 242E
LOGIC CIRCUITS LABORATORY
EXPERIMENT REPORT

EXPERIMENT NO	:	2
EXPERIMENT DATE	:	31.03.2023
LAB SESSION	:	FRIDAY - 14.00
GROUP NO	:	G08

GROUP MEMBERS:

150200081 : KAAN KARATAŞ
150210719 : NACİ TOYGUN GÖRMÜŞ

SPRING 2023

Contents

1 INTRODUCTION

Throughout this experiment, the C.A.D.E.T. was tested while the specified functions were analyzed. According to the functions, truth tables were produced, and the outcomes were compared to the CADET unit. The experiments' primary goal is to create the circuitry using the required gates and the Karnaugh maps.

2 MATERIALS AND METHODS

Tools used on this experiment:

- C.A.D.E.T
- 7400 series ICs
  - 74xx00 - Quadruple 2-input Positive NAND Gates
  - 7404 Hex Inverter
  - 74xx08 - Quadruple 2-input Positive AND Gates
  - 74xx10 - Triple 3-input Positive NAND Gates
  - 74xx11 - Triple 3-input Positive AND Gates
  - 74xx27 - Triple 3-input Positive NOR Gates
  - 74xx32 - Quadruple 2-input Positive OR Gates
  - 74xx138 - 3:8 Decoder
  - 74xx151 - 8:1 Multiplexer

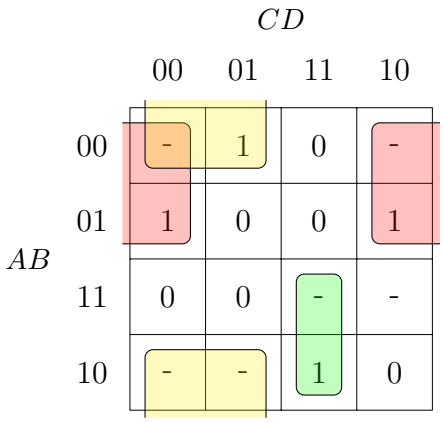
3 EXPERIMENT

3.1 Preliminery

The following function's prime implicants have been constructed on this section using a Karnaugh map and implemented as logic circuits utilizing AND, OR, and NOT gates.

$$F(a,b,c,d) = \cup_1(1,4,6,11) + \cup_\phi(0,2,8,9,14,15)$$

3.1.1 Karnaugh Map



Karnaugh Map of F

$A'D' + B'C' + ACD$

$Cost = 6 + 6 + 6 = 18$

A	B	C	D	A'D' + B'C' + ACD
0	0	0	0	X
0	0	0	1	1
0	0	1	0	X
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	X
1	0	0	1	X
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	X
1	1	1	1	X

Truth Table of F

Even though other implicants, such as AB'D, may have been picked to cover minterm 11, ACD was chosen since it has the lowest cost.

3.1.2 Quine-McCluskey method

Group	Decimal	Binary
0	0	0000 ✓
1	1	0001 ✓
1	2	0010 ✓
1	4	0100 ✓
1	8	1000 ✓
2	6	0110 ✓
2	9	1001 ✓
3	11	1011 ✓
3	14	1011 ✓
3	15	1111 ✓

Group	Decimal	Binary
0	0, 1	000- ✓
0	0, 2	00-0 ✓
0	0, 4	0-00 ✓
0	0, 8	-000 ✓
1	1, 9	-001 ✓
1	2, 6	01-0 ✓
1	4, 6	01-0 ✓
1	8, 9	100- ✓
2	6, 14	-110 ×
2	9, 11	10-1 ×
3	11, 15	1-11 ×
3	14, 15	111- ×

