# Experiment No. 4

# Karnaugh map Simplification

## 1. Introduction

A Karnaugh map provides a systematic method for simplifying Boolean expressions and, if properly used, will produce the simplest SOP or POS expression possible, known as the minimum expression

### 1.1 Objective

The objective of using a **Karnaugh map (K-map)** is to simplify Boolean algebra expressions, which are used in digital logic design

### 1.2 Work Environment

The CircuitMaker software is used to design and simulate logical circuits.

### 1.3 Theory

A **Karnaugh Map (K-map)** is a graphical tool used for simplifying Boolean algebra expressions in digital logic design. Developed by Maurice Karnaugh in 1953, it is an enhancement of the truth table method. K-maps are widely used in digital electronics to minimize logic functions, which helps in designing efficient digital circuits with fewer gates and reduced complexity.

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## Karnaugh Map SOP Minimization

### 1- Truth table

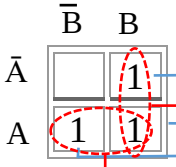
| Input | | Output |
|---|---|---|
| A | B | Y |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

$\bar{A}.B$
$A.\bar{B}$
$A.B$

### 2- Minterm Boolean expression

$A.B + A.\bar{B} + \bar{A}.B$

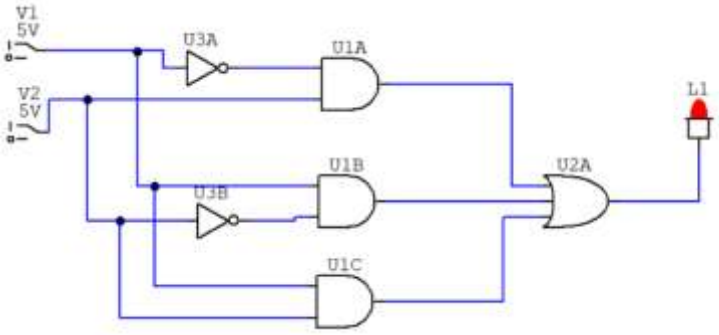
### 3- Plotting 1s on map

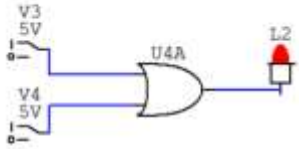



### 4- Looping

### 5- The final result is A+B = Y

A + B



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## Experiment

Using CircuitMaker, complete the following steps:

1- Generate the truth table for the standard SOP expression

$$A\overline{B}C + \overline{A}BC + \overline{A}\,\overline{B}C + \overline{A}\,\overline{B}\,\overline{C} + A\overline{B}\,\overline{C}$$

2- Draw the logic circuit using CircuitMaker

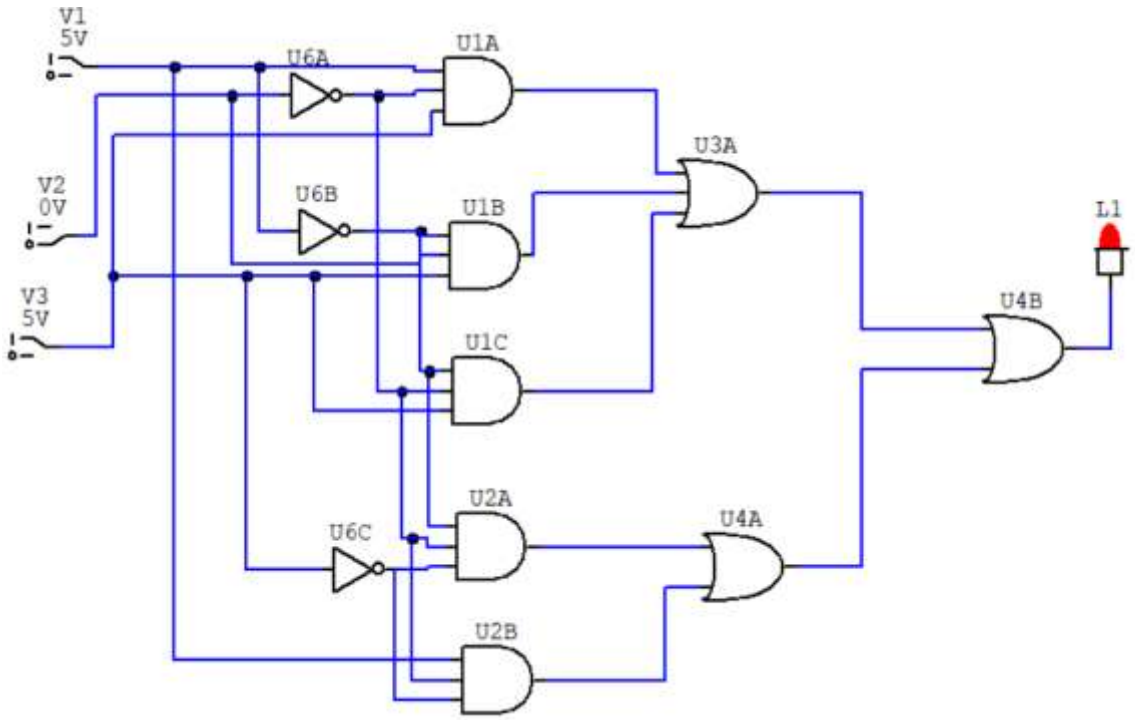
3- Simplify the standard SOP expression using the Karnaugh map.

4- Draw the simplified logic circuit.

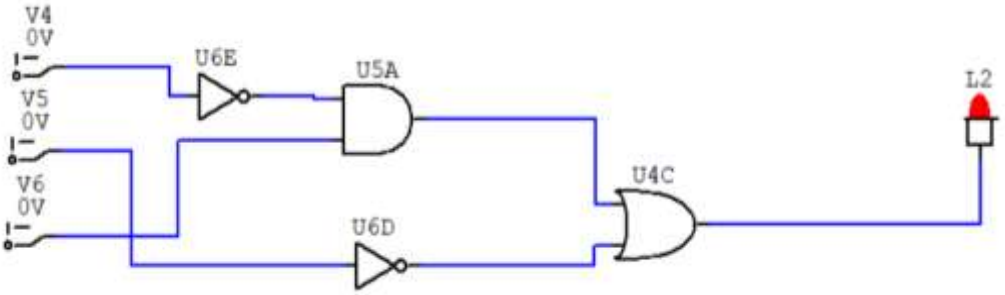
***Solution:***

| Input | | | output |
|---|---|---|---|
| **C** | B | A | Y |
| 0 | 0 | 1 | 1 |
| 0 | 0 | 0 | |
| 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | |
| 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 1 | 1 | |
| 1 | 1 | 0 | |

## Before simplification




## After simplification



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## Discussion:

1- Why are Karnaugh map is important in logic circuit design?

2- Explain the two types of Karnaugh map.

3- Illustrate the SOP expression before and after simplification

4- Draw the logic circuit before and after simplification.