

DOC Course 112: Hardware: Tutorial 5 Solution

Q1.

C1	Q3	Q2	Q1	Curr. State	Next State	Q3	Q2	Q1
0	0	0	0	0	2	0	1	0
0	0	0	1	1	3	0	1	1
0	0	1	0	2	OV	1	1	1
0	0	1	1	3	OV	1	1	1
0	1	0	0	UN	0	0	0	0
0	1	0	1	don't care	don't care	X	X	X
0	1	1	0	don't care	don't care	X	X	X
0	1	1	1	OV	OV	1	1	1
1	0	0	0	0	UN	1	0	0
1	0	0	1	1	UN	1	0	0
1	0	1	0	2	0	0	0	0
1	0	1	1	3	1	0	0	1
1	1	0	0	UN	UN	1	0	0
1	1	0	1	don't care	don't care	X	X	X
1	1	1	0	don't care	don't care	X	X	X
1	1	1	1	OV	0	0	0	0

Q2.

D3

C1 \ Q3	00	01	11	10
00	0	0	1	1
01	0	X	1	X
11	1	X	0	X
10	1	1	0	0

D2

C1 \ Q3	00	01	11	10
00	1	1	1	1
01	0	X	1	X
11	0	X	0	X
10	0	0	0	0

D1

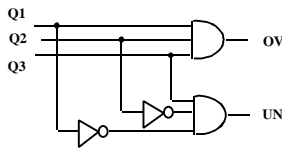
C1 \ Q3	00	01	11	10
00	0	1	1	1
01	0	X	1	X
11	0	X	0	X
10	0	0	1	0

D3 = $C1' \cdot Q2 + C1 \cdot Q2' = C1 \lt;+\gt; Q2$ $\lt;+\gt; = \text{XOR}$

D2 = $C1' \cdot Q3' + C1 \cdot Q2 = C1' \cdot (Q2 + Q3')$

D1 = $C1' \cdot Q1 + C1 \cdot Q2 + Q3' \cdot Q2 \cdot Q1 = C1' \cdot (Q1 + Q2) + Q3' \cdot Q2 \cdot Q1$

Q3 The obvious solution is to decode the minterms for the state:



By K-map design we obtain a better solution (NB Other solutions are possible):

UN

Q2, Q1	00	01	11	10
0	0	0	0	0
1	1	X	0	X

$UN = Q3 \cdot Q2'$

OV

Q2, Q1	00	01	11	10
0	0	0	0	0
1	0	X	1	X

$OV = Q3 \cdot Q2$

Optional:

D3

C1 \ Q3	00	01	11	10
00	0	0	1	1
01	0	0	1	1
11	1	1	0	0
10	1	1	0	0

D2

C1 \ Q3	00	01	11	10
00	1	1	1	1
01	0	0	1	1
11	0	0	0	0
10	0	0	0	0