

**Department of Electrical Engineering**  
City University of Hong Kong

EE 1001 Foundations of Digital Techniques

Laboratory Manual

**Aims:**

1. To familiarize simple logic circuits
2. To get acquaintance with logic ICs (integrated circuits)
3. To implement logic circuits with bread board

**Laboratory Sessions:**

- LAB1            Familiarization of simple logic circuits
- LAB2            Using logic gates to fabricate a 4-bits adder

**Notes:**

1. Student is required complete the experiment within 3 weeks.

**Components (per Student):**

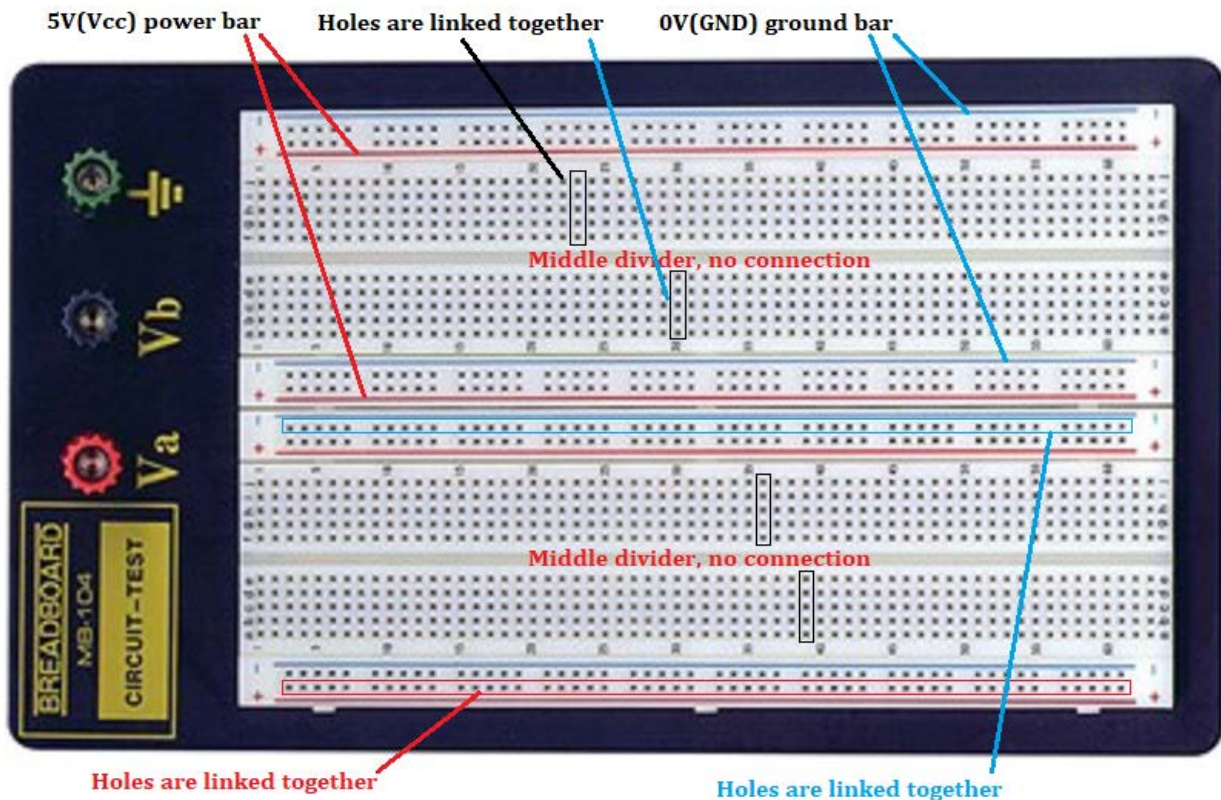
Breadboard		1
2-input AND gate	74LS08	2
3-input AND gate	74LS11	1
2-input OR gate	74LS32	1
2-input XOR gate	74LS86	2
LEDs (Red x 4, white x4)		8
4-ways DIP switch		2
470 $\Omega$ resistor (color ring: yellow, purple, black, black)		10
1k $\Omega$ resistor (color ring: brown, black, black, brown)		10
5V USB wire (option: lab at home)		1
Breadboard red wire (option: lab at home)		0.5M
Breadboard black wire (option: lab at home)		0.5M
Breadboard yellow wire (option: lab at home)		2M
Breadboard green wire (option: lab at home)		2M

