Indian Institute of Information Technology Vadodara International Campus Diu

IIITV-ICD

Practical Workbook

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Certificate

This is certify that **Shreyas Ladhe** of B.tech of semester III .Enrollment Number **202211081** Branch Computer Science and Engineering (CSE) has been found satisfactory in the continuous internal evaluation of laboratory, practical and term work in the subject EC261 for the academic year 2022-23.

Signature

List of Experiments

Lab No.	Lab Name	Date
1	Familiarity with Logic Gates	22 - 09 - 2023
2	Circuits using universal Gates	29 - 09 - 2023
3	2 bit operations and converters	13 - 10 - 2023

Contents

1 Lab-1 : Familiarity with Logic Gates

1.1 Aim

Basic familiarity with logic gate. Verify the truth table of given 74 series IC.

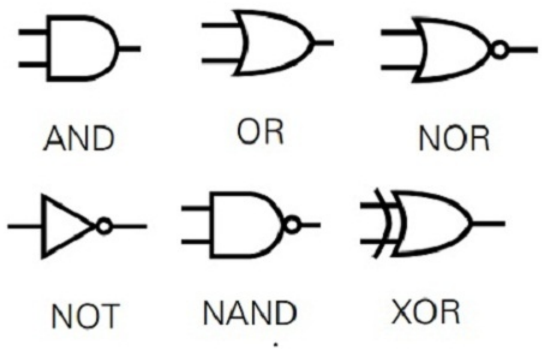
- AND
- NAND
- NOT
- NOR
- OR
- XOR

1.2 Apparatus

Sr No.	Components	Quantity
1	Digital Trainer Kit	1
2	NAND (7400)	1
3	NOR (7402)	1
4	NOT (7404)	1
5	AND (7408)	1
6	OR (7432)	1
7	XOR (7486)	1
8	Connecting Wires	As Required
9	Bread board	1

1.3 Theory

Here is a small rundown about the logic gates we are working on:



1.4 Observation

We verified the following truth tables for the logic gates: The sequence is as follows (left to right):-

- AND
- OR
- NOT
- NAND
- NOR
- XOR

Inputs		Output
A	B	AB
0	0	0
0	1	0
1	0	0
1	1	1

Inputs		Output
A	B	A + B
0	0	0
0	1	1
1	0	1
1	1	1

Inputs	Output
A	B
0	1
1	0

Inputs		Output
A	B	$\overline{AB}$
0	0	1
0	1	1
1	0	1
1	1	0

Inputs		Output
A	B	$\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

Inputs		Output
A	B	$A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

1.5 Conclusion

Learned about different IC and hands on experience on working with logic gates. Verified the working of all the logic gates.

2 Lab-2 : Circuits using Universal Gates

2.1 Aim

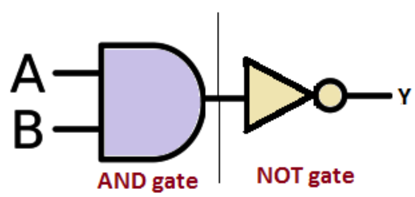
- Make the different basic logic gates using the universal gate.
- Make half adder and subtractor using universal gate.

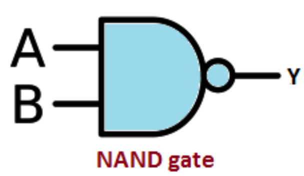
2.2 Apparatus

Sr No.	Components	Quantity
1	Digital Trainer Kit	1
2	NAND (7400)	1
3	NOR (7402)	1
4	Connecting Wires	As Required
5	Bread board	1

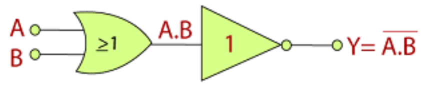
2.3 Theory

NAND Gate: combination of two basic logic gates, the AND gate and the NOT gate connected in series. The output of a NAND gate is high when either of the inputs is high or if both the inputs are low. In other words, the output is always high and goes low only when both the inputs are high.



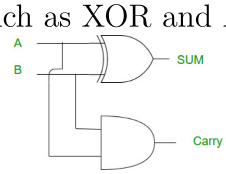


NOR Gate: A NOR gate ("not OR gate") is a logic gate that produces a high output (1) only if all its inputs are false, and low output (0) otherwise. Hence the NOR gate is the inverse of an OR gate, and its circuit is produced by connecting an OR gate to a NOT gate. Just like an OR gate, a NOR gate may have any number of input probes but only one output probe.A NOT gate followed by an OR gate makes a NOR gate.

