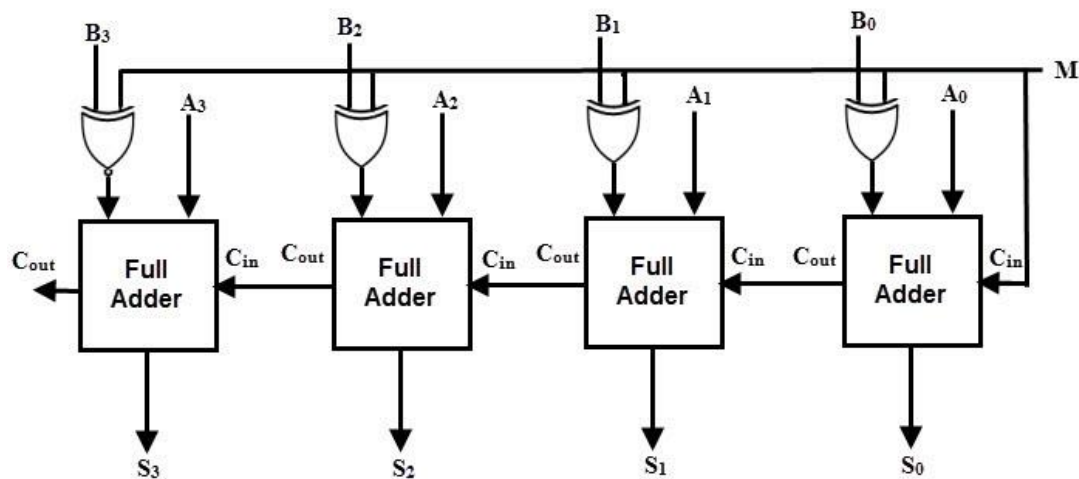# DAY-15

#100DAYSOFRTL

Aim:- Implementation of Binary Adder/Subtractor Circuit with control input.