**Submit your work to laboratory supervisor**

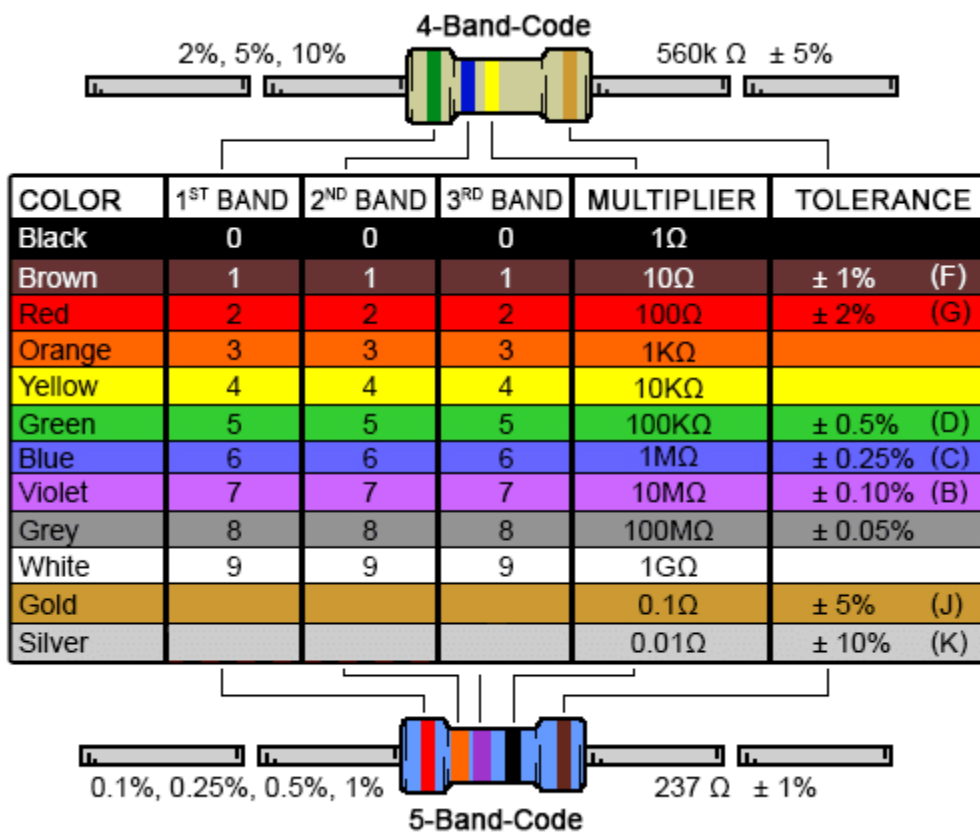
**Experiment 1: pages 7-8**

**Experiment 2: Pages 9-10**

## Introduction to bread board:

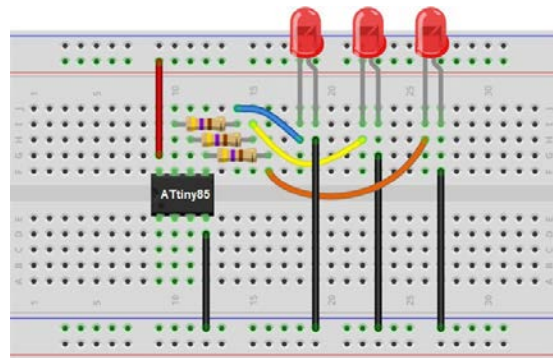
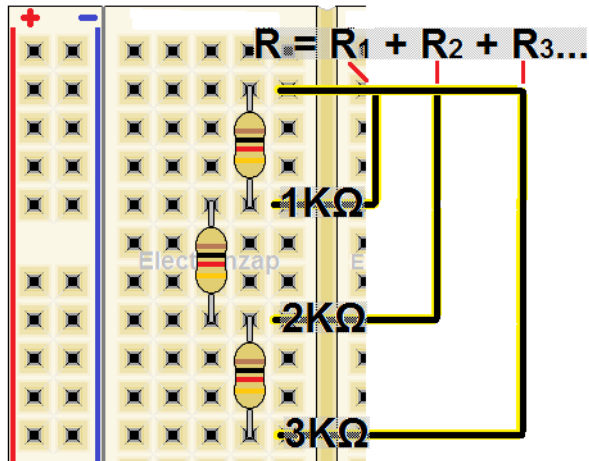


## Resistor Color Code



## Examples of circuit connection:

Series three 1K  $\Omega$  resistors to obtain 3 K  $\Omega$  resistance



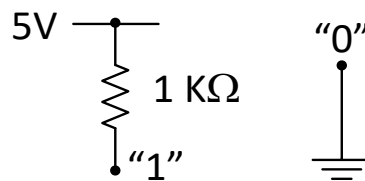
