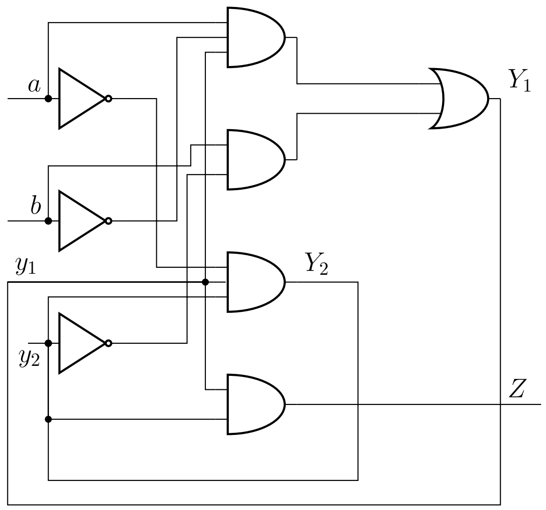
TP 4
Digital Electronics [ELEC-H-310]
Correction

v1.0.1

Question 1. What are the logic equations for this circuit? Fill a Huffman table and find the corresponding state graph.

a)



Answer:

$$Y_1 = a\bar{b}y_1 + b\overline{y_2}$$
$$Y_2 = \bar{a}y_1y_2$$
$$Z = y_1y_2$$

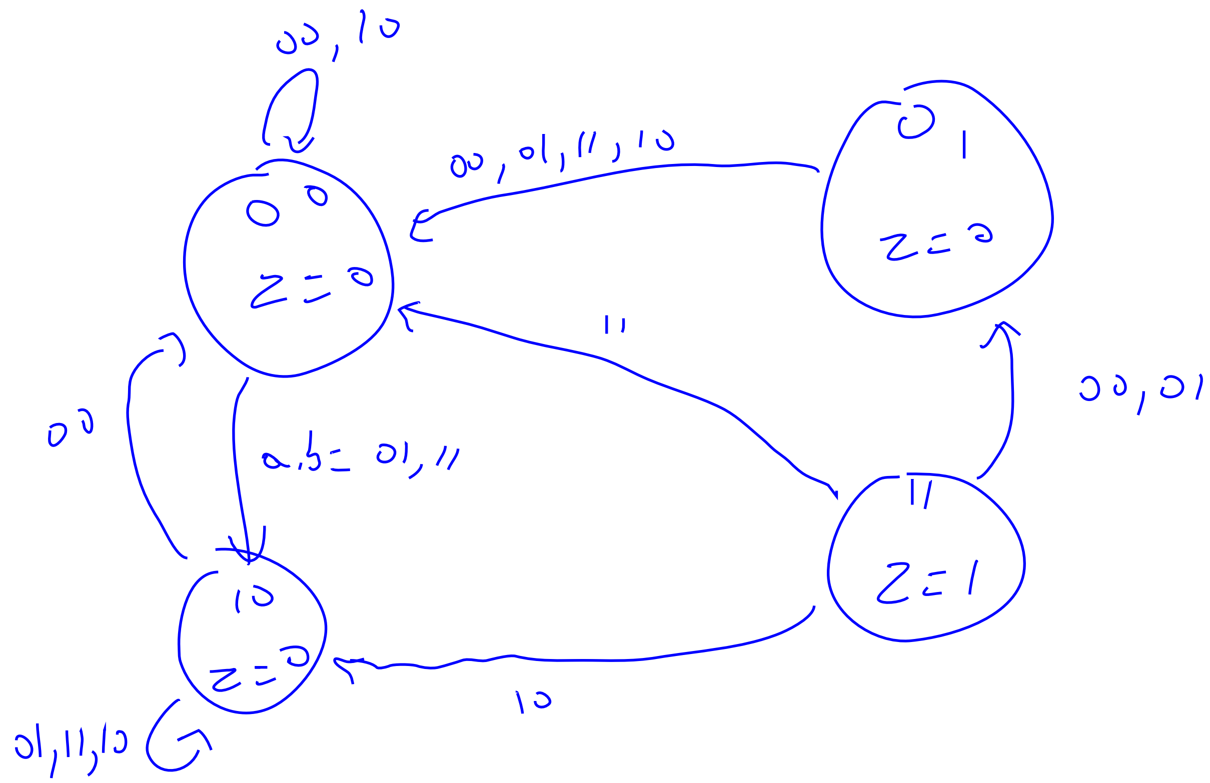
	ab				
Y_1Y_2	00	01	11	10	Z
00	00	10	10	00	0
01	00	00	00	00	0
11	01	01	00	10	1
10	00	10	10	10	0

