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):

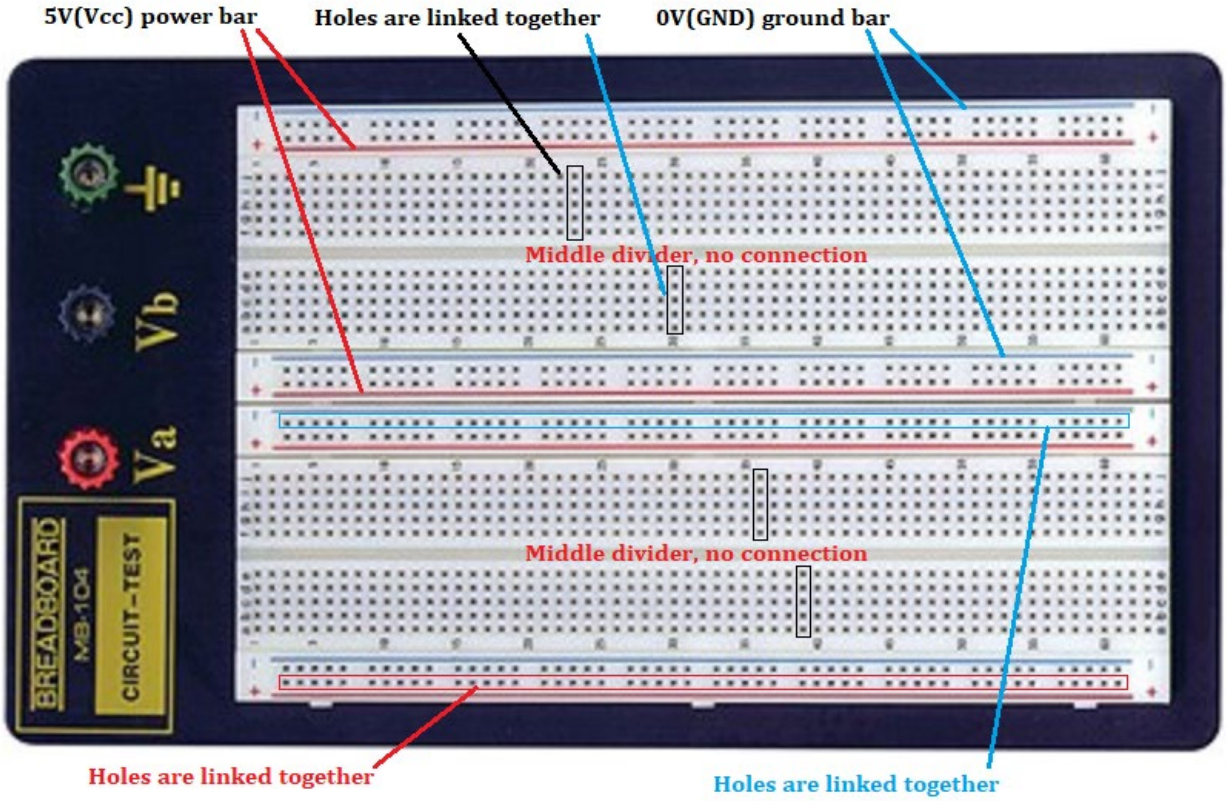
Breadboard		1
2-input AND gate	74LS08	2
3-input AND gate	74LS11	1
2-input OR gate	74LS32	1
2-input XOR gate	74LS86	2
LEDs (Red x 4, white x4)		8
4-ways DIP switch		2
470Ω resistor (color ring: yellow, purple, black, black)		10
1kΩ resistor (color ring: brown, black, black, brown)		10
5V USB wire (option: 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

