

### Lab 4: Adders/Subtractors

#### Objectives

- To practice on signed binary numbers.
- To perform addition and subtraction by using 4-bit binary adder.

#### Apparatus

7483 4-bit binary adder  
7486 quad 2-input XOR gates

#### PreLab Questions:

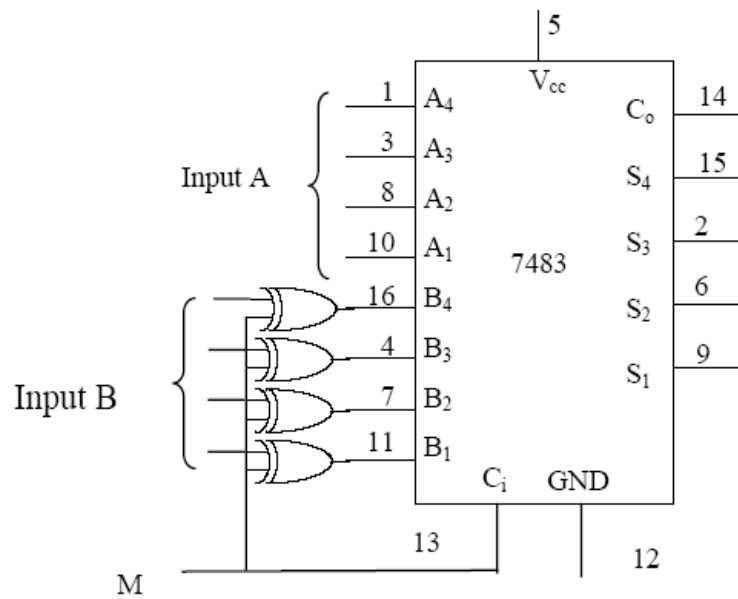
1. Design a half adder circuit and a full adder circuit by using only XOR gates and NAND gates.
2. Fill the table with the 1's and 2's complements of the binary numbers.

	1s complement	2s complement
1011	0100	0101
1111	0000	0001
0101	1010	1011
0000	1111	10000
0011	1100	1101

3. Fill the table with the 8-bit signed representations of the decimal numbers.

Decimal	Signed Magnitude	Signed 1's complement	Signed 2' complement
-4	10000100	01111011	01111100
-12	10001100	01110011	01110100
-8	10001000	01110111	01111000
-16	10010000	01101111	01110000
-1	10000001	01111110	11111111

4. The 4 bit adder/subtractor circuit implemented with IC 7483 is shown in Fig.3. The circuit uses signed 2's complement system for negative numbers. Explain the operation of the circuit with your own words, briefly.

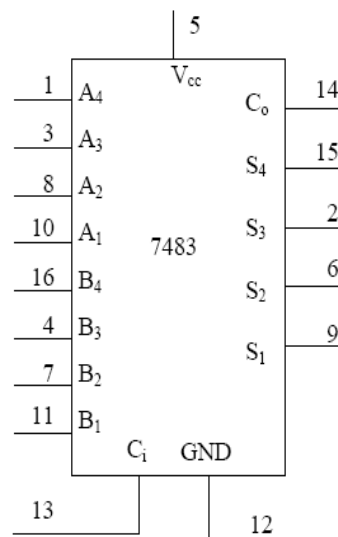


M = 0 for add and M = 1 for subtract

**Fig.3** 4-bit adder/subtractor

#### IC Description:

IC type 7483 is a 4-bit binary adder with fast carry. The pin-out for the 7483 is shown in Fig 5. The two 4-bit input binary numbers are applied to the inputs A(1:4) and (B1:4). The 4-bit sum is obtained from S(1:4). C<sub>i</sub> and C<sub>o</sub> are the carry input and carry output pins.



**Fig. 5** Pin-out for IC 7483

**Procedure**

1. Connect the adder/subtractor circuit given in Fig.4. Apply the following numbers in 4-bit binary to circuit and select the operation with the select (M), and record the sum (S) and carry-out (C0).

Decimal		Sum (S1:4)				Carry Out
A	B	S1	S2	S3	S4	C0
2	+ 5	1	1	1	0 (+7)	0
7	- 4	0	0	1	1 (+3)	0
6	+ 7	1	0	1	1 (+13)	0
-5	+ 4	1	0	0	0 (-1)	1
-6	- -3	0	1	0	1 (-3)	1
3	- 3	1	1	1	0 (-0)	0

- Observe that Co =1 when the sum is bigger than 15.
- In signed 2's complement system, the number ranges for 4-bit between -8 to +7. If the result after addition/subtraction exceeds these limits, it said that the overflow has occurred. Determine in which operations overflow occurs.