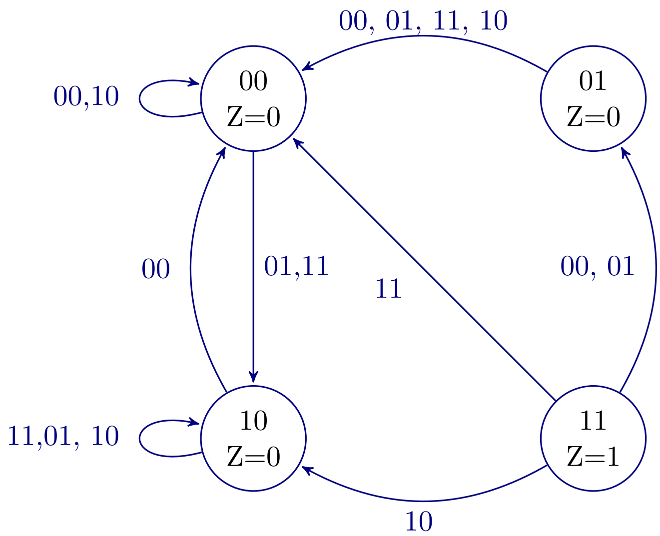
1. a) $Y_1 = (a \cdot \bar{b}\, y_1) + b\, \bar{y_2}$

$Y_2 = \bar{a}\, y_1 y_2$

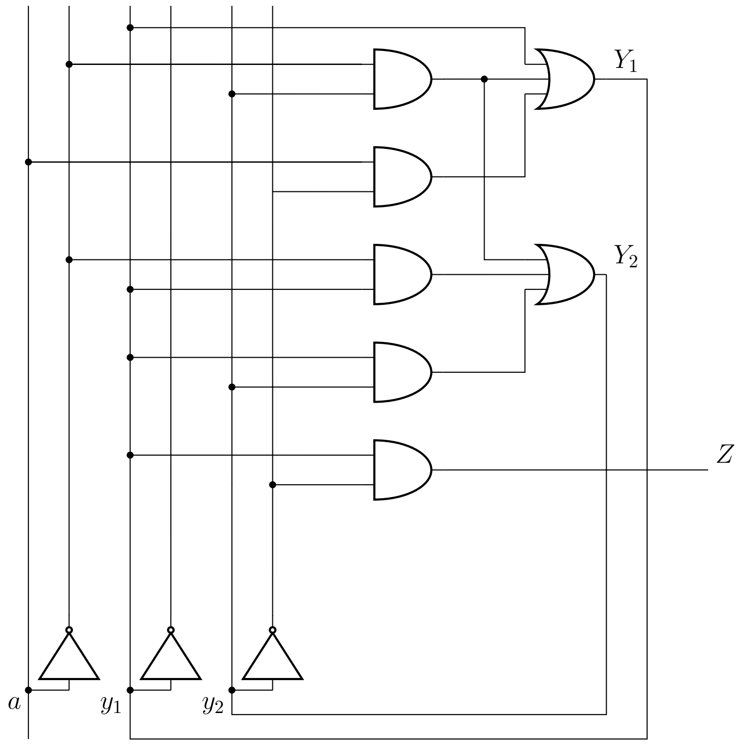
$Z = y_1 y_2$

Y_1Y_2	ab = 00	01	11	10	Z
00	00	10	10	00	0
01	00	00	00	00	0
11	01	01	00	10	1
10	00	10	10	10	0
y_1y_2					





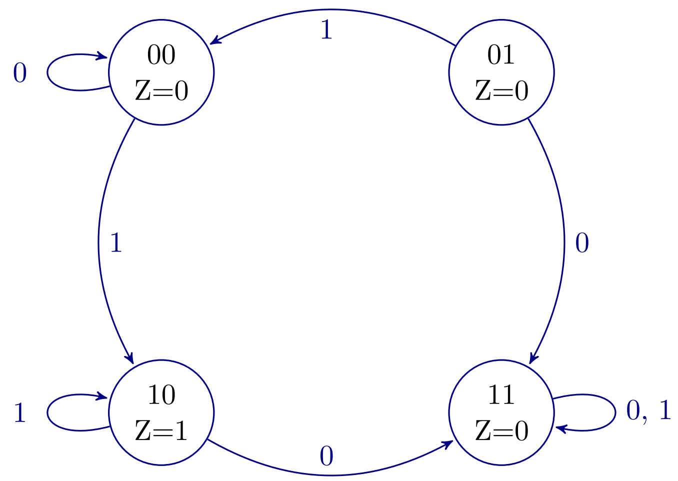
b)



Answer:

$$Y_1 = y_1 + \overline{a}y_2 + a\overline{y_2}$$
$$Y_2 = \overline{a}y_2 + \overline{a}y_1 + y_1y_2$$
$$Z = y_1\overline{y_2}$$

	a		
Y_1Y_2	0	1	Z
00	00	10	0
01	11	00	0
11	11	11	0
10	11	10	1



Question 2. A door opener is controlled by a password that is controlled using two buttons a and b. We assume that the value associated to each button equals 1 when the button is pressed, 0 otherwise. The door is being opened if the output Z_1 is set to 1, which happens whenever the last button of the password is pressed. The code is the following: press and release a two times, then press and release b and finaly press and release a again. Any wrong sequence sets the output Z_2 to 1, triggering the alarm. Once activated, the alarm stays active whatever the input.

