**Department of Computer Science**
**Faculty of Computing**
**UNIVERSITI TEKNOLOGI MALAYSIA**

| | | |
|---|---|---|
| SUBJECT | : | SCSR1013 DIGITAL LOGIC |
| SESSION/SEM | : | ……. |
| **LAB 1** | **:** | **COMBINATIONAL LOGIC** |
| NAME 1 | : | ……. |
| NAME 2 | : | ……. |
| DATE | : | ……. |

REMARKS :

**MARKS:**

## Lab # 1

## Introduction to Logic Circuits

### A. Objectives

The objectives of this laboratory are to introduce the student to:

- basic bread boarding and wiring techniques
- the use of input switches and output LEDs in generating truth tables for a combinational logic circuit
- to verify the characteristic of the basic gates

### B. Materials

- Breadboard
- 7408 Quad 2-input AND - 1
- 7404 Hex Inverter - 1
- 7400 Quad 2-input NAND - 1
- 7432 Quad 2 –input OR - 1
- ETS-5000 Digital Training kit

### C. Introduction

This lab focuses on several practical issues related to bread boarding and testing combinational logic circuits. Several helpful points are made below.

**Wire gauge** - Use only 22 gauge wire. The breadboard may be damaged by forcing smaller gauge (larger diameter) wire into the holes.

**Wire color** - Use organized color schemes when wiring circuits. For example, use RED wire for all $V_{cc}$ connections, BLACK wire for all ground connections, BLUE wire for all input switches, and YELLOW wire for all intermediate signal connections.

**Wire length and placement** - Use wires that are the appropriate length so that they can lie flat on the breadboard. Avoid running wires over IC's in case the IC's need to be removed.

**Testing IC's** - Chip tester is available in lab, always check your IC's before you begin wiring the circuit.

**Inserting IC's** - IC's are not difficult to insert in the socket strips once they have been properly adjusted. Brand new IC's are shipped with their pins bent apart from the vertical (typically 15° outward) in order to facilitate handling by automatic insertion equipment. Therefore, before an IC is used for the first time its pins must be bent back so that their spacing is vertical.

**IC Orientation** - Arrange all IC's in the same direction. This will facilitate connecting $V_{cc}$ on each IC to a 5V strip on the breadboard and GND on each IC to a ground strip. If an IC is reversed (thus $V_{cc}$ and ground are reversed), it may be destroyed. It is recommended that you begin wiring by making all $V_{cc}$ and ground connections.

**IC Removal** - It is recommended that you use some sort of extraction tool for removing IC's. Attempts to remove IC's by hand may result in bent pins.

**Monitoring the logic level of the circuit**

Use the LED (at the top right of the digital kit) to monitor the logic level of the digital circuit. A GREEN indicates that the logic level is LOW (0) and a RED means the logic level is HIGH (1). If the LED does not lit, there is something wrong with the circuit. Switch off the power supply and recheck the circuit.

**Note: Please be certain that the MODE switch is flip to TTL not CMOS.**

You can use a logic probe (at the bottom right of the digital circuit) to monitor the logic level of any node (point) of the circuit. **H** indicates logic HIGH (1), **L** means LOW (0) and **P** means pulse (the signal keeps on changing between HIGH and LOW).

**Switches**

There are 8 toggle switches at the bottom row of the digital circuit. These switches will provide a logic input of HIGH (1) and LOW (0) to the circuit.

## D. Preiminary Work

1. Draw a symbol, determine the IC number and produce a truth table for the following gate.

**AND**

Symbol:

IC Number: ……..

Truth Table 1

| Input | | Output |
|---|---|---|
| A | B | F |
| | | |
| | | |
| | | |
| | | |

**NAND**

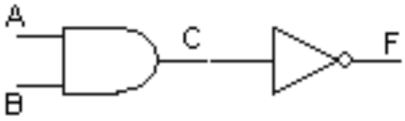
Symbol:

IC Number: ……..

Truth Table 2

| Input | | Output |
|---|---|---|
| A | B | F |
| | | |
| | | |
| | | |
| | | |

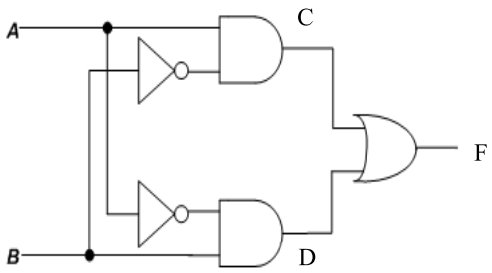
2. Complete the truth table for the following circuit.




Truth Table 3

| A | B | C | F |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

3. Write the Boolean expression for output C, D and F the following circuit.




C =

D =

F =

4. Complete the truth table for the circuit in (3) based on the Boolean expression produced for C, D and F.

Truth Table 4

| A | B | C | D | F |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## E. Laboratory Work

### Part 1

1. Construct Circuit 1 on the breadboard. Connect all inputs (A, B) to a switches and output F to LEDs.


Circuit 1

Truth Table 5

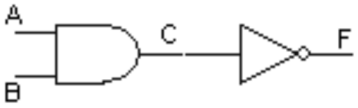
| Input | | Output |
|---|---|---|
| A | B | F |
| | | |
| | | |
| | | |
| | | |

2. Test Circuit 1 and fill in Truth Table 5 for the circuit response to all possible input combinations. The Truth Table 5 should match the Truth Table 1 prepared in the Preliminary Work.

*Fully Completed* ☐ *Partially Completed* ☐ *Checked by:* _____

### Part 2

3. Construct Circuit 2 on the breadboard. Connect all inputs (A, B) to a switches and output C and F to LEDs.




Circuit 2

Truth Table 6

| A | B | C | F |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

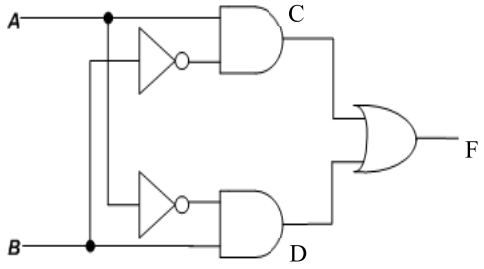
4. Test Circuit 2; fill in Truth Table 6, for the circuit response to all possible input combinations.

5. Compare Truth Table 6 to Truth Table 2. What conclusion can you make?

*Fully Completed* ☐ *Partially Completed* ☐ *Checked by:* _____

**Part 3**

6. Construct circuit 3 on the breadboard. Connect all inputs (A, B) to a switches and output C, D and F to LEDs.




Circuit 3

Truth Table 7

| A | B | C | D | F |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

7. Test Circuit 3; fill in Truth Table 7 for the circuit outputs (C, D, and F) for all possible input combinations.

8. What single gate does Circuit 3 represent?

*Fully Completed* ☐ *Partially Completed* ☐ *Checked by:* _____