Name: Theepakorn Phayomrat Student ID: 67011352
Name: .... Student ID: ....

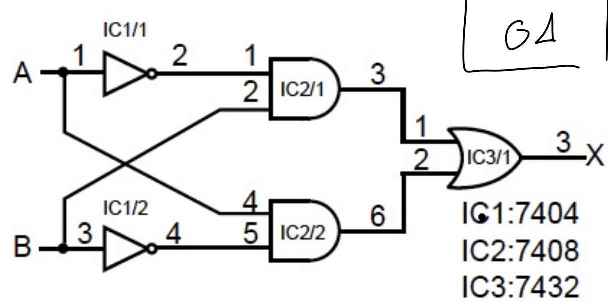
Laboratory 4

Exclusive-OR gate and Exclusive-NOR gate

1. Exclusive-OR gate:

1.1 Given a circuit as shown in the following figure:

04 | 08 | 32



1.2 Connect the circuit. Use logic switch to supply inputs as specified. The output signals should be connected to the logic monitor. Record the results in the following truth table.

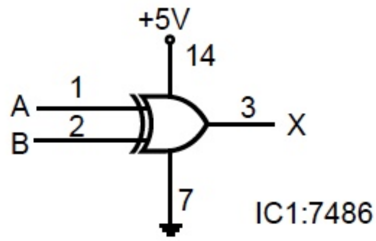
A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

1.3 Find the Boolean expression for the given circuit in 1.1.

$\overline{A}B + A\overline{B} = A \oplus B$

Instructor's signature

1.4 Given a circuit as shown in the following figure



1.5 Connect the circuit. Use logic switch to supply inputs as specified. The output signals should be connected to the logic monitor. Record the result in the following truth table.

A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

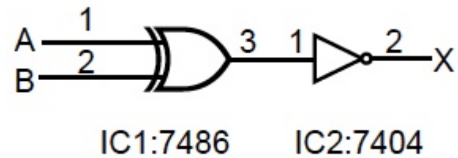
1.6 Compare the outputs of the previous two circuits and give conclusion?

Both circuit behave the same way for every variable given.

Instructor's signature

2. Exclusive-NOR gate:

2.1 Given a circuit as shown in the following figure



2.2 Connect the circuit. Use logic switch to supply inputs as specified. The output signals should be connected to the logic monitor. Record the result in the following truth table.

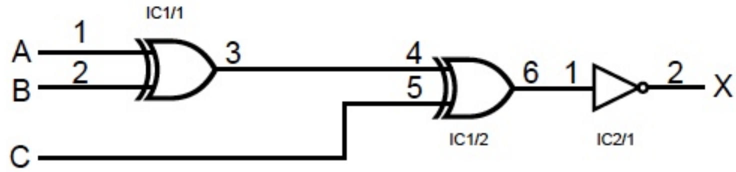
A	B	X
0	0	1
0	1	0
1	0	0
1	1	1

2.3 Find the Boolean expression and simplify it for the given circuit in 2.1.

$AB + \bar{A}\bar{B} = \overline{A \oplus B}$

Instructor's signature

2.4 Given a circuit as shown in the following figure



IC1:7486
IC2:7404

2.5 Connect the circuit. Use logic switch to supply inputs as specified. The output signals should be connected to the logic monitor. Record the results in the following truth table.

A	B	C	X
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

2.6 Find the Boolean expression and simplify for the given circuit in 2.4.

$$\bar{A}\bar{B}\bar{C} + \bar{A}BC + A\bar{B}C + AB\bar{C}$$

$$= \bar{A}\bar{B}\bar{C} + (A \oplus B)C + AB\bar{C}$$

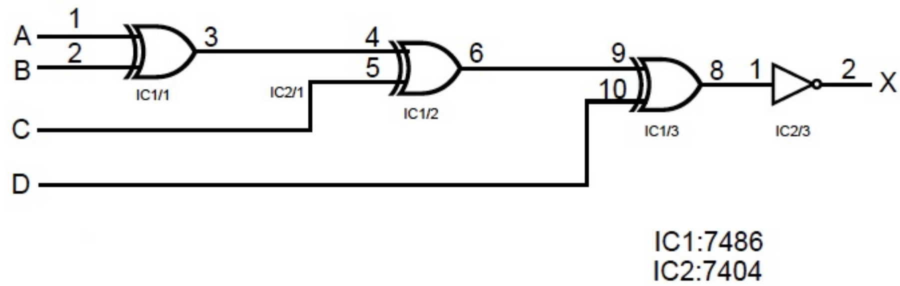
$$= (\overline{A \oplus B})\bar{C} + (A \oplus B)C$$

$$= \overline{(A \oplus B) \oplus C}$$

Instructor's signature

Mua

2.7 Given a circuit as shown in the following figure



2.8 Connect the circuit. Use logic switch to supply inputs as specified. The output signals should be connected to the logic monitor. Record the results in the following truth table.