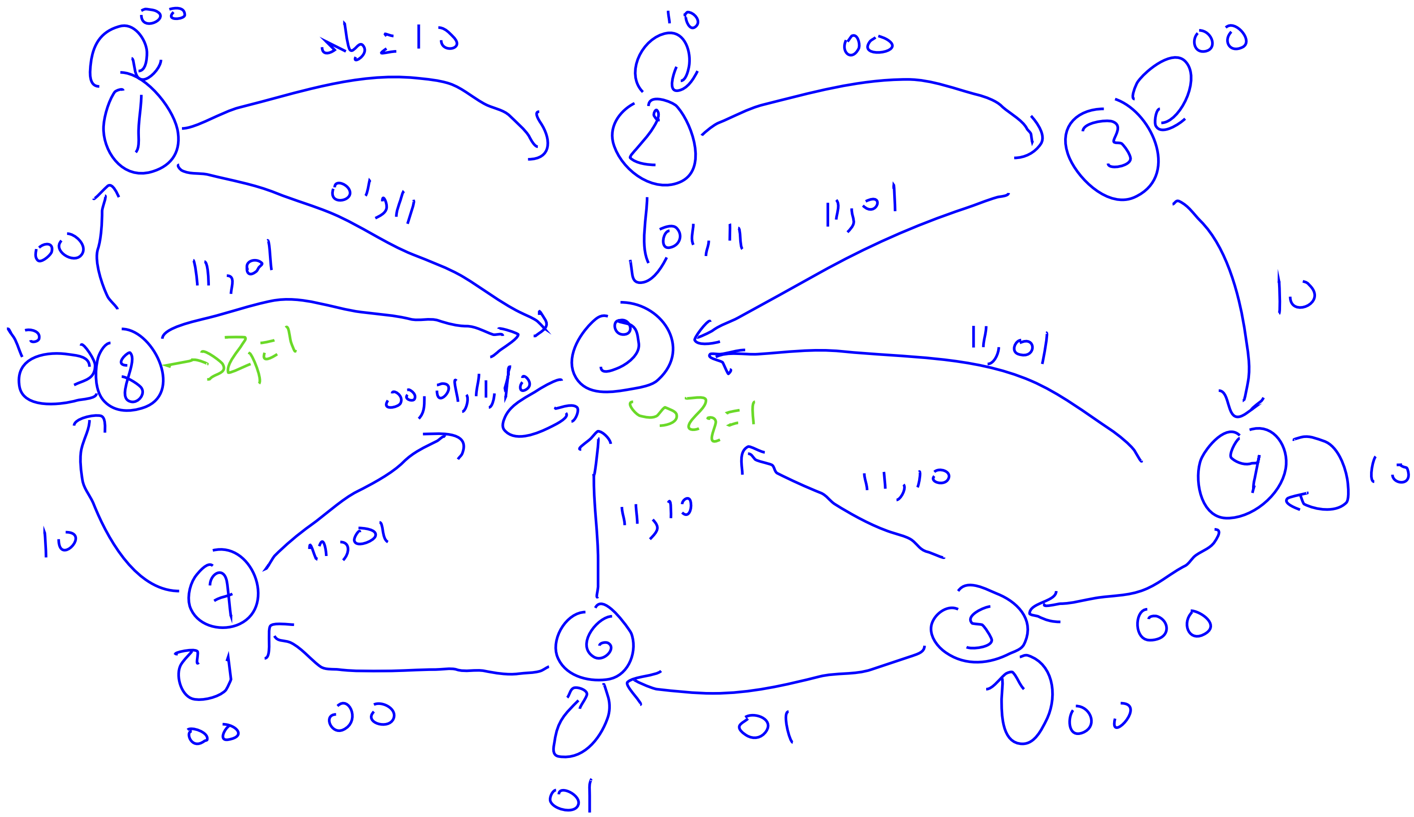
Build the state graph and Huffman table for this problem.

