

## Digital Electronics

# Combinational Logic Functions

## BCD Adders & Subtractors

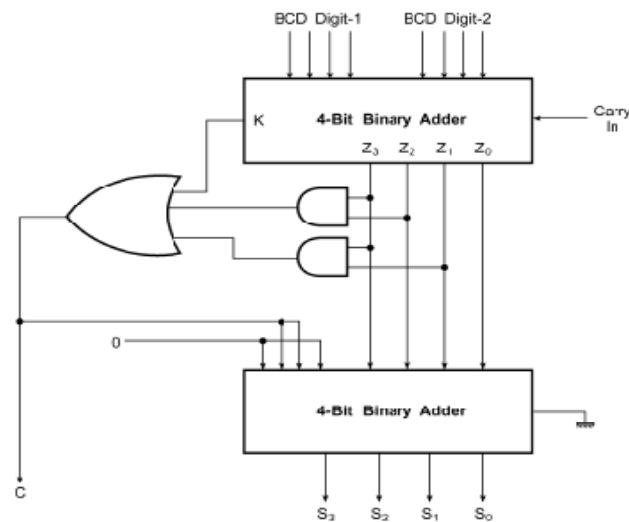
### BCD Adder:

A BCD adder is a combinational circuit that adds two BCD digits in parallel and produces a sum digit which is also in BCD.

Add two 4-bit BCD numbers using straight binary addition. If the four bit sum is equal to or less than 9, the sum is in proper BCD form. If the four bit sum is greater than 9 or if a carry is generated from the sum, the sum is not in BCD form. In this case a correction is required that is obtained by adding the digit 6 (0110) to the sum produced by binary adder.



$$C = K + Z_3Z_2 + Z_3Z_1$$

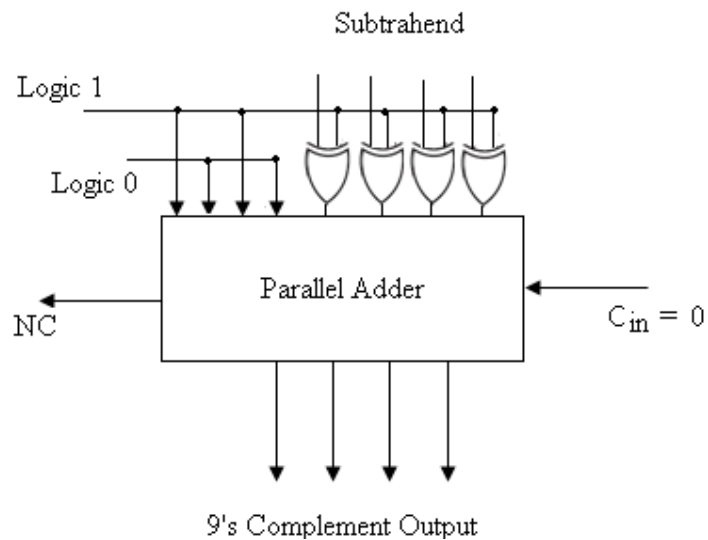


Decimal sum	Binary sum					BCD sum				
	K	Z <sub>3</sub>	Z <sub>2</sub>	Z <sub>1</sub>	Z <sub>0</sub>	C	S <sub>3</sub>	S <sub>2</sub>	S <sub>1</sub>	S <sub>0</sub>
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	1	0	0	0	0	1
2	0	0	0	1	0	0	0	0	1	0
3	0	0	0	1	1	0	0	0	1	1
4	0	0	1	0	0	0	0	1	0	0
5	0	0	1	0	1	0	0	1	0	1
6	0	0	1	1	0	0	0	1	1	0
7	0	0	1	1	1	0	0	1	1	1
8	0	1	0	0	0	0	1	0	0	0
9	0	1	0	0	1	0	1	0	0	1
10	0	1	0	1	0	1	0	0	0	0
11	0	1	0	1	1	1	0	0	0	1
12	0	1	1	0	0	1	0	0	1	0
13	0	1	1	0	1	1	0	0	1	1
14	0	1	1	1	0	1	0	1	0	0
15	0	1	1	1	1	1	0	1	0	1
16	1	0	0	0	0	1	0	1	1	0
17	1	0	0	0	1	1	0	1	1	1
18	1	0	0	1	0	1	1	0	0	0
19	1	0	0	1	1	1	1	0	0	1

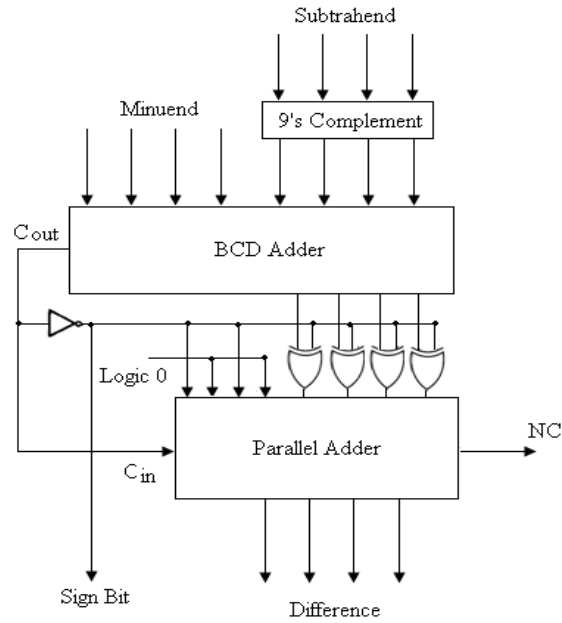
**BCD Subtractor:**

In BCD subtraction, minuend is added with 9's complement of subtrahend. The 9's complement is obtained by using

$$9's\ Complement = 1's\ Complement + 1010$$



When minuend is added with 9's complement of subtrahend, if there is a carry out, it must be added as an end around carry (EAC) and the result is a positive number. If there is no carry, the result is a negative number and hence 9's complement of the result is formed to get the magnitude.



**BCD Adder/Subtractor:**

When  $M = 0$ , the circuit acts as an adder and when  $M = 1$ , the circuit acts as a Subtractor.