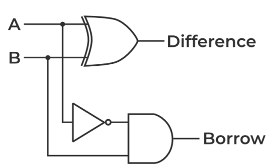


2- Input "AND" gate plus a "NOT" gate

Half Adder Circuit: A half adder is a digital logic circuit that performs binary addition of two single-bit binary numbers. It has two inputs, A and B, and two outputs, SUM and CARRY. The SUM output is the least significant bit (LSB) of the result, while the CARRY output is the most significant bit (MSB) of the result, indicating whether there was a carry-over from the addition of the two inputs. The half adder can be implemented using basic gates such as XOR and AND gates.



Half Subtractor Circuit: A half subtractor is a digital logic circuit that performs binary subtraction of two single-bit binary numbers. It has two inputs, A and B, and two outputs, DIFFERENCE and BORROW. The DIFFERENCE output is the difference between the two input bits, while the BORROW output indicates whether borrowing was necessary during the subtraction.The half subtractor can be implemented using basic gates such as XOR and NOT gates. The DIFFERENCE output is the XOR of the two inputs A and B, while the BORROW output is the NOT of input A and the AND of inputs A and B.



2.4 Observation

We made circuits using NAND and NOR Gate. The following are the truth tables for the universal gates:

Inputs		Output
A	B	$\overline{AB}$
0	0	1
0	1	1
1	0	1
1	1	0

Inputs		Output
A	B	$\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

Half Adder and Subtractor circuits are also made and the truth table for the same was verified:

A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

A	B	Diff	Borrow
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

2.5 Conclusion

Made Basic Logic gates using universal gates (NAND and NOR) and made half adder and subtractor circuit and verified their truth table.

3 Lab-3 : 2-bit operations and converters

3.1 Aim

- 2-bit adder and subtractor using logic gate or universal gate.
- Binary to gray code converter.
- Binary to BCD converter.

3.2 Apparatus

Sr No.	Components	Quantity
1	Digital Trainer Kit	1
2	NAND (7400)	1
3	NOR (7402)	1
4	AND (7408)	1
5	OR (7432)	1
6	Connecting Wires	As Required
7	Bread board	1

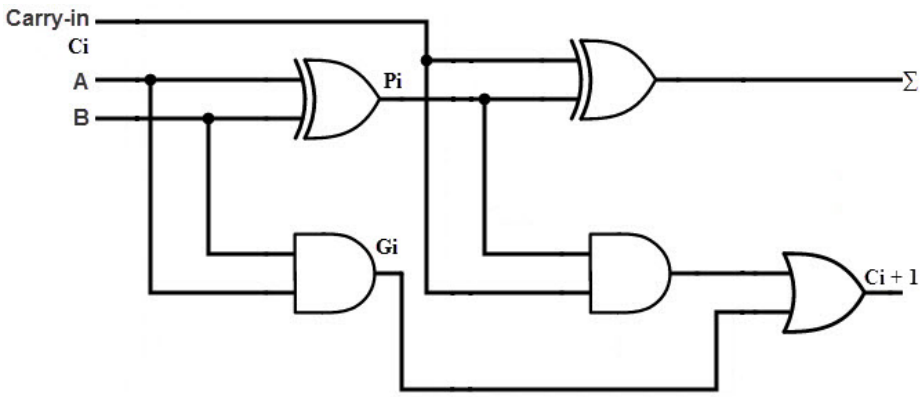
3.3 Theory

3.3.1 Explanation

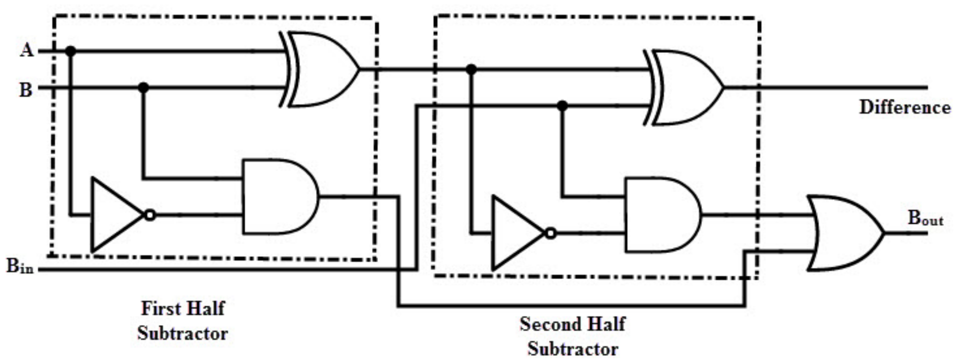
- Addition and Subtraction are two basic Arithmetic Operations that must be performed by any Digital Computer. If both these operations can be properly implemented, then Multiplication and Division tasks become easy (as multiplication is repeated addition and division is repeated subtraction).
- A Full Adder is a combinations logic circuit which performs addition on three bits and produces two outputs: a Sum and a Carry. As we have seen that the Half Adder cannot respond to three inputs and hence the full adder is used to add three digits at a time. It consists of three inputs, of which two are input variables representing the two significant bits to be added, whereas the third input terminal is the carry from the previous addition. The two outputs are a Sum and Carry outputs.

