Aim: Design and implement 1 digit BCD adder using IC7483

IC's Used:

IC 7404(Hex INV), 7432 (OR-gate), 7408 (AND-gate), 7486 (Ex- gate), 7483 (4-bit Binary Adder)

Theory:

BCD Adder:
BCD adder is a circuit that adds two BCD digits & produces a sum of digits also in BCD.
    Rules for BCD addition:

       1. Add two numbers using rules of Binary addition.

       2. If the 4 bit sum is greater than 9 or if carry is generated then the sum is invalid. To correct the sum add 0110 i.e. $(6)_{10}$ to sum. If carry is generated from this addition add it to next higher order BCD digit.

       3. If the 4 bit sum is less than 9 or equal to 9 then sum is in proper form.

CASE I: Sum <= 9 & carry = 0

    Add BCD digits 3 & 4
         1. 0 0 1 1
         + 0 1 0 0
          ----
          0 1 1 1
    Answer is valid BCD number = (7) BCD & so 0110 is not added.

CASE II: Sum > 9 & carry = 0

    Add BCD digits 6 & 5
         1.   0 1 1 0
            + 0 1 0 1
           ----
           10 1 1
    Invalid BCD (since sum > 9) so 0110 is to be added
         2. 1 0 1 1
         + 0 1 1 0
         ----
         1 0 0 0 1
         (1 1)BCD
    Valid BCD result = (11) BCD

CASE III: Sum < = 9 & carry = 1
Add BCD digits 9 & 9

  1. 1 0 0 1
  + 1 0 0 1
  ----
  1 0 0 1 0

Invalid BCD (since Carry = 1) so 0110 is to be added

  2. 1 0 0 1 0
  + 0 1 1 0
  ----
  1 1 0 0 0
  (1 8)BCD

Valid BCD result = **(18) BCD**

DESIGN:
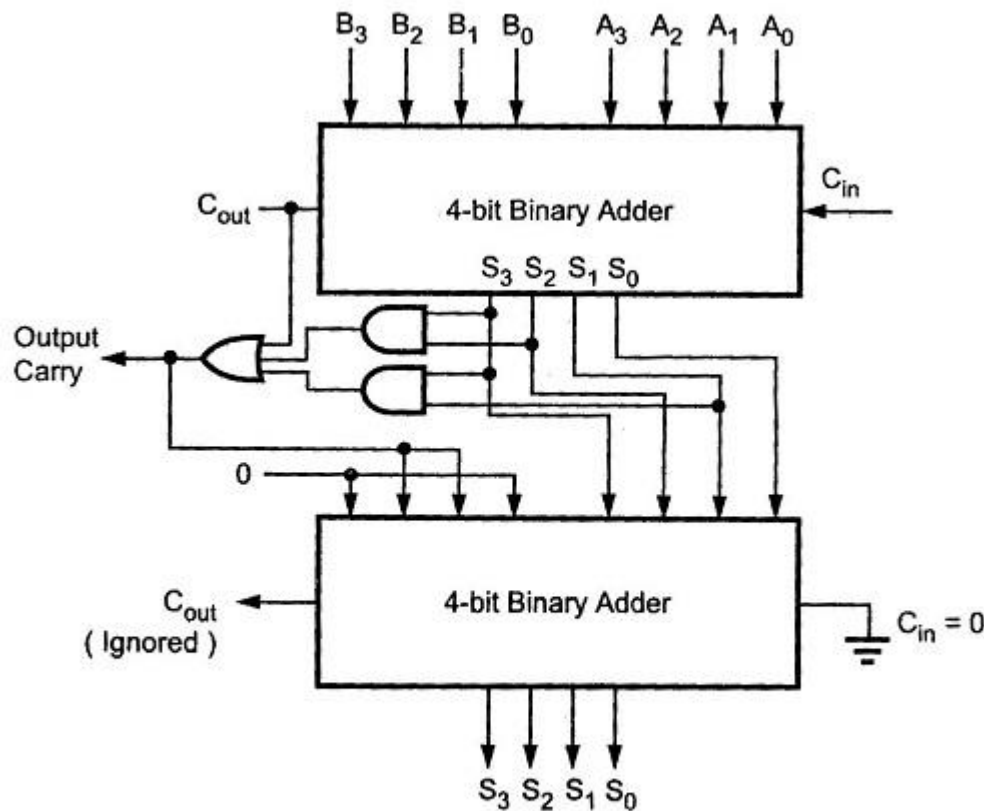 i) Truth Table for design of combinational circuit for BCD adder to check invalid BCD:

BCD Code				Output (Valid Sum)
S_3	S_2	S_1	S_0	Y
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

 ii) Find expression for invalid BCD number. Y =

$$Y = S_3S_2 + S_3S_1$$

iii) Circuit diagram for BCD adder:

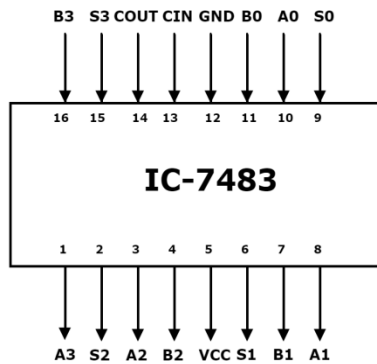**Fig. 3.32 Block diagram of BCD adder**

iv)   Hardware Requirements:

GATE	Quantity	IC	Quantity
Binary adder	2	7483	2
AND	2	7408	1
OR	2	7432	1

CONCLUSION:

Thus, students were studied the addition of BCD numbers. If the sum of two numbers is less than or equal to 9, then the value of BCD sum and binary sum will be same otherwise they will differ by 6(0110 in binary).

FAQ's:
1) Draw IC 7483 Pin Diagram.

B3 S3 COUT CIN GND B0 A0 S0

| 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 |

IC-7483

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

A3 S2 A2 B2 VCC S1 B1 A1

2) Mention the Excess-3 addition Rules.

According to excess-3 code we need to add 3 to both digit in the decimal number then convert into 4-bit binary number for result of each digit

3) Add 3 & 5, 8 &9, 6 & 7 by BCD addition.

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  0011                    1000              0110
+0101                   + 1001            + 0111
─────────              ──────────        ──────────
  1000                   10001              1101
                       +    110           + 1 10
                       ──────────        ──────────
                         10111              10011
```