Answer:

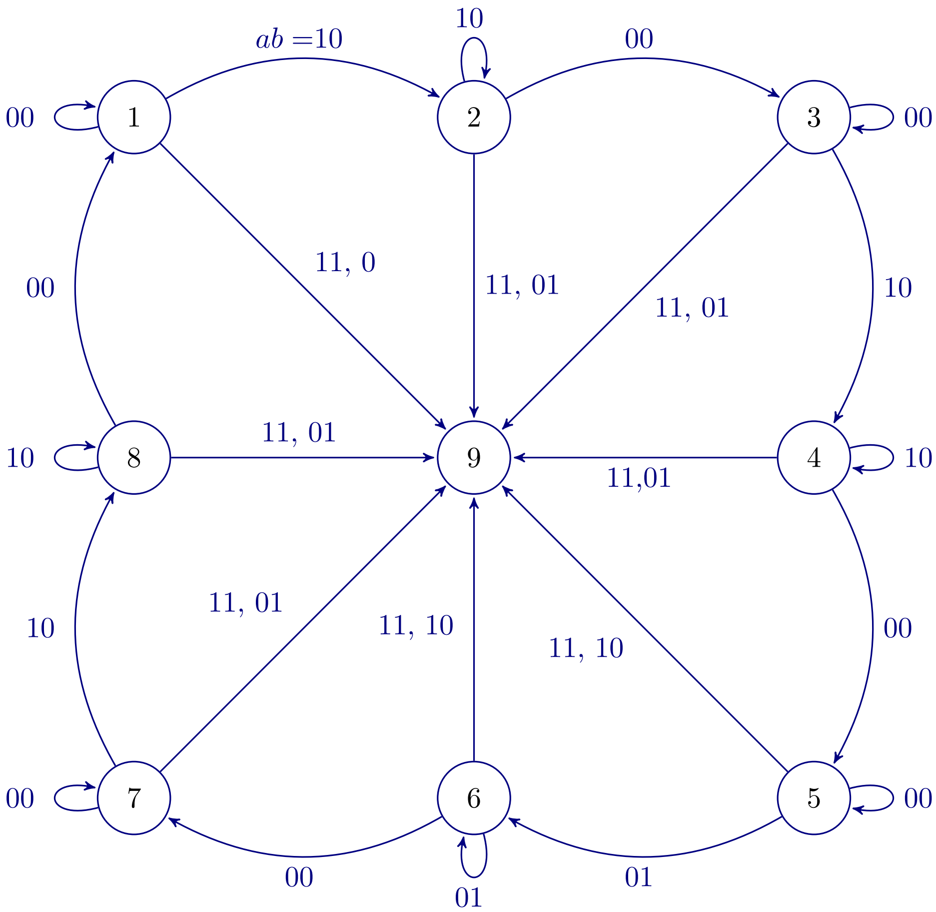
	ab					
	00	01	11	10	Z_1	Z_2
1	**1**	9	9	2	0	0
2	3	9	9	**2**	0	0
3	**3**	9	9	4	0	0
4	5	9	9	**4**	0	0
5	**5**	6	9	9	0	0
6	7	**6**	9	9	0	0
7	**7**	9	9	8	0	0
8	1	9	9	**8**	1	0
9	**9**	**9**	**9**	**9**	0	1

	ab 00	01	11	10	z1	z2
1	1	9	9	2	0	0
2	3	9	9	2	0	0
3	3	9	9	4	0	0
4	5	9	9	4	0	0
5	5	6	9	9	0	0
6	7	6	9	9	0	0
7	7	9	9	8	0	0
8	1	9	9	8	1	0
9	9	9	9	9	0	1

état alarme



ab = 10
00
01, 11
11, 01
10
00, 01, 11, 10
$z_1 = 1$
$z_2 = 1$
11, 10
01



The state 9 is stable for all inputs. The retroaction loops have been omitted to keep the graph light, though

Question 3. Use a K-map to simplify the following equation:

$$f(a,b,c,d,e) = \sum_m (0,2,5,7,8,9,10,11,13,23,26,27,29) + \sum_d (3,12,15,18,19,21,22,31)$$

Answer:

de \ abc	000	001	011	010	100	101	111	110
00	1	0	-	1	0	0	0	0
01	0	1	1	1	0	-	1	0
11	-	1	-	1	-	1	-	1
10	1	0	0	1	-	-	0	1

$$F = \overline{a}\,\overline{c}\,\overline{e} + ce + \overline{a}b\overline{c} + \overline{c}d$$

de \ abc	000	001	011	010	100	101	111	110
00	1 0	0 4	– 12	1 8	0 16	0 20	0 28	0 24
01	0 1	1 5	1 13	1 9	0 17	– 21	1 29	0 25
11	– 3	1 7	– 15	1 11	– 19	1 23	– 31	1 27
10	1 2	0 6	0 14	1 10	– 18	– 22	0 30	1 26

=>

1	0	–	1	0	0	0	0
0	1	1	1	0	–	1	0
–	1	–	1	–	1	–	1
1	0	0	1	–	–	0	1