

#50DAYS CHALLENGE

DAY 3

FULL ADDER

a)Design Code

Data Flow Modelling

```
module full_adder(input a,b,cin,output sum,carry);  
    assign sum=a^b^cin;  
    assign carry=(a&b) | (b&cin) | (a&cin);  
endmodule
```

Behavioral Modelling

```
module full_adder(a,b,cin,sum,carry);  
    input a,b,cin;  
    output reg sum,carry;  
    always@(*)  
    begin  
        {carry,sum}=a+b+cin;  
    end  
endmodule
```

Gate Level Modelling

```
module full_adder(input a,b,cin,output sum,carry);  
    wire w1,w2,w3;  
    xor x1(w1,a,b);  
    xor x2(sum,w1,cin);  
    and a1(w2,a,b);  
    and a2(w3,w1,cin);  
    or o1(carry,w2,w3);  
endmodule
```

b) Testbench

```

module full_adder_tb();
  reg a,b,cin;
  wire sum,carry;
  integer i;

  full_adder dut(.a(a),.b(b),.cin(cin),.sum(sum),.carry(carry));
  initial
  begin
    for(i=0;i<8;i=i+1)
    begin
      {a,b,cin}=i;
      #10;
      $display("Time:%t | a=%b b=%b cin=%b |sum=%b |carry=%b |", $time,a,b,cin,sum,carry);
    end
    $finish();
  end
endmodule

```

c) Waveform



d) Console Output

```

# Time: 10 | a=0 b=0 cin=0 |sum=0 |carry=0 |
# Time: 20 | a=0 b=0 cin=1 |sum=1 |carry=0 |
# Time: 30 | a=0 b=1 cin=0 |sum=1 |carry=0 |
# Time: 40 | a=0 b=1 cin=1 |sum=0 |carry=1 |
# Time: 50 | a=1 b=0 cin=0 |sum=1 |carry=0 |
# Time: 60 | a=1 b=0 cin=1 |sum=0 |carry=1 |
# Time: 70 | a=1 b=1 cin=0 |sum=0 |carry=1 |
# Time: 80 | a=1 b=1 cin=1 |sum=1 |carry=1 |

```

FULL ADDER USING HALF ADDER

a)Design Code

```
module half_adder(input a,b,output sum,carry);
    assign sum=a^b;
    assign carry=a&b;
endmodule

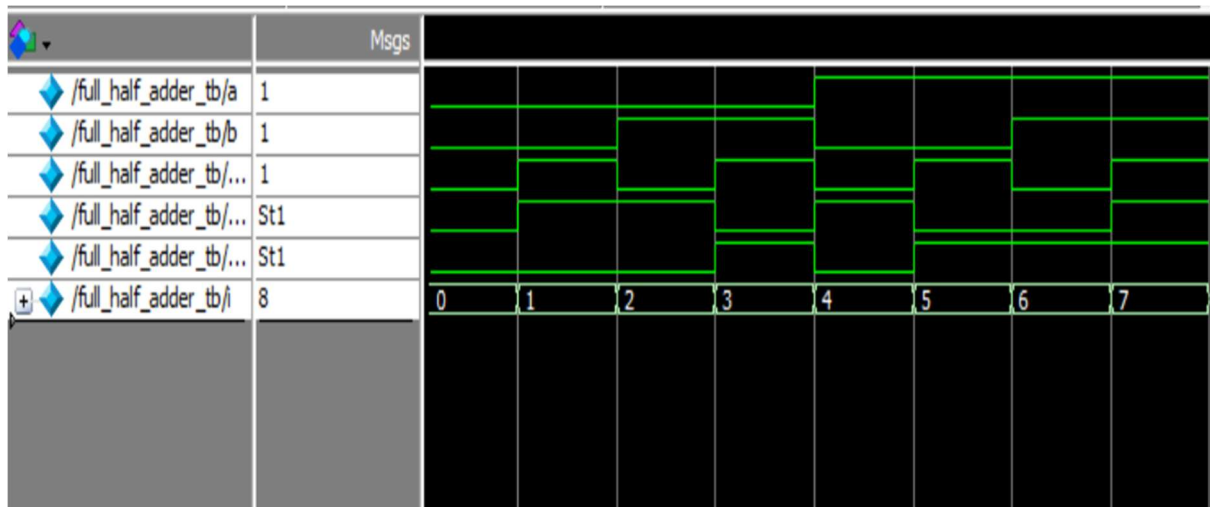
module full_half_adder(input a,b,cin,output sum,carry);
    wire w1,w2,w3;
    half_adder h1(a,b,w1,w3);
    half_adder h2(cin,w1,sum,w2);
    assign carry= w3|w2;
endmodule
```

b)Testbench

```
module full_half_adder_tb();
    reg a,b,cin;
    wire sum,carry;
    integer i;

    full_half_adder dut(.a(a),.b(b),.cin(cin),.sum(sum),.carry(carry));
    initial
    begin
        for(i=0;i<8;i=i+1)
        begin
            {a,b,cin}=i;
            #10;
            $display("Time:%t | a=%b b=%b cin=%b |sum=%b |carry=%b |",$time,a,b,cin,sum,carry);
        end
        $finish();
    end
endmodule
```

c)Waveform



d)Console Output

```

# Time: 10 | a=0 b=0 cin=0 |sum=0 |carry=0 |
# Time: 20 | a=0 b=0 cin=1 |sum=1 |carry=0 |
# Time: 30 | a=0 b=1 cin=0 |sum=1 |carry=0 |
# Time: 40 | a=0 b=1 cin=1 |sum=0 |carry=1 |
# Time: 50 | a=1 b=0 cin=0 |sum=1 |carry=0 |
# Time: 60 | a=1 b=0 cin=1 |sum=0 |carry=1 |
# Time: 70 | a=1 b=1 cin=0 |sum=0 |carry=1 |
# Time: 80 | a=1 b=1 cin=1 |sum=1 |carry=1 |

```