Tutorial on how use bread board is available on youtube:

<https://www.youtube.com/watch?v=6WReFkfrUIk>

## A few tips for logic circuit implementation:

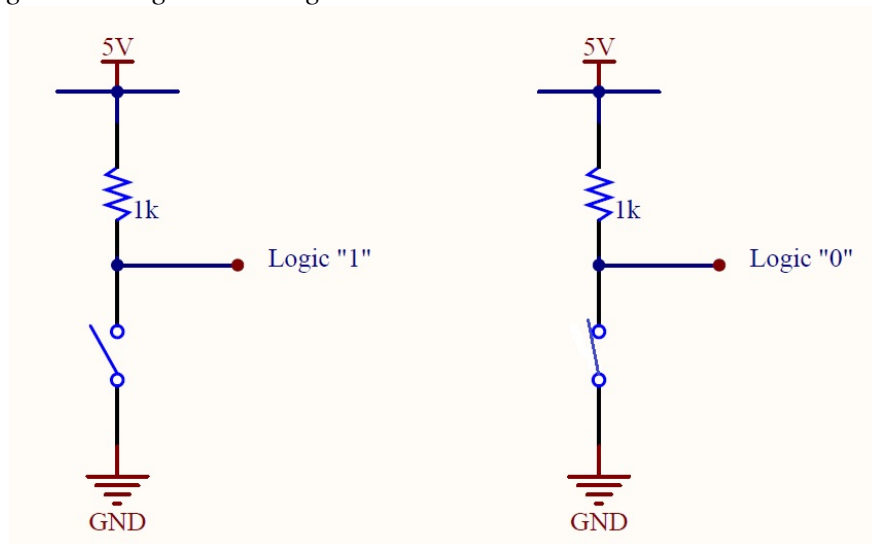
### 1. Logic "1" & "0"

Use the following circuit to produce logic "1" and logic "0" as input to the logic circuit.



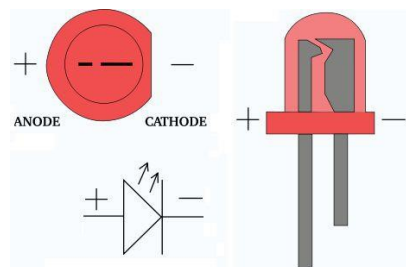
**IMPORTANT:** NEVER directly connect to 5V to obtain logic "1", the logic gate IC may easily be damaged.