A	B	C	D	X
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1

A	B	C	D	X
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

2.9 Find the Boolean expression for the given circuit in 2.7

$$\bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}CD + \bar{A}B\bar{C}D + \bar{A}BC\bar{D} + A\bar{B}\bar{C}D + A\bar{B}C\bar{D} + AB\bar{C}\bar{D} + ABCD$$

$$= (\overline{A\oplus B})\bar{C}\bar{D} + (\overline{A\oplus B})CD + \bar{A}B(C\oplus D) + A\bar{B}(C\oplus D)$$

$$= (\overline{A\oplus B})(\overline{C\oplus D}) + (A\oplus B)(C\oplus D)$$

$$= \overline{(A\oplus B\oplus C\oplus D)}$$

2.10 Explain the characteristics of the circuit in 2.1, 2.4 and 2.7.

2.1 → The circuit represent the NXOR gate

2.4 → If the circuit has the amount of HIGH Logic as an even number, the light turns on.

2.7 → Same as 2.4

Instructor's signature

3 Assignments

3.1 There are 2 sensors required in a machine for electronics board manufacturing system. The first sensor detects the complete amount of a set of electrical components. This sensor gives LOW signals when a set of components is complete. The other sensor detects the damage of the board. It gives HIGH signal when the board is damage. The machine requires two display LEDs. The first and second LED will be ON when the board has a complete set of components but it is damage. The second LED will also be ON, when the board doesn't have a complete set of components but the board itself is not damage. Realize the logic circuit for this machine.

Instructor's signature

3.2 Connect a three-inputs circuit that results in the outputs specified in the following truth table.

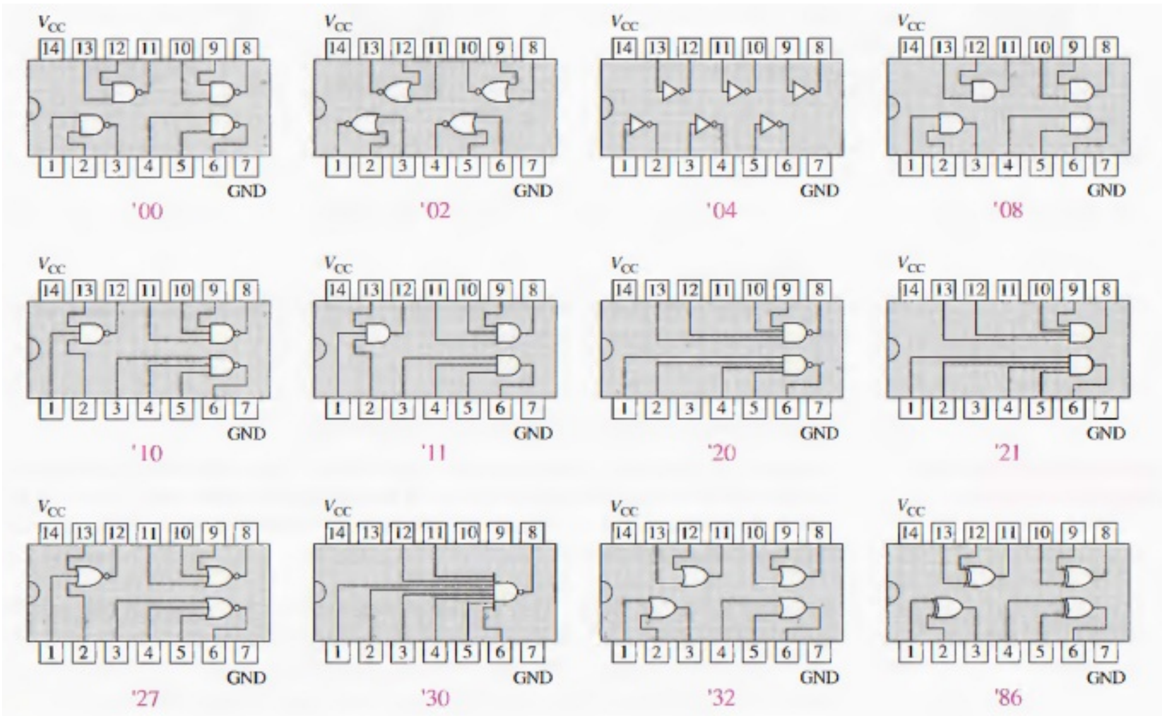
A	B	C	X
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

Instructor's signature

3.3 The input signal is given as BCD digit (0-9). Realize a circuit including at least one exclusive-OR gate such that the outputs of the circuit will be the remainder of the inputs divided by 6.