Block Diagram:-

RTL CODE:-

```verilog
////DATE:-15/01/2024
////4-BIT BINARY ADDER AND SUBTRACTOR WITH CONTROL INPUT
module FUAdder(input A,B,Cin,
output Sum,Cout);
assign Sum=A^B^Cin;
assign Cout=A&B|B&Cin|Cin&A;
endmodule

module Adder_Subtractor(input [3:0]A,B,
input Cin, output [3:0] Sum,
output Cout );
wire [2:0]C;
wire [3:0] W;
xor g1(W[0],B[0],Cin);///Cin=0=ADDER
xor g2(W[1],B[1],Cin);///Cin=1=Subtractor
xor g3(W[2],B[2],Cin);////Exceeds 15  Subtraction takes 2's complement
xor g4(W[3],B[3],Cin);
FUAdder F1(.A(A[0]),.B(W[0]),.Cin(Cin),.Sum(Sum[0]),.Cout(C[0]));
FUAdder F2(.A(A[1]),.B(W[1]),.Cin(C[0]),.Sum(Sum[1]),.Cout(C[1]));
FUAdder F3(.A(A[2]),.B(W[2]),.Cin(C[1]),.Sum(Sum[2]),.Cout(C[2]));
FUAdder F4(.A(A[3]),.B(W[3]),.Cin(C[2]),.Sum(Sum[3]),.Cout(Cout));
endmodule
```
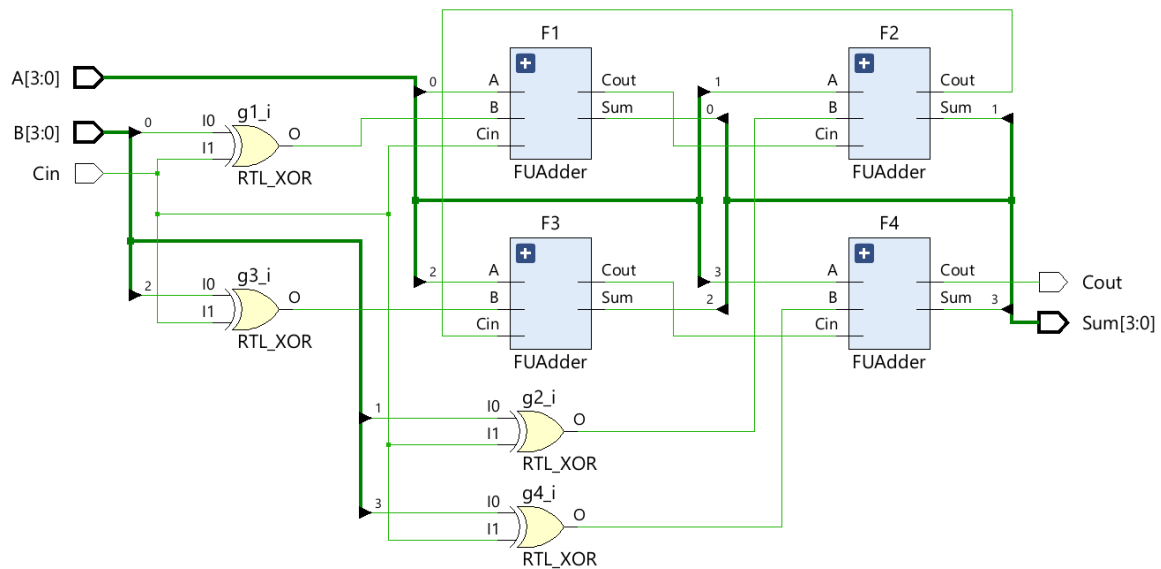
TESTBENCH:-

```verilog
module Adder_Subtractor_tb();
reg [3:0] A,B;
reg Cin;
wire [3:0] Sum;
wire Cout;
Adder_Subtractor uut(A,B,Cin,Sum,Cout);
initial begin
for(integer i=0;i<10;i=i+1) begin
A=$random();
B=$random();
Cin=$random();
#10;
$display("A=%d,B=%d,Cin=%d,Sum=%d,Cout=%d",A,B,Cin,Sum,Cout);
#10;
end
end
initial begin
#300;
$finish();
end
endmodule
```

OUTPUT:-

```
A= 4,B= 1,Cin=1,Sum= 3,Cout=1
A= 3,B=13,Cin=1,Sum= 6,Cout=0
A= 5,B= 2,Cin=1,Sum= 3,Cout=1
A=13,B= 6,Cin=1,Sum= 7,Cout=1
A=13,B=12,Cin=1,Sum= 1,Cout=1
A= 6,B= 5,Cin=0,Sum=11,Cout=0
A= 5,B= 7,Cin=0,Sum=12,Cout=0
A=15,B= 2,Cin=0,Sum= 1,Cout=1
A= 8,B= 5,Cin=0,Sum=13,Cout=0
A=13,B=13,Cin=1,Sum= 0,Cout=1
```

SCHEMATIC:-

A[3:0]
B[3:0]
Cin

g1_i I0 I1 O RTL_XOR
g3_i I0 I1 O RTL_XOR
g2_i I0 I1 O RTL_XOR
g4_i I0 I1 O RTL_XOR

F1 A B Cin Cout Sum FUAdder
F2 A B Cin Cout Sum FUAdder
F3 A B Cin Cout Sum FUAdder
F4 A B Cin Cout Sum FUAdder

Cout
Sum[3:0]

WAVEFORMS:-

Name	Value	0.000 ns			50.000 ns			100.000 ns			150.000 ns		200.000 ns	250.000 ns
A[3:0]	1101	0100	0011	0101	1101		0110	0101	1111	1000		1101		
B[3:0]	1101	0001	1101	0010	0110	1100	0101	0111	0010	0101		1101		
Cin	1													
Su...0	0000	0011	0110	0011	0111	0001	1011	1100	0001	1101		0000		
Cout	1													