19th Day

Factorial of Given Number

Design

```
module factorial(
   input clk,
   input rst,
   input start,
   input [2:0] number,
   output reg [15:0] result,
   output reg done
);

   reg [2:0] n;
   reg busy;

   always @( posedge clk)
   begin
      if (rst)
      begin
         result <= 1;
         n <= 0;
         done <= 0;
         busy <= 0;
      end

      else
      begin
```

```
        if (start && !busy)
        begin
           result <= 1;
           n <= number;
           done <= 0;
           busy <= 1;
        end

       else if (busy)
        begin
           if (n > 1)
            begin
              result <= result * n;
              n <= n - 1;
            end

            else
            begin
              busy <= 0;
              done <= 1;
            end

      end
    end
  end

endmodule
```

Testbench

```
module fact_n_tb;
    reg clk, rst, start;
    reg [2:0] number;
    wire [15:0] result;
    wire done;

    factorial dut (
        .clk(clk),
        .rst(rst),
        .start(start),
        .number(number),
        .result(result),
        .done(done)
    );

    always #5 clk=~clk;

    initial begin
        clk=0;
        rst = 1;
        start = 0;
        number = 0;
        #20 rst = 0;

        number = 4'd6;  // Factorial of 6 = 720
        #10
        start = 1;
        #10
        start = 0;
```

```
        wait(done);
        #10
         $display("Factorial = %0d", result);
        #10
        $finish;
    end
endmodule
```

Simulation

```
#    }
# }
# run 1000ns
Factorial = 720
$finish called at time : 115 ns : File "C:/Users/manojmsd/100_days_of_RTL_2/100_days_of_RTL_2.srcs/sources_1/new,
INFO: [USF-XSim-96] XSim completed. Design snapshot 'fact_n_tb_behav' loaded.
INFO: [USF-XSim-97] XSim simulation ran for 1000ns
launch_simulation: Time (s): cpu = 00:00:02 ; elapsed = 00:00:12 . Memory (MB): peak = 1572.547 ; gain = 0.000
```