Daniela morales lab 04
1923

ejercicio 1

1.

C \ AB	00	01	11	10
0	1	1	0	1
1	0	0	1	1

000
010
$\bar{A}\bar{C}$ +

111
101
AC +

100
101
$A\bar{B}$

$Y = \bar{A}\bar{C} + A\bar{B} + AC$

2.

C \ AB	00	01	11	10
0	1	0	0	X
1	X	0	0	1

100
101
000
001
$\bar{B}$

$Y = \bar{B}$

3.

CD \ AB	00	01	11	10
00	1	0	1	0
01	0	1	0	1
11	1	0	1	0
10	0	1	0	1

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

4.

CD \ AB	00	01	11	10
00	X	0	1	1
01	X	X	1	0
11	0	X	1	1
10	X	0	X	X

1100 1000 1110 1010 → $A\bar{D}$

1111 1011 1110 1010 → AC

1100 1101 1111 1110 → AB

$Y = A\bar{D} + AC + AB$

Ejercicio 02

1. $Y = ABC\bar{D} + A\bar{B}CD + \overline{(A+B+C+D)}$

A	B	C	D	$ABC\bar{D}$	$A\bar{B}CD$	$\overline{A+B+C+D}$	Y
0	0	0	0	0	0	1	1
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
0	1	0	1	0	0	0	0
0	1	1	0	0	0	0	0
0	1	1	1	0	0	0	0
1	0	0	0	1	1	0	1
1	0	0	1	1	1	0	1
1	0	1	0	1	1	0	1
1	0	1	1	1	1	0	1
1	1	0	0	1	1	0	1
1	1	0	1	1	1	0	1
1	1	1	0	1	1	0	1
1	1	1	1	0	0	0	0

Ejercicio 02

1. $Y = AB\bar{C}\bar{D} + A\overline{BCD} + \overline{A+B+C+D}$

CD \ AB	00	01	11	10
00	1	0	1	1
01	0	0	1	1
11	0	0	0	1
10	0	0	1	1

$Y = A\bar{C} + B\bar{C}\bar{D} + A\bar{B} + A\bar{D}$

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

1100
1101
1000
1001
$A\bar{C}$ +

1000
0000
$B\bar{C}\bar{D}$ +

1000
1001
1011
1010
$A\bar{B}$ +

1100
1000
1110
1010
$A\bar{D}$

2. $Y = \bar{A}BC + \overline{B\bar{C}} + BC$

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

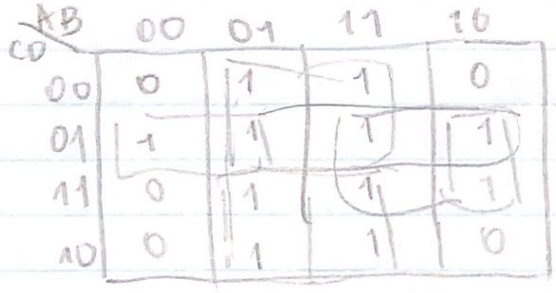
C \ AB	00	01	11	10
0	1	0	0	1
1	1	1	1	1

$Y = C + \bar{B}$

A	B	C	Y	
X	X	1	1	4
X	0	X	1	4
X	1	0	0	2

3. $Y = (\overline{A+B+C \cdot D}) + \overline{AD+B}$

A	B	C	D	$\overline{A+B+C}$	$\overline{A+B+C \cdot D}$	$\overline{AD}$	Y
0	0	0	0	1	0	0	0
0	0	0	1	1	1	0	1
0	0	1	0	0	0	0	0
0	0	1	1	0	0	0	0
0	1	0	0	0	0	0	1
0	1	0	1	0	0	0	1
0	1	1	0	0	0	0	1
0	1	1	1	0	0	0	1
1	0	0	0	0	0	0	0
1	0	0	1	0	0	1	1
1	0	1	0	0	0	0	0
1	0	1	1	0	0	1	1
1	1	0	0	0	0	0	1
1	1	0	1	0	0	1	1
1	1	1	0	0	0	0	1
1	1	1	1	0	0	1	1



