



Mustansiriyah University
College of Engineering
Electrical Engineering Dept.



Fundamentals of Logic Circuits

Laboratory

First Year



Object: To consider various important codes and the logic for converting from one to another.

Theory:

As we know, decimal, octal, and hexadecimal numbers can be represented by binary digits. Not only numbers, but letters and other symbols, can be represented by 1's and 0's.

In fact, any entity expressible as numbers, letters, or other symbols can be represented by binary digits, and therefore can be processed by digital logic circuits. Combination of binary digits that represent numbers, letters, or symbols are digital codes. In many applications special codes are used for such auxiliary functions as error detection.

BCD code:

To code the ten decimal digits, ten unique symbols consisting of the binary digits 0&1 are needed. A code of this type, which represents the decimal digits with binary digits, is called a binary-coded decimal, or BCD. There are several such codes in use. The BCD code of a decimal number of more than one digit is obtained by replacing each digit by its 4-bit BCD code. In general, any binary code used to represent the decimal digit is called BCD. Table below shows the most general binary codes.



Table 3.1: Binary codes

Decimal	Weighted codes				Unweighted code	
	8 4 2 1	2 4 2 1	5 2 1 1	7 4 2 1	Ex-3	Gray
0	0000	0000	0000	0000	0011	0000
1	0001	0001	0001	0001	0100	0001
2	0010	0010	0100	0010	0101	0011
3	0011	0011	0110	0011	0110	0010
4	0100	0100	0111	0100	0111	0110
5	0101	1011	1000	0101	1000	0111
6	0110	1100	1001	0110	1001	0101
7	0111	1101	1011	1000	1010	0100
8	1000	1110	1110	1001	1011	1100
9	1001	1111	1111	1010	1100	1101

Procedure:

- 1- Design a logic circuit represented by the following Boolean functions using any logic gates:

$$X = A.B + A.C.D$$

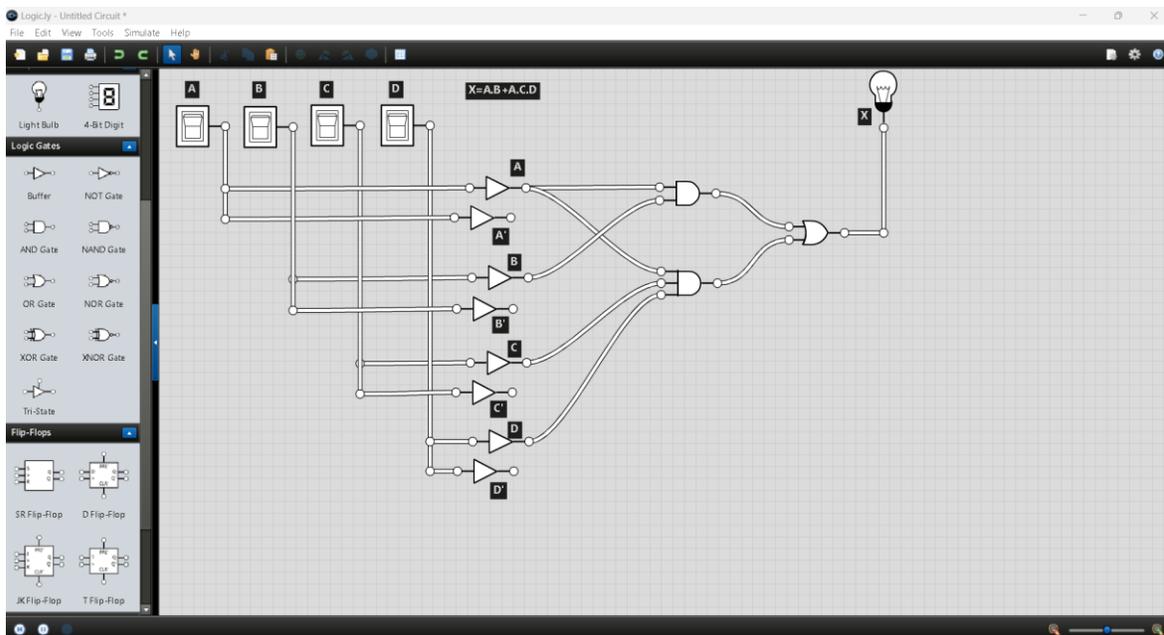
$$Y = B'.C' + B'.D' + B.C.D$$

- 2- Design a logic circuit to convert BCD code to EX-3 code using NAND gates only.

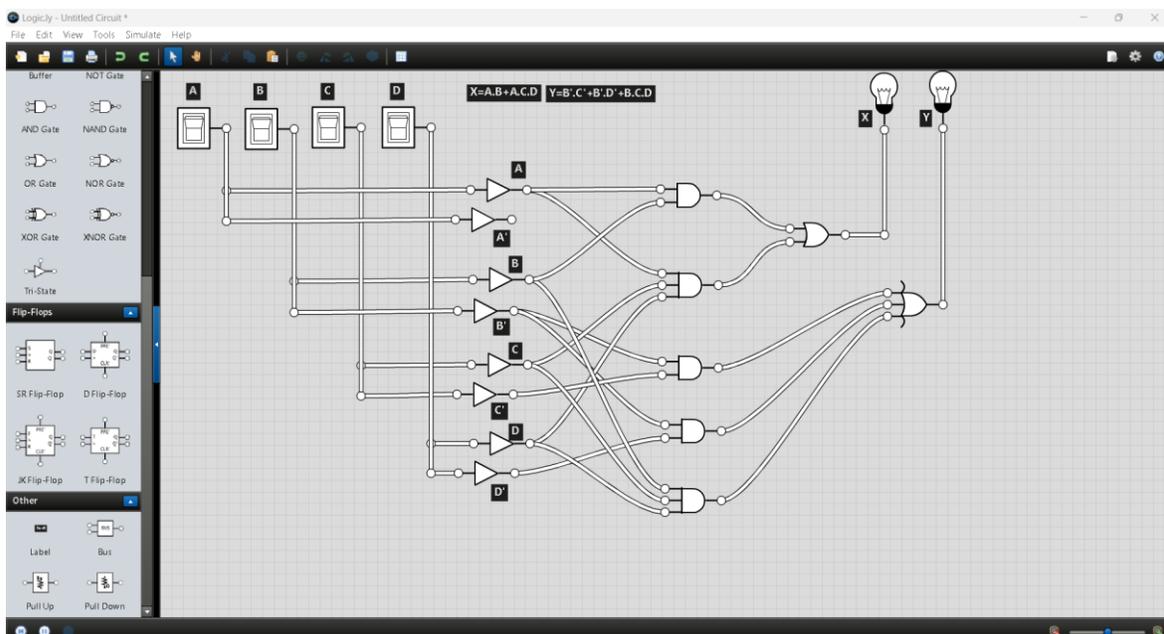
Exp. No. 3:
CODE CONVERSION



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(a)



(b)

Fig. 3.1. Logic diagram of Boolean functions: (a) X; (b) X and Y



Discussion:

1. Convert each EX-3 code number to decimal:
a. 0011 b. 1001 c. 10000101
2. Design a logic circuit with an output (F) and four-bit input A , B , C , and D .
The output ($F=1$) when the input is BCD number and ($F=0$) otherwise.
3. Design a logic circuit which converts EX-3 code to BCD code using NAND gates only.