Group	Decimal	Binary
0	0, 1, 8, 9	-00- ×
0	0, 2, 4, 6	0–0 ×

Prime implicants of the function

$$A'D', B'C', ABC, AB'D, ACD, BCD'$$

3.1.3 Prime Implicant Chart

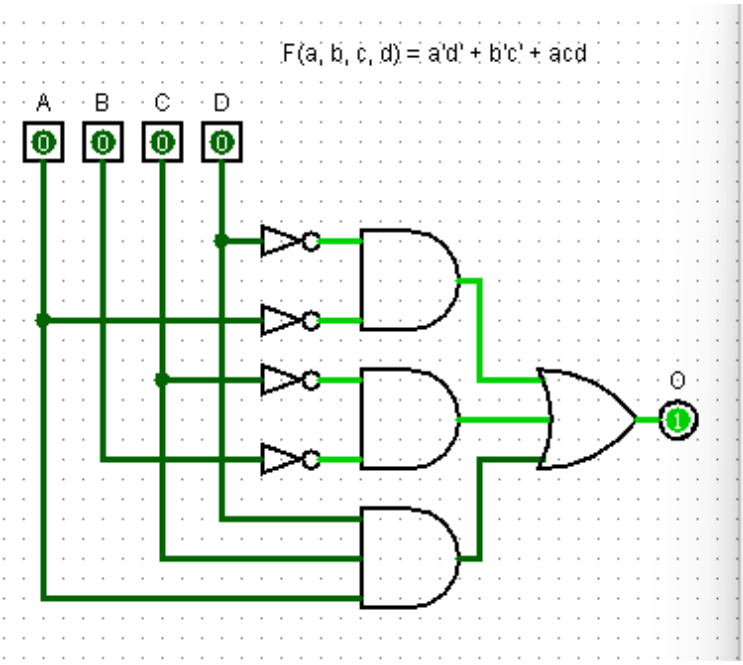
Minterms	1	4	6	11	Cost
A'D'		X	X		6
B'C'	X				6
ABC					6
AB'D				X	7
ACD				X	6
BCD'		X			7

The Essential Prime Implicants Are

$$B'D', A'BC, ACD$$

$$Cost = 8 * 2 + 3 = 19$$

3.2 Part 1

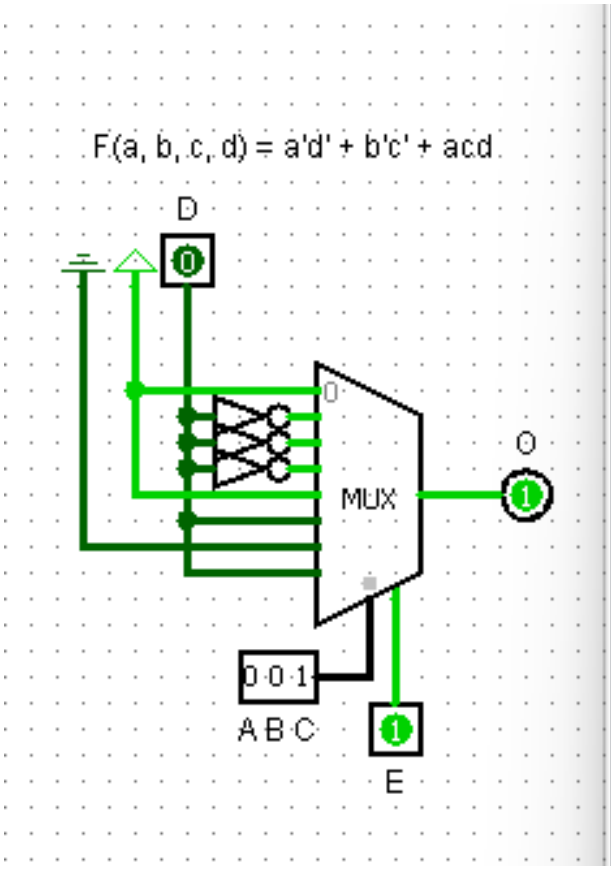


A	B	C	D	O
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

Figure 1: Part 1 Circuit Design

3.3 Part 2

In this section, the previous function will be rebuilt using an 8:1 multiplexer and NOT gates.



A	B	C	D	O
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

Figure 2: Part 2 Circuit Design

4 RESULTS

The intended outputs are obtained when the circuit is configured with all of the provided functionalities. The experiments' outcomes were consistent with their truth tables.

5 DISCUSSION

This experiment highlights the value of the methods employed for function analysis. Afterwards it was demonstrated that there are various ways to imply a circuit and how important it is to use the one with the lowest cost.

6 CONCLUSION

Even though the gates of two distinct circuits are different, a function can nevertheless generate the same outcome. In this method, a circuit for a device can be chosen out of several others with the exact same output that is most appropriate and has the lowest cost.