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

0100
0101
0111
0110
1100
1101
1111
1110

1101
1111
1001
1011

0001
0101
1101
1001

$= Y = B + AD + \bar{C}D$

4. $Y = BC + \bar{A}\bar{B}\bar{C} + B\bar{C}$

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

C \ AB	00	01	11	10
0	1	1	1	0
1	0	1	1	0

$Y = B + \bar{A}\bar{C}$

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

Ejercicios

A → Alarma
B → Ventana/puerta
C → sensor movimiento
Y → prender alarma

A	B	C	Y
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	(1)
1	0	1	(1)
1	1	0	0
1	1	1	(1)

AB / C	00	01	11	10
0	0	0	0	1
1	0	0	1	1

111 + 101 = AC

100 + 101 = $A\bar{B}$

$Y = AC + A\bar{B}$

$A\bar{B}\bar{C} + A\bar{B}C + ABC = Y$

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

Ejercicio 1

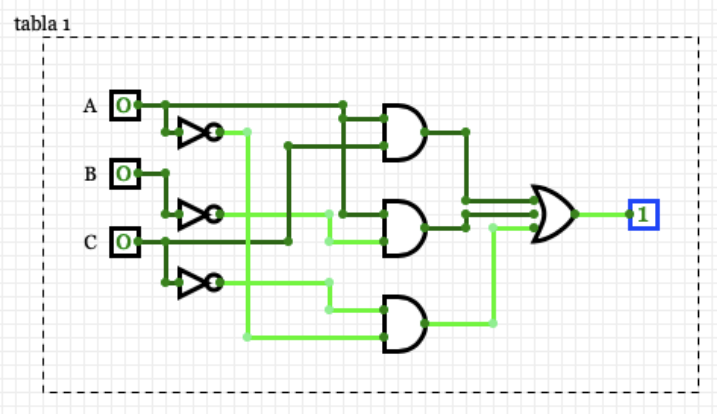
ejercicio 1

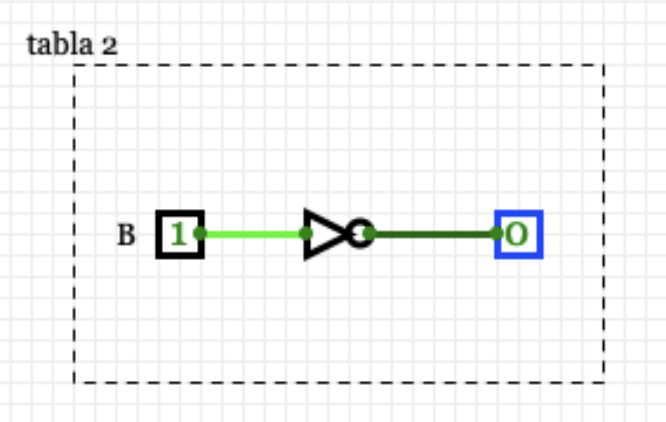
ejercicio 1, tabla 1 y 2

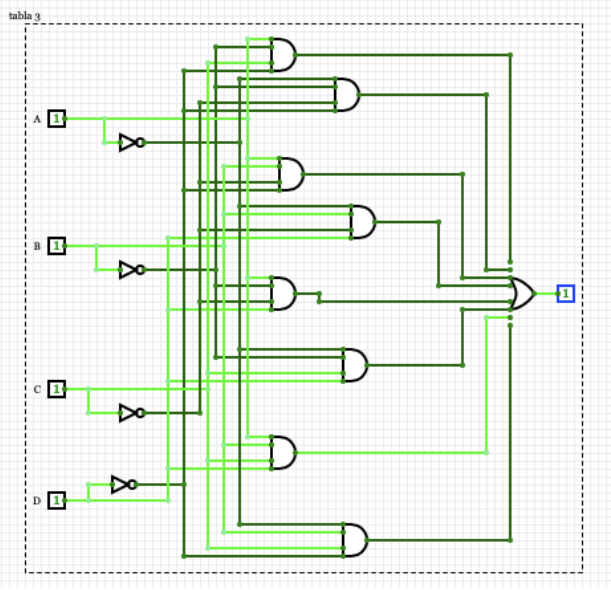
A	B	C	Y1	Y2
0	0	0	1	1
0	0	1	0	1
0	1	0	1	0
0	1	1	0	0
1	0	0	1	1
1	0	1	1	1
1	1	0	0	0
1	1	1	1	0