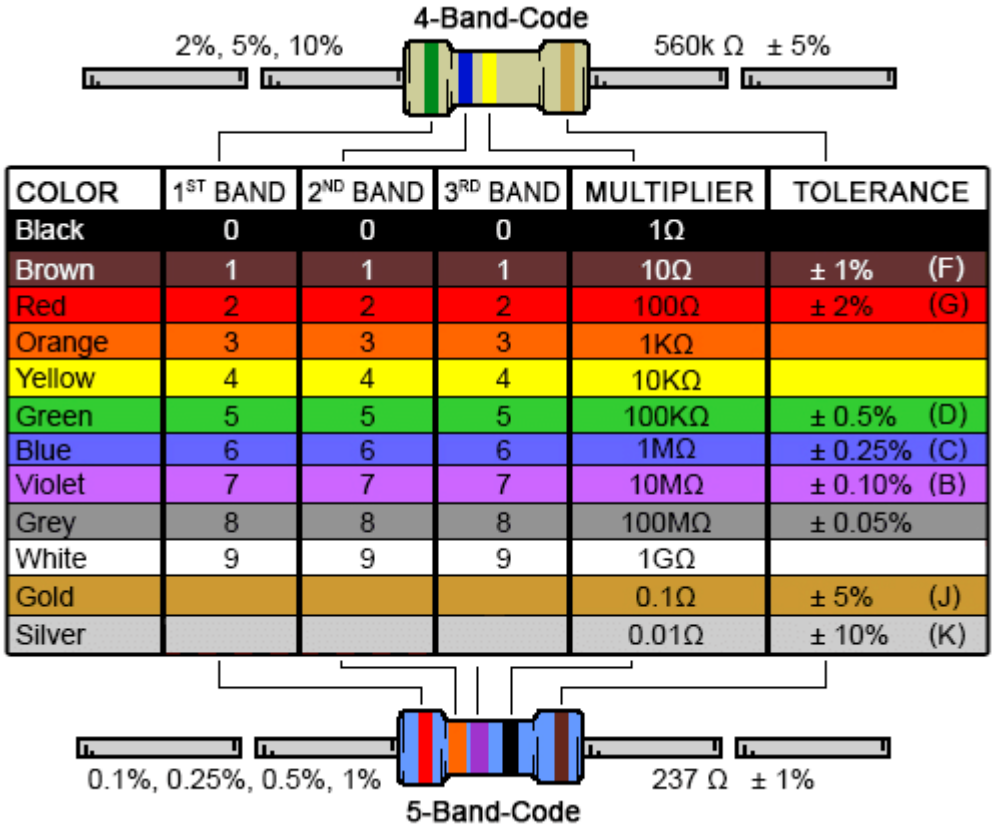
Experiment 1: pages 7-8

Experiment 2: Pages 9-10

Introduction to bread board:

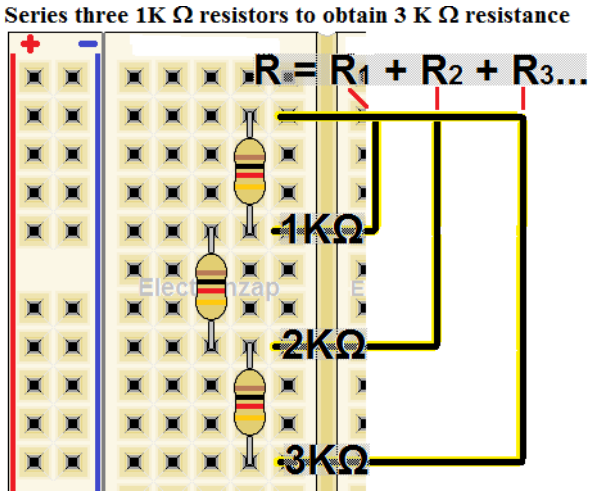


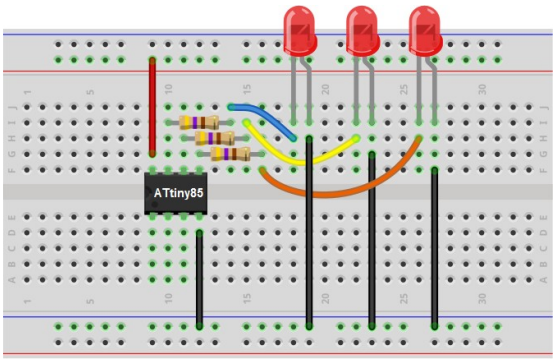
Resistor Color Code



COLOR	1ST BAND	2ND BAND	3RD BAND	MULTIPLIER	TOLERANCE
Black	0	0	0	1Ω	
Brown	1	1	1	10Ω	± 1% (F)
Red	2	2	2	100Ω	± 2% (G)
Orange	3	3	3	1KΩ	
Yellow	4	4	4	10KΩ	
Green	5	5	5	100KΩ	± 0.5% (D)
Blue	6	6	6	1MΩ	± 0.25% (C)
Violet	7	7	7	10MΩ	± 0.10% (B)
Grey	8	8	8	100MΩ	± 0.05%
White	9	9	9	1GΩ	
Gold				0.1Ω	± 5% (J)
Silver				0.01Ω	± 10% (K)

Examples of circuit connection:





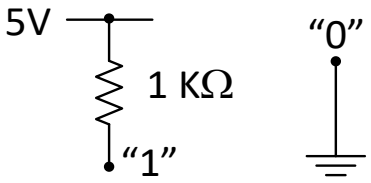
Tutorial on how use bread board is available on youtube:

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

A few tips for logic circuit implementation:

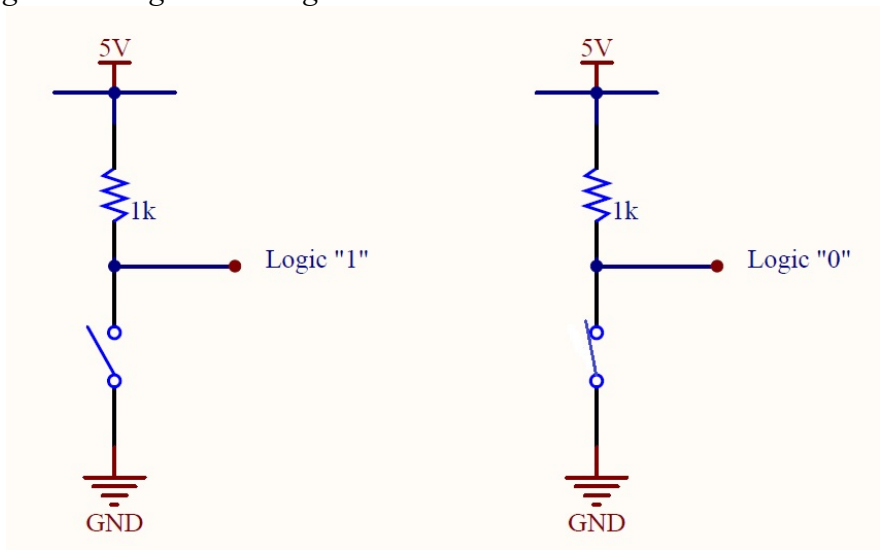
1. Logic "1" & "0"

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



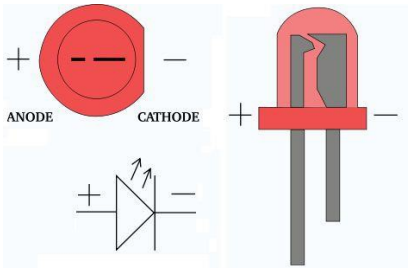
IMPORTANT: NEVER directly connect to 5V to obtain logic "1", the logic gate IC may easily be damaged.

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

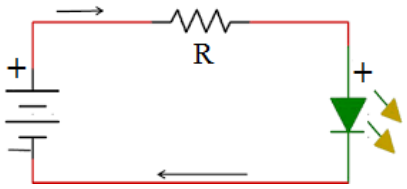


3. Use LED to indicate Logic "1" & "0"

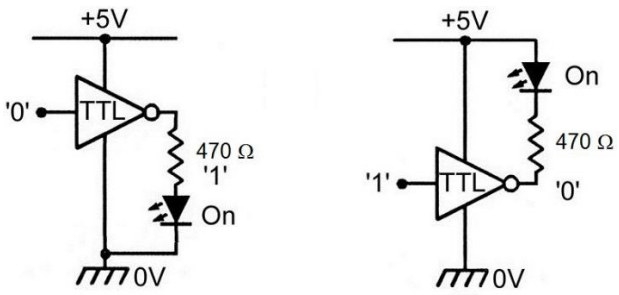
LED is with polarity, with long leg representing anode and short leg representing cathode.



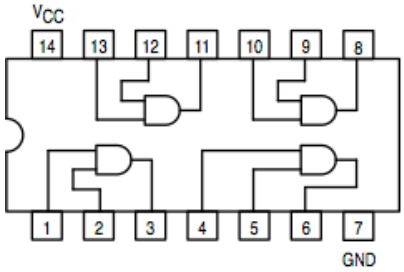
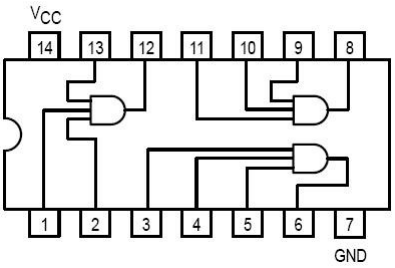
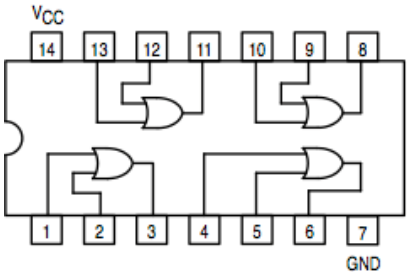
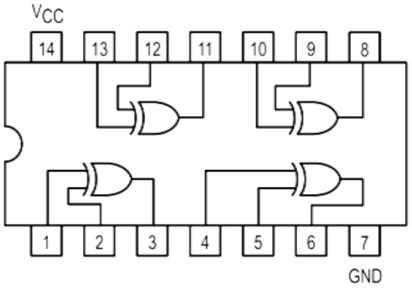
To turn a LED, the LED should be forward-biased as shown below:



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:

74LS08	74LS11
	
74LS32	**74LS86**
	

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.

