2

Combinational Logic Circuits

2.1 Introduction

The aim in this experiment is to find the expression with the lowest cost for combinational logic circuits and implement them.

2.2 Preliminary

1. Find all prime implicants of the function F below.
   a) using Karnaugh diagram
   b) using Quine-McCluskey method
   $$F(a,b,c,d) = \cup_1(1,4,6,11) + \cup_\phi(0,2,8,9,14,15)$$
   Also create the prime implicant chart of the function F and find the expression with the lowest cost. Cost criteria is 2 units for each variable and 1 unit for each complement. Draw the lowest cost expression using AND, OR, and NOT gates.
2. Design and draw the same function using a single 8:1 multiplexer and NOT gates.

2.3 Equipments and Integrated Circuits (ICs)

Following equipment and ICs are going to be used in the experiment.

- C.A.D.E.T. (**C**omplete **A**nalogue **D**igital **E**lectronic **T**rainer)
- 74000 series ICs
  - 74xx00 - Quadruple 2-input Positive NAND Gates
  - 74xx04 - Hex Inverters
  - 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

Fundamental information (function tables and pin configurations) of the ICs listed above are given in the Appendix **??**. You should also examine the data-sheets in order to acquire further information about these ICs.

2.4 Experiment

2.4.1 Experiment - Part 1

Build the circuit you have designed in Preliminary Question 1 using the ICs. Fill up a truth table to evaluate your implementation.

2.4.2 Experiment - Part 2

Build the circuit you have designed in Preliminary Question 2 using the ICs. Fill up a truth table to evaluate your implementation.

2.5 Report

Prepare your report by using the guidelines and the report template which are posted on Ninova e-Learning System. Your report should also include the following materials:

- Circuits diagrams of the expressions which were implemented during this experiment.
- Function tables (or truth tables) of the implemented expressions.
- Discuss the output of your circuits for undetermined (ϕ) inputs. Why did you get these outputs?

During the experiment, please do not forget to take notes about the critical points of the implementations in order to write a proper report for the experiment. Additionally, if there were any complications which affect your performance during the experiment, please also indicate these difficulties in your report.