ejercicio 1, tabla 3 y 4

A	B	C	D	Y3	Y4
0	0	0	0	1	0
0	0	0	1	0	0
0	0	1	0	0	0
0	0	1	1	1	0
0	1	0	0	0	0
0	1	0	1	1	0
0	1	1	0	1	0
0	1	1	1	0	0
1	0	0	0	0	1
1	0	0	1	1	0
1	0	1	0	1	1
1	0	1	1	0	1
1	1	0	0	1	1
1	1	0	1	0	1
1	1	1	0	0	1
1	1	1	1	1	1







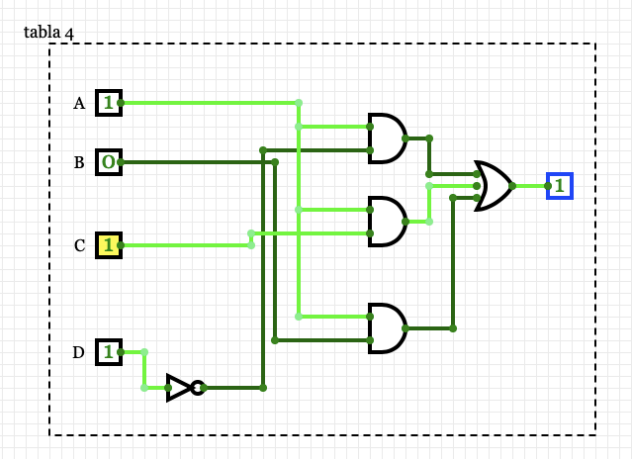


Tabla 1 y 2

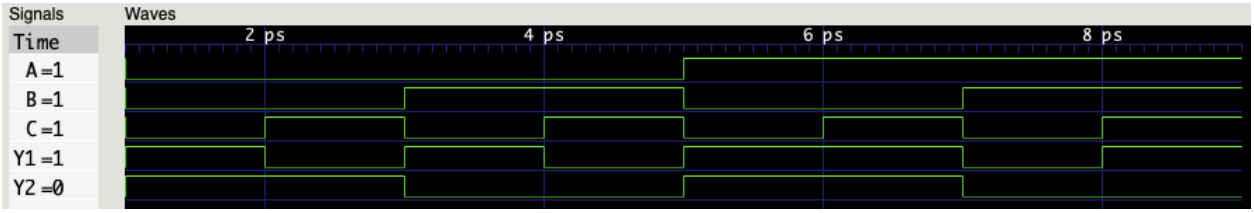
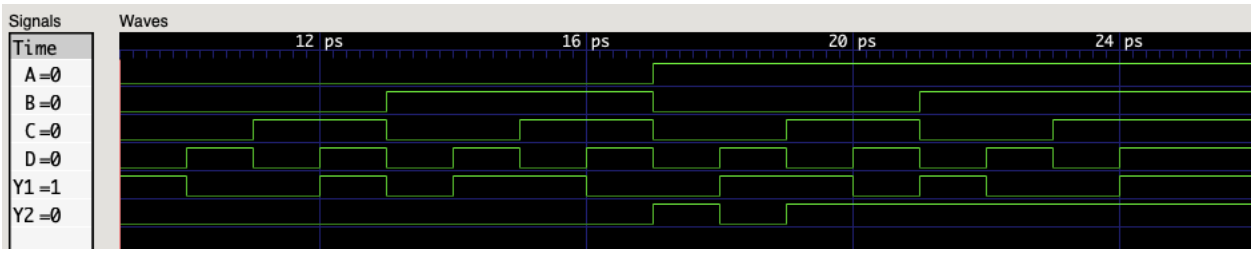
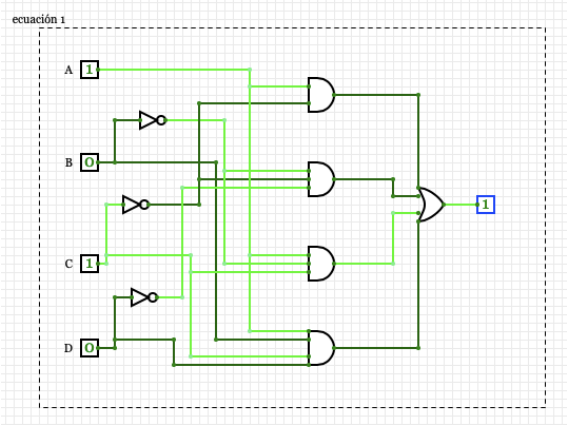