- A Full Subtractor is a combinations logic circuit which performs a subtraction between the two 1-bit binary numbers and it also considers the borrow of the previous bit i.e., whether 1 has been borrowed by the previous minuend bit.So, a Full Subtractor has three inputs, in which two inputs corresponding to the two bits to be subtracted (minuend A and subtrahend B), and a borrow bit, usually represented as Bin, corresponding to the borrow operation. There are two outputs, one corresponds to the difference D output and the other Borrow output Bo.

3.3.2 Circuit Diagrams for circuits



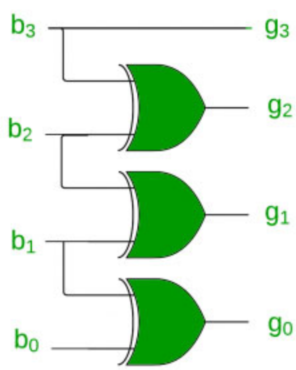
Full Adder Circuit



Full Subtractor Circuit

3.3.3 Converters

- Gray Code system is a binary number system in which every successive pair of numbers differs in only one bit. It is used in applications in which the normal sequence of binary numbers generated by the hardware may produce an error or ambiguity during the transition from one number to the next. For example, the states of a system may change from 3(011) to 4(100) as- 011 — 001 — 101 — 100. Therefore there is a high chance of a wrong state being read while the system changes from the initial state to the final state. This could have serious consequences for the machine using the information. The Gray code eliminates this problem since only one bit changes its value during any transition between two numbers.
- To find the corresponding digital circuit, we will use the K-Map technique for each of the gray code bits as output with all of the binary bits as input.
- The corresponding digital circuit –



- BCD is binary coded decimal number, where each digit of a decimal number is respected by its equivalent binary number. That means, LSB of a decimal number is represented by its equivalent binary number and similarly other higher significant bits of decimal number are also represented by their equivalent binary numbers.

3.4 Observations

We made certain circuits to make a full adder and subtractor to perform 2 bit additions and subtractions.

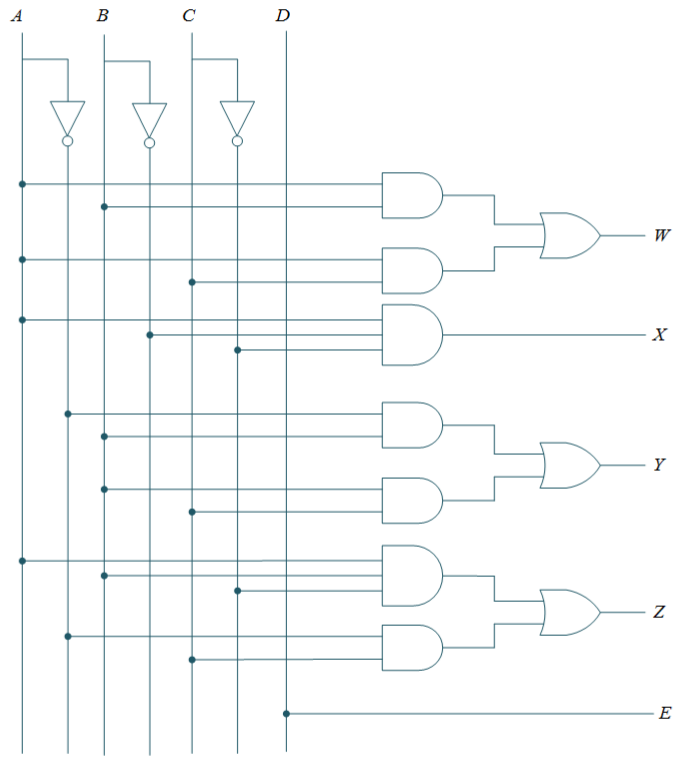
Inputs			Outputs	
A	B	C – IN	Sum	C - Out
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

The truth table above is for a Full Adder Circuit.

INPUT			OUTPUT	
A	B	Bin	D	Bout
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

The truth table above is for a full Subtract Circuit.

To convert Binary to Gray code we will use the following circuit:



3.5 Conclusion

Learned how to make 2 Bit adders and Subtractor Circuits and made Binary to Gray code as well as Binary to BCD converter using logic gates.