Instructor's signature

Logic Diagram of frequently used gates



3 Assignments

3.1 There are 2 sensors required in a machine for electronics board manufacturing system. The first sensor detects the complete amount of a set of electrical components. This sensor gives LOW signals when a set of components is complete. The other sensor detects the damage of the board. It gives HIGH signal when the board is damage. The machine requires two display LEDs. The first and second LED will be ON when the board has a complete set of components but it is damage. The second LED will also be ON, when the board doesn't have a complete set of components but the board itself is not damage. Realize the logic circuit for this machine.

A = Amount → 1 = Incomplete
→ 0 = Complete

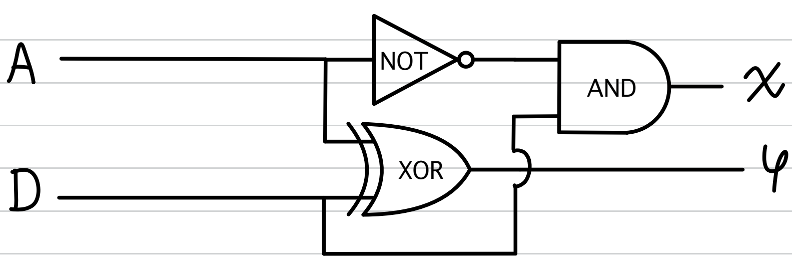
X = First LED
Y = Second LED

$x = \bar{A}D$
$Y = \bar{A}D + A\bar{D}$

D = Damage → 1 = Damage
→ 0 = Normal

A	D	x	Y
0	0	0	0
0	1	1	1
1	0	0	1
1	1	0	0

$\therefore x = \bar{A}D$
$\therefore Y = A \oplus D$



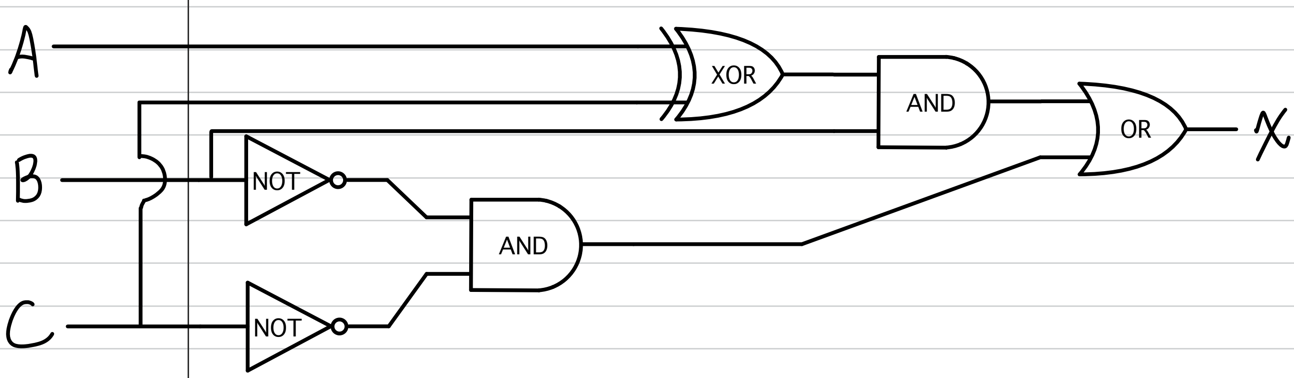
3.2 Connect a three-inputs circuit that results in the outputs specified in the following truth table.

A	B	C	X
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

$x = \Sigma m(0,3,4,6)$

A \ BC	$\bar{B}\bar{C}$	$\bar{B}C$	BC	$B\bar{C}$
$\bar{A}$	1	0	1	0
A	1	0	0	1

$$\therefore x = \bar{B}\bar{C} + \bar{A}BC + AB\bar{C}$$
$$= \bar{B}\bar{C} + B(\bar{A}C + A\bar{C})$$
$$= \bar{B}\bar{C} + B(A \oplus C)$$



3.3 The input signal is given as BCD digit (0-9). Realize a circuit including at least one exclusive-OR gate such that the outputs of the circuit will be the remainder of the inputs divided by 6.

To simplified →

Input	Output
0	0
1	1
2	2
3	3
4	4
5	5
6	0
7	1
8	2
9	3

→ In BCD

A	B	C	D	x	y	z	α
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	0	0	0	1	0
0	0	1	1	0	0	1	1
0	1	0	0	0	1	0	0
0	1	0	1	0	1	0	1
0	1	1	0	0	0	0	0
0	1	1	1	0	0	0	1
1	0	0	0	0	0	1	0
1	0	0	1	0	0	1	1