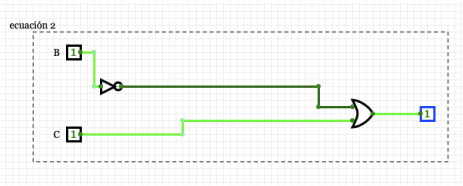
Tabla 3 y 4

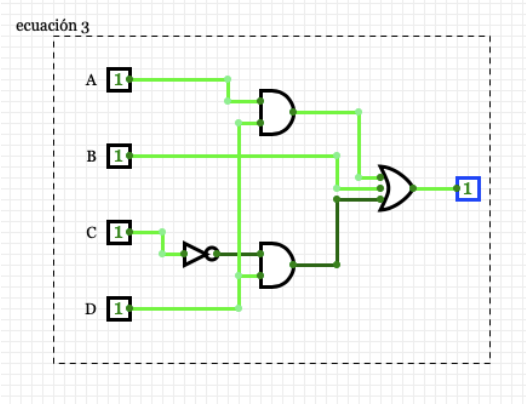


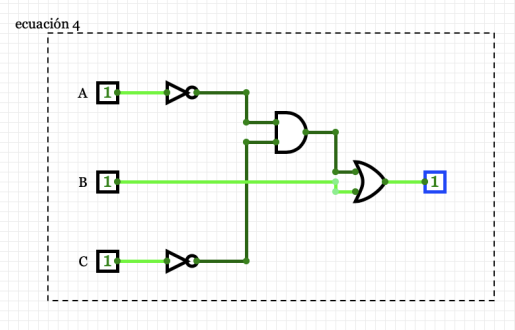
Ejercicio 2

```
ejercicio 2


ejercicio 2, tabla 1 y 3
A B C D | Y1| Y3
--------|---|---
0 0 0 0 | 1 | 0
0 0 0 1 | 0 | 1
0 0 1 0 | 0 | 0
0 0 1 1 | 0 | 0
0 1 0 0 | 0 | 1
0 1 0 1 | 0 | 1
0 1 1 0 | 0 | 1
0 1 1 1 | 0 | 1
1 0 0 0 | 1 | 0
1 0 0 1 | 1 | 1
1 0 1 0 | 1 | 0
1 0 1 1 | 1 | 1
1 1 0 0 | 1 | 1
1 1 0 1 | 1 | 1
1 1 1 0 | 1 | 1
1 1 1 1 | 0 | 1


ejercicio 2, tabla 2 y 4
A B C | Y2| Y4
------|---|---
0 0 0 | 1 | 1
0 0 1 | 1 | 0
0 1 0 | 0 | 1
0 1 1 | 1 | 1
1 0 0 | 1 | 0
1 0 1 | 1 | 0
1 1 0 | 0 | 1
1 1 1 | 1 | 1
```

