

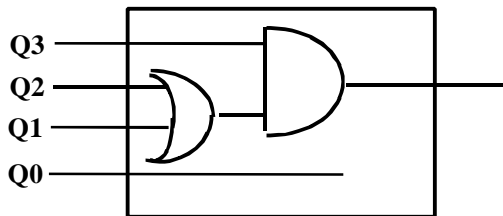
# DOC Course 112: Hardware: Tutorial 7 Solution

## Problem 1.

		Q1,Q0			
		00	01	11	10
Q3,Q2	00	0	0	0	0
	01	0	0	0	0
	11	1	1	1	1
	10	0	0	1	1

$$\text{Bad BCD digit} = Q3 \cdot Q2 + Q3 \cdot Q1$$

$$= Q3 \cdot (Q2 + Q1)$$



INCORRECT  
BCD DIGIT

## Problem 2.

Sum	10	11	12	13	14	15	16	17	18	19
Bin. Sum	1010	1011	1100	1101	1110	1111	0000	0001	0010	0011
Bin. C.Out	0	0	0	0	0	0	1	1	1	1
BCD Sum	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001
BCD C.Out	1	1	1	1	1	1	1	1	1	1

We need to provide a carry for these cases

		Q1,Q0			
		00	01	11	10
Q3,Q2	00	0	0	0	0
	01	0	0	0	0
	11	1	1	1	1
	10	0	0	1	1

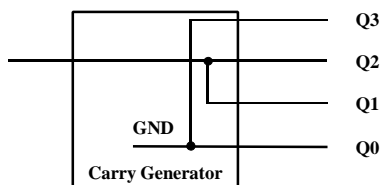
$$\text{BCD Carry} = Q3 \cdot Q2 + Q3 \cdot Q1$$

$$= Q3 \cdot (Q2 + Q1)$$

The Same !!!!!

## Problem 3.

In order to generate the BCD sum from the binary sum when the sum is larger than **1001 (9)** we have to add the binary number **0110 (6)** and this works for all numbers between 10 and 19.



## The final circuit