2. Using switch to generate Logic "1" & "0"

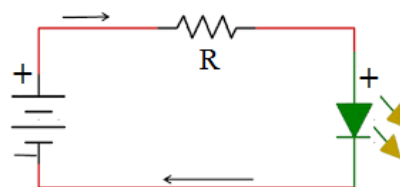


3. Use LED to indicate Logic "1" & "0"

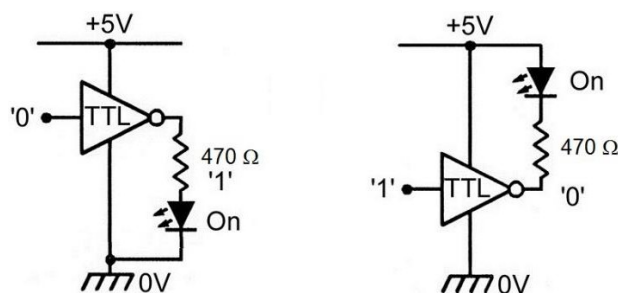
LED is with polarity, with long leg representing anode and short leg representing cathode.



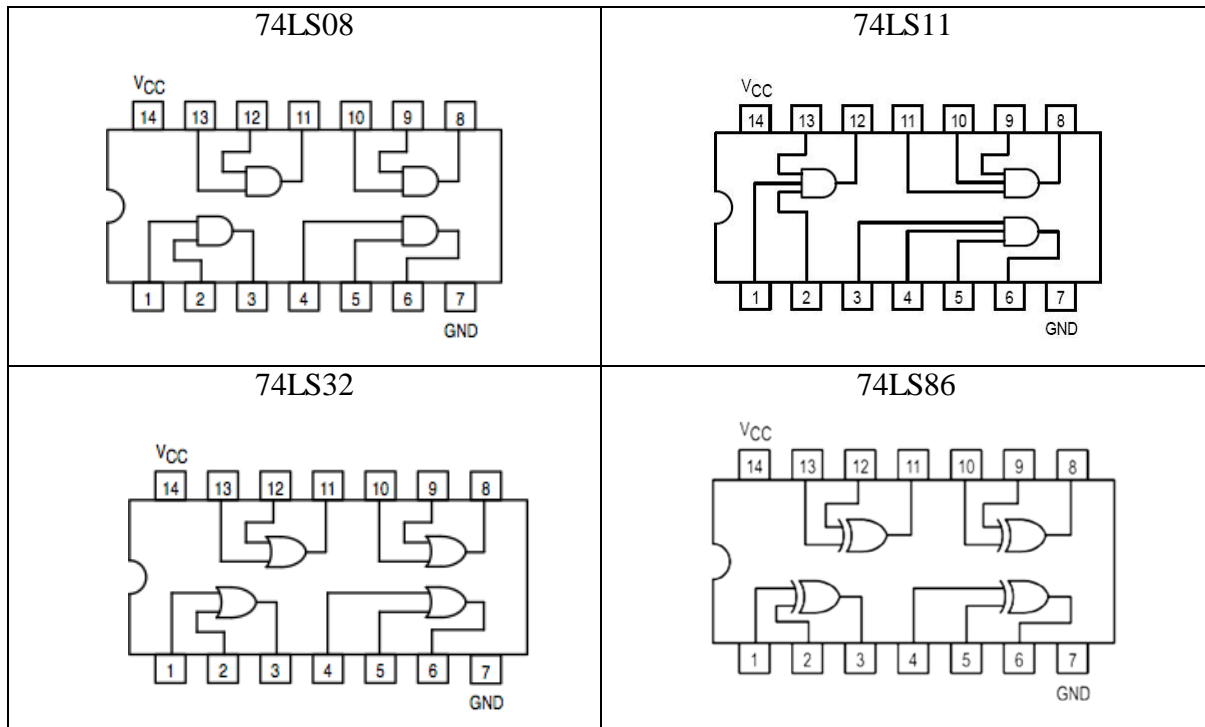
To turn a LED, the LED should be forward-biased as shown below:



The following circuit shows the TTL output circuits for turning on the LED with either logic "1" output or logic "0" output. The function of the resistor is to limit the current passing through the LED to avoid damage.



**TTL Logic IC Pin assignment:**



For detail data sheet, search from Google to obtain on-line.

For example: Type “74LS86 datasheet pdf” to search for detail information for 74LS86 IC.