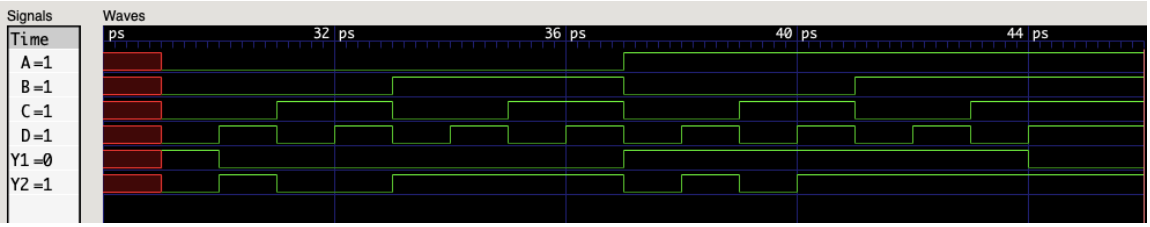




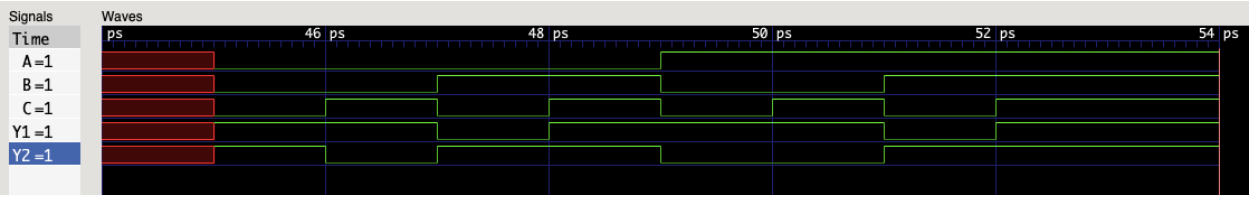




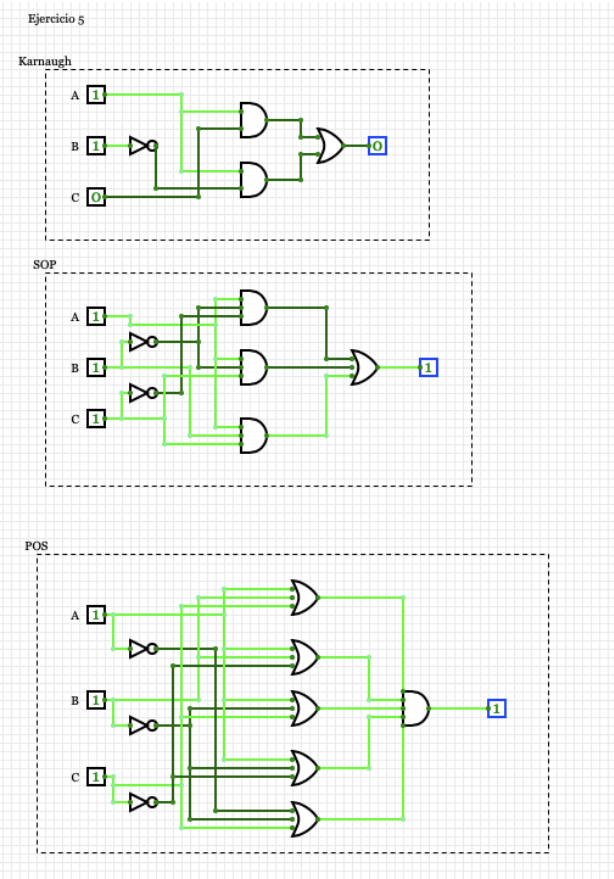
Ecuaciones 1 y 3



Ecuaciones 2 y 4



Ejercicio 5

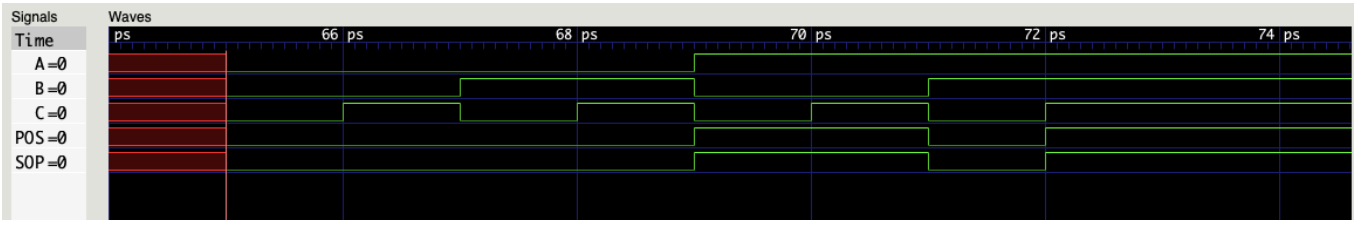


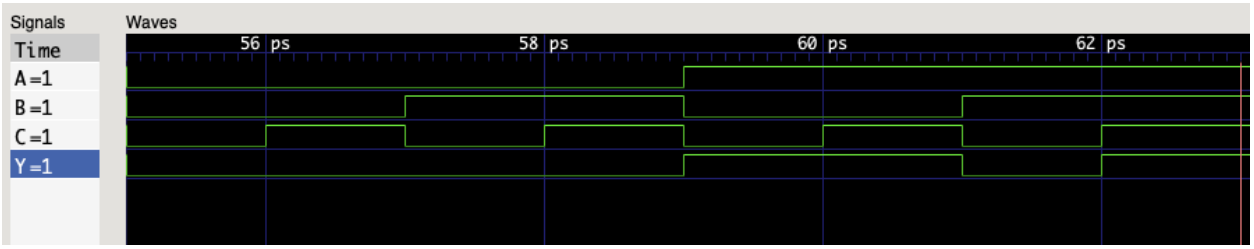
ejercicio 5, Karnaugh

A	B	C	Y
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

ejercicio 5, SOP y POS

A	B	C	SOP	POS
0	0	0	0	0
0	0	1	0	0
0	1	0	0	0
0	1	1	0	0
1	0	0	1	1
1	0	1	1	1
1	1	0	0	0
1	1	1	1	1


Signals
Waves
Time
A =0
B =0
C =0
POS =0
SOP =0
ps
66 ps
68 ps
70 ps
72 ps
74 ps


Signals
Waves
Time
A =1
B =1
C =1
Y =1
56 ps
58 ps
60 ps
62 ps

lab4.v

```
module  gatelevel1(input wire A, B, C, output wire Y1, Y2);
// Y1 = A'B'+ AB' + AC

    wire w1, w2, w3, nota, notb, notc;
    not (nota, A);
    not (notb, B);
    not (notc, C);
    and (w1, nota, notc);
    and (w2, A, notb);
    and (w3, A, C);
    or (Y1, w1, w2, w3);

// Y2 = B'
    not (Y2, B);

endmodule

module gatelevel2(input wire A, B, C, D, output wire Y1, Y2);

// Y = AB'CD' + A'B'C'D' + ABC'D' + A'BC'D + AB'C'D +A'B'CD + ABCD + A'BCD'
    wire w1, w2, w3, w4, w5, w6, w7, w8, v1, v2, v3, NOTA, NOTB, NOTC, NOTD;
    not (NOTA, A);