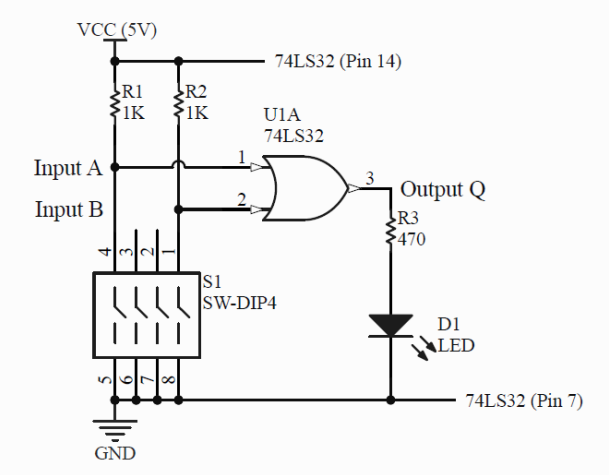
Name:_____.SID:_____.

Experiment 1: Familiarization of simple logic circuits

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

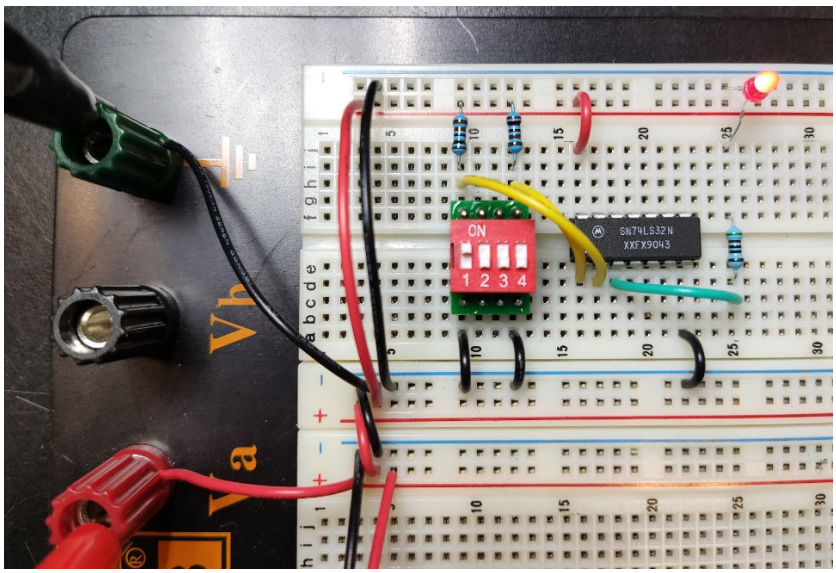
74LS32:

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



74LS32

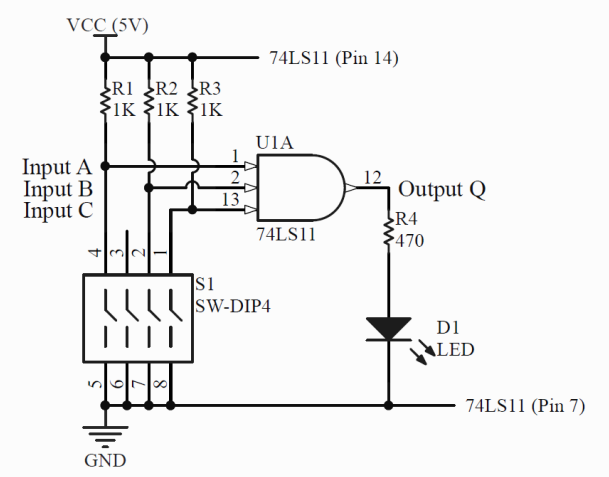
Input		Output
A	B	Q
0	0	
0	1	
1	0	
1	1	



Name:_____.SID:_____.