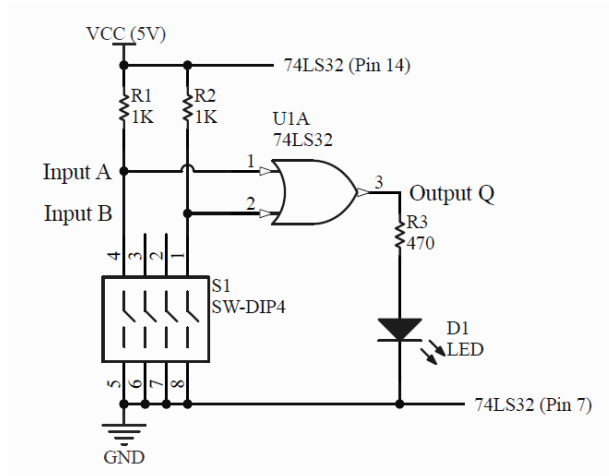
Name: \_\_\_\_\_ .SID: \_\_\_\_\_.

## Experiment 1: Familiarization of simple logic circuits

Refer to Pages 3 to 6 and watch the youtube clip for breadboard fundamentals.

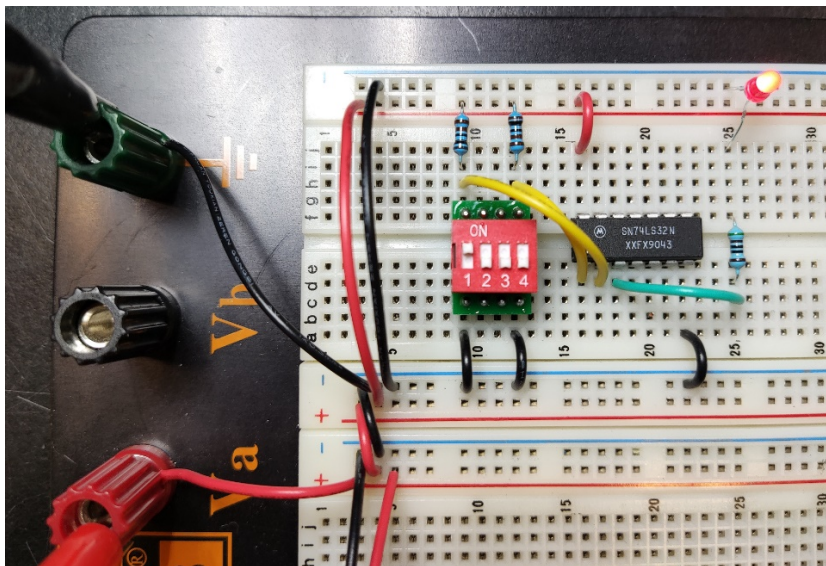
### 74LS32:

Connect the circuit as shown below schematic diagram and complete the logic table.



74LS32

Input		Output
A	B	Q
0	0	
0	1	
1	0	
1	1	

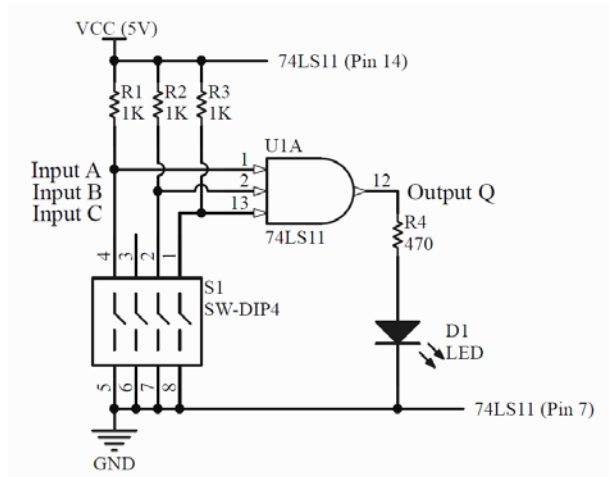


For lab at home – Student need to take a short video to show your demonstration and upload into CANVAS.