    not (NOTB, B);
    not (NOTC, C);
    not (NOTD, D);
    and (w1, A, NOTB, C, NOTD);
    and (w2, NOTA, NOTB, NOTC, NOTD);
    and (w3, A, B, NOTC, NOTD);
    and (w4, NOTA, B, NOTC, D);
    and (w5, A, NOTB, NOTC, D);
    and (w6, NOTA, NOTB, C, D);
    and (w7, A, B, C, D);
    and (w8, NOTA, B, C, NOTD);
    or (Y1, w1, w2,w3,w4, w5, w6,w7, w8);

// Y = AD' + AC +AB
    and (v1, A, NOTD);
    and (v2, A, C);
    and (v3, A, B);
    or (Y2, v1, v2, v3);

endmodule

module operadores1(input wire A, B, C, D, output wire Y1, Y2);

    assign  Y1 = (A & ~C) | (~B & ~C & ~D) | (A & ~B) | (A &
    ~D);
    assign  Y2 = B | (A & D) | (~C & D);

endmodule


module operadores2(input wire A, B, C, output wire Y1, Y2);
    assign  Y1 = (~B | C);
    assign  Y2 = B | (~A & ~C);
endmodule

module  gatelevel5(input wire A, B, C, output wire Y);
    wire w1, w2, NOTB;
    not (NOTB, B);
    and (w1, A, C);
    and (w2, A, NOTB);
    or (Y, w1, w2);
endmodule

module  operadores5(input wire A, B, C, output wire SOP, POS);
    assign  SOP = (A & ~B & ~C) | (A & ~B & C) | (A & B & C);
    assign  POS = (A|B|C) & (A|B|~C) & (A|~B|C) & (A|~B|~C) & (~A|~B|C);
endmodule
```