74LS11:

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

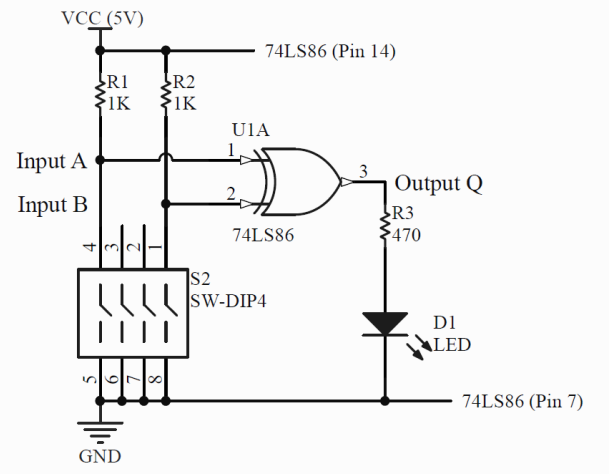


74LS11

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	

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	

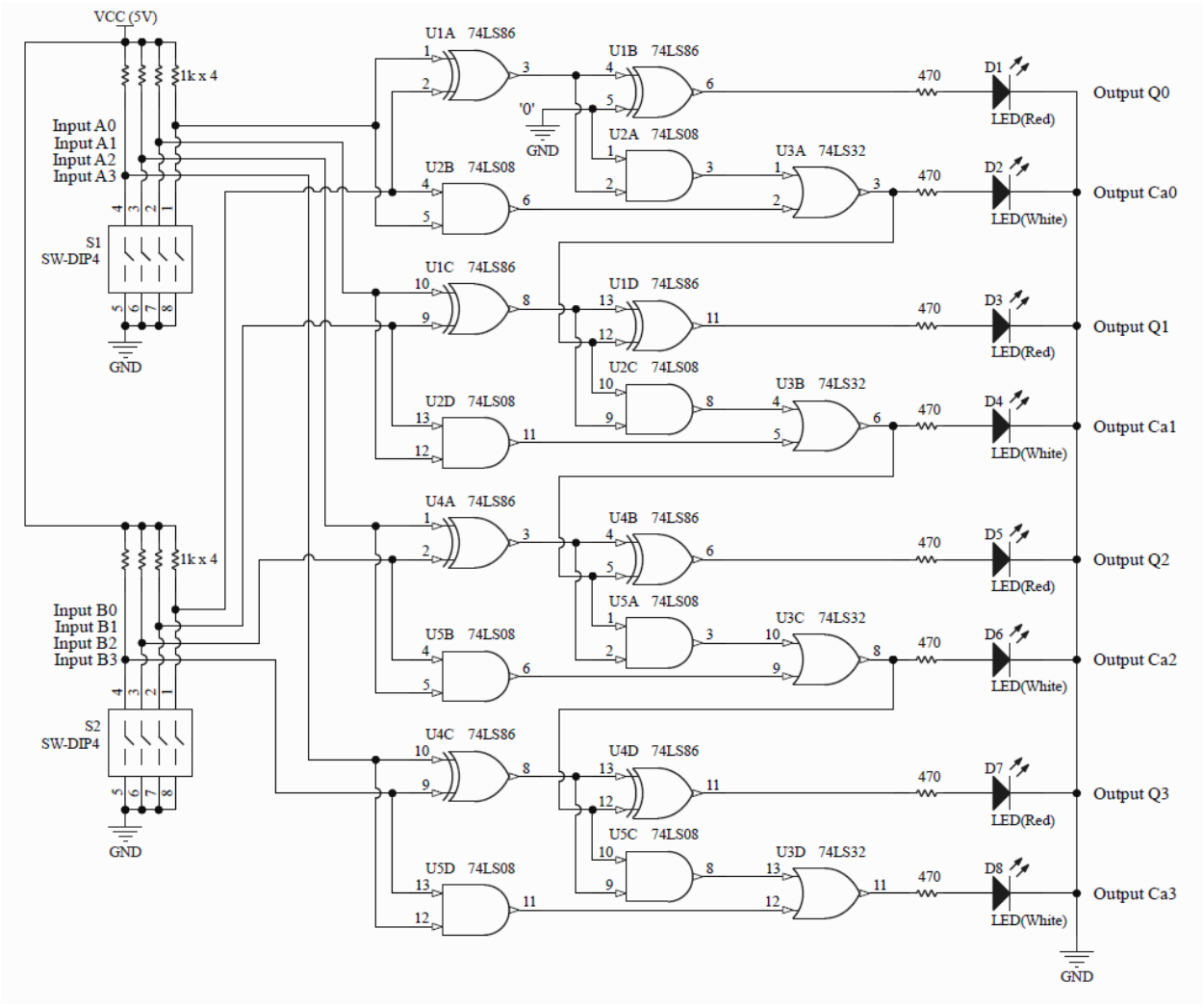
Show your results to Laboratory Supervisor.

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=wvJc9CZcvBc) 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	Ca3	Q3	Ca2	Q2	Ca1	Q1	Ca0	Q0
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	0	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								

4-bits Adder (for demonstration)

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