Name: \_\_\_\_\_ .SID: \_\_\_\_\_.

### 74LS11:

Connect the circuit as shown below schematic diagram and complete the logic table.



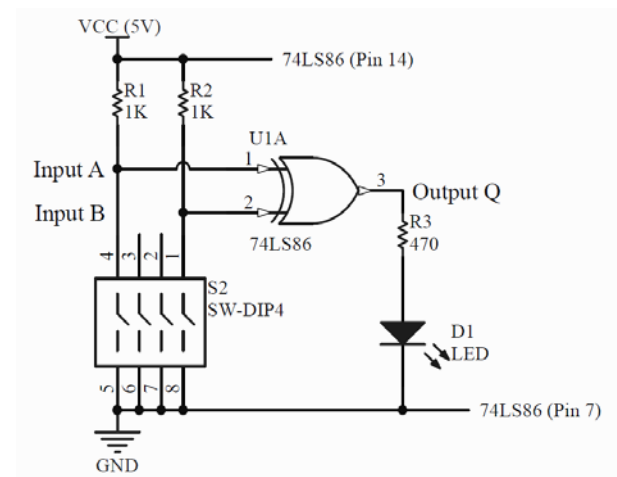
**74LS11**

Input			Output
A	B	C	Q
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

For lab at home – Student need to take a short video to show your demonstration and upload into CANVAS.

### 74LS86:

Connect the circuit as shown below schematic diagram and complete the logic table.



**74LS86**

Input		Output
A	B	Q
0	0	
0	1	
1	0	
1	1	

For lab at home – Student need to take a short video to show your demonstration and upload into CANVAS.

Show your results to Laboratory Supervisor.

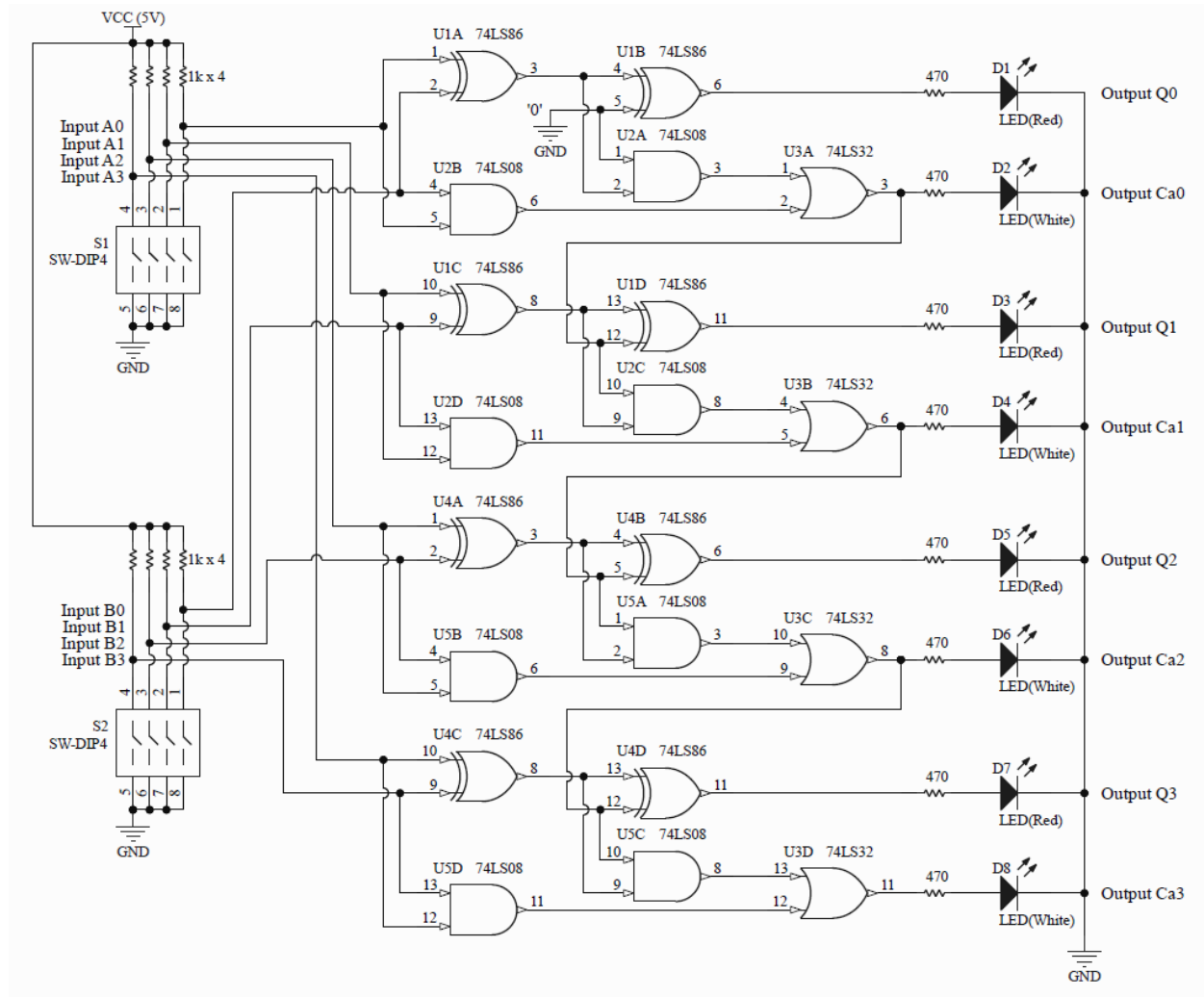
Items	Grade
Attitude and progress (1 – 10)	
Quality of implementation (1 – 10)	
Completion % (0% – 100%)	
Supervisor Signature	