lab4_tb.v

```
module testbench();

    reg p1, p2, p3, c1, c2, c3, c4, p4, p5, p6, p7, d4, d5, d6, d7, g1, g2, g3, o1, o2, o3;
    wire led1, led2, C, D, led3, led4, led5, g, SOP, POS;

    gatelevel1  G1(p1, p2, p3, led1, led2);
    gatelevel2  G2(c1, c2, c3, c4, C, D);
    operadores1 OP1(p4, p5, p6, p7, led3, led4);
    operadores2 OP2(d5, d6, d7, led5, led6);
    gatelevel5  G5(g1, g2, g3,g);
    operadores5 OP5(o1, o2, o3, SOP, POS);

    initial begin
    #1
        $display("\n \n ejercicio 1");
        $display("\n");
        $display("ejercicio 1, tabla 1 y 2");
        $display("A B C | Y1| Y2");
        $display("-------|---|---");
        $monitor("%b %b %b | %b | %b", p1, p2, p3, led1, led2);
            p1 = 0; p2 = 0; p3 = 0;
        #1  p1 = 0; p2 = 0; p3 = 1;
        #1  p1 = 0; p2 = 1; p3 = 0;
        #1  p1 = 0; p2 = 1; p3 = 1;
        #1  p1 = 1; p2 = 0; p3 = 0;
        #1  p1 = 1; p2 = 0; p3 = 1;
        #1  p1 = 1; p2 = 1; p3 = 0;
        #1  p1 = 1; p2 = 1; p3 = 1;
    end


    initial begin
    #9
        $display("\n");
        $display("ejercicio 1, tabla 3 y 4");
        $display("A B C D | Y3| Y4");
        $display("---------|---|---");
        $monitor("%b %b %b %b | %b | %b", c1, c2, c3, c4, C, D);
            c1 = 0; c2 = 0; c3 = 0; c4 = 0;
        #1  c1 = 0; c2 = 0; c3 = 0; c4 = 1;
        #1  c1 = 0; c2 = 0; c3 = 1; c4 = 0;
        #1  c1 = 0; c2 = 0; c3 = 1; c4 = 1;
        #1  c1 = 0; c2 = 1; c3 = 0; c4 = 0;
        #1  c1 = 0; c2 = 1; c3 = 0; c4 = 1;
        #1  c1 = 0; c2 = 1; c3 = 1; c4 = 0;
        #1  c1 = 0; c2 = 1; c3 = 1; c4 = 1;
        #1  c1 = 1; c2 = 0; c3 = 0; c4 = 0;
        #1  c1 = 1; c2 = 0; c3 = 0; c4 = 1;
        #1  c1 = 1; c2 = 0; c3 = 1; c4 = 0;
        #1  c1 = 1; c2 = 0; c3 = 1; c4 = 1;
        #1  c1 = 1; c2 = 1; c3 = 0; c4 = 0;
        #1  c1 = 1; c2 = 1; c3 = 0; c4 = 1;
        #1  c1 = 1; c2 = 1; c3 = 1; c4 = 0;
        #1  c1 = 1; c2 = 1; c3 = 1; c4 = 1;
    end

    initial begin
    #29
        $display("\n            ejercicio 2");
        $display("\n");
        $display("ejercicio 2, tabla 1 y 3");
        $display("A B C D | Y1| Y3");
        $display("---------|---|---");
        $monitor("%b %b %b %b | %b | %b ", p4, p5, p6, p7, led3, led4);
            p4 = 0; p5 = 0; p6 = 0; p7 = 0;
        #1  p4 = 0; p5 = 0; p6 = 0; p7 = 1;
        #1  p4 = 0; p5 = 0; p6 = 1; p7 = 0;
        #1  p4 = 0; p5 = 0; p6 = 1; p7 = 1;
        #1  p4 = 0; p5 = 1; p6 = 0; p7 = 0;
        #1  p4 = 0; p5 = 1; p6 = 0; p7 = 1;
```

Line 1, Column 1 — master 68 — Tab Size: 4 — Plain Text

lab4_tb.v

```
        #1  p4 = 1; p5 = 0; p6 = 1; p7 = 1;
        #1  p4 = 1; p5 = 1; p6 = 0; p7 = 0;
        #1  p4 = 1; p5 = 0; p6 = 0; p7 = 1;
        #1  p4 = 1; p5 = 1; p6 = 1; p7 = 0;
        #1  p4 = 1; p5 = 1; p6 = 1; p7 = 1;
    end

    initial begin
    #45
        $display("\n");
        $display("ejercicio 2, tabla 2 y 4");
        $display("A B C | Y2| Y4");
        $display("-----|---|---");
        $monitor("%b %b %b | %b | %b ", d5, d6, d7, led5, led6);
            d5 = 0; d6 = 0; d7 = 0;
        #1  d5 = 0; d6 = 0; d7 = 1;
        #1  d5 = 0; d6 = 1; d7 = 0;
        #1  d5 = 0; d6 = 1; d7 = 1;
        #1  d5 = 1; d6 = 0; d7 = 0;
        #1  d5 = 1; d6 = 0; d7 = 1;
        #1  d5 = 1; d6 = 1; d7 = 0;
        #1  d5 = 1; d6 = 1; d7 = 1;

    end

    initial begin
    #55
        $display("\n");
        $display("ejercicio 5, Karnaugh");
        $display("A B C | Y");
        $display("-----|---");
        $monitor("%b %b %b | %b ", g1, g2, g3, g);
            g1 = 0; g2 = 0; g3 = 0;
        #1  g1 = 0; g2 = 0; g3 = 1;
        #1  g1 = 0; g2 = 1; g3 = 0;
        #1  g1 = 0; g2 = 1; g3 = 1;
        #1  g1 = 1; g2 = 0; g3 = 0;
        #1  g1 = 1; g2 = 0; g3 = 1;
        #1  g1 = 1; g2 = 1; g3 = 0;
        #1  g1 = 1; g2 = 1; g3 = 1;

    end

    initial begin
    #65
        $display("\n");
        $display("ejercicio 5, SOP y POS");
        $display("A B C | SOP | POS ");
        $display("-----|-----|-----");
        $monitor("%b %b %b | %b   |   %b ", o1, o2, o3, SOP, POS);
            o1 = 0; o2 = 0; o3 = 0;
        #1  o1 = 0; o2 = 0; o3 = 1;
        #1  o1 = 0; o2 = 1; o3 = 0;
        #1  o1 = 0; o2 = 1; o3 = 1;
        #1  o1 = 1; o2 = 0; o3 = 0;
        #1  o1 = 1; o2 = 0; o3 = 1;
        #1  o1 = 1; o2 = 1; o3 = 0;
        #1  o1 = 1; o2 = 1; o3 = 1;
        #1 $display("\n");
    end

    initial
        #75 $finish;

    initial begin
        $dumpfile("lab4.vcd");
        $dumpvars(0, testbench);
    end

    endmodule
```