Name: \_\_\_\_\_ .SID: \_\_\_\_\_.

## Experiment 2: Using logic gates to fabricate a 4-bits adder

Student need to watch a youtube video (<https://www.youtube.com/watch?v=vvJc9CZcvBc>) of a 4-bit adder and fully understand the working principle. Connect the circuit as shown below schematic diagram and complete the logic table.



Name: \_\_\_\_\_, SID: \_\_\_\_\_.

4-bits Adder

Input								Output							
A3	B3	A2	B2	A1	B1	A0	B0	Q3	Ca3	Q2	Ca2	Q1	Ca1	Q0	Ca0
0	0	0	0	0	0	0	0								
0	0	0	0	0	0	0	1								
0	0	0	0	0	0	1	0								
0	0	0	0	0	0	1	1								
0	0	0	0	0	1	0	0								
0	0	0	0	1	0	0	1								
0	0	0	0	1	1	1	0								
0	0	0	0	1	1	1	1								
0	0	0	1	1	0	0	0								
0	0	0	1	1	0	0	1								
0	0	1	0	1	0	1	0								
0	0	1	1	1	0	1	1								
0	0	0	0	1	1	0	0								
0	1	0	1	1	1	0	1								
1	0	1	0	1	1	1	0								
1	1	1	1	1	1	1	1								

For lab at home – Student need to take a short video to show the demonstration and upload into CANVAS (use the below table to show your demonstration).

4-bits Adder (for demonstration)

Input								Output							
A3	B3	A2	B2	A1	B1	A0	B0	Q3	Ca3	Q2	Ca2	Q1	Ca1	Q0	Ca0
0	0	0	0	0	0	0	0								
0	0	0	0	0	0	0	1								
0	0	0	0	0	0	1	0								
0	0	0	0	0	0	1	1								
0	0	0	0	0	1	1	1								
0	0	0	0	1	1	1	1								
0	0	0	1	1	1	1	1								
0	0	1	1	1	1	1	1								
0	1	1	1	1	1	1	1								
1	1	1	1	1	1	1	1								

Show your results to Laboratory Supervisor.

Items	Grade
Attitude and progress (1 – 10)	
Quality of implementation (1 – 10)	
Completion % (0% – 100%)	
Supervisor Signature	