RAJ KAUSHAL YADAV

REAL TIME CLOCK

RTL CODE

//DESIGN CODE

```
module rtc (
   input wire clk,                          // 1Hz clock input
   input wire reset,                        // synchronous reset
   output reg [5:0] seconds,                // 0-59
   output reg [5:0] minutes,                // 0-59
   output reg [4:0] hours                   // 0-23
);
always @(posedge clk) begin
   if (reset) begin

 // Reset all time values to 00:00:00
      seconds <= 0;
      minutes <= 0;
      hours   <= 0;
   end
   else begin

 // Increment seconds
      if (seconds == 6'd59) begin
         seconds <= 0;
```

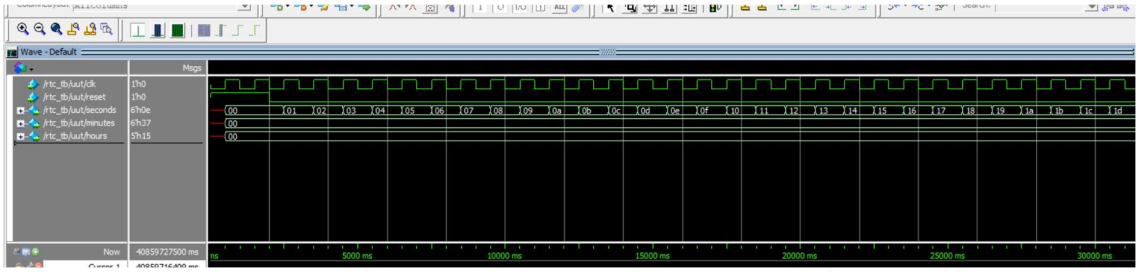
```
// Increment minutes
        if (minutes == 6'd59) begin
           minutes <= 0;


 // Increment hours
           if (hours == 5'd23)
              hours <= 0;
           else
              hours <= hours + 1;
        end
        else
           minutes <= minutes + 1;
     end
     else
        seconds <= seconds + 1;
  end
end


endmodule
```

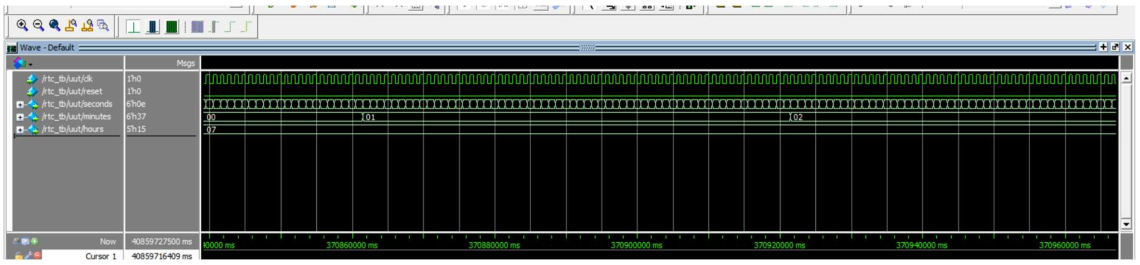
//testbench

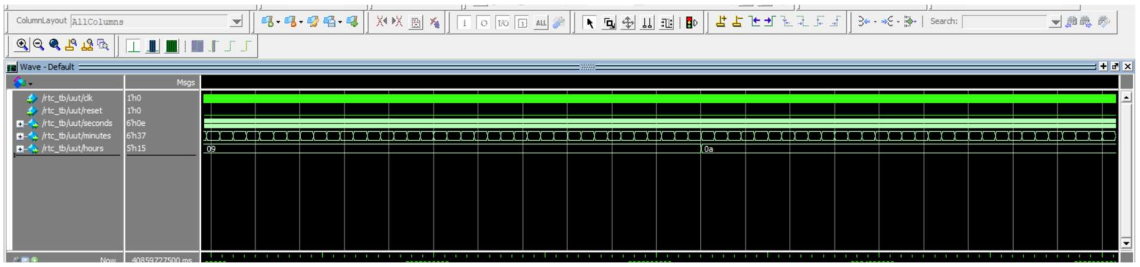
```
`timescale 1s / 1ms                    // 1s simulation time unit
module rtc_tb;
// Inputs
 reg clk;
 reg reset;

// Outputs
 wire [5:0] seconds;
 wire [5:0] minutes;
 wire [4:0] hours;

// Instantiate the RTC module
 rtc uut (
  .clk(clk),
  .reset(reset),
  .seconds(seconds),
  .minutes(minutes),
  .hours(hours)
 );

// Clock generation: 1Hz clock (toggle every 0.5s)
 initial begin
  clk = 0;
  forever #0.5 clk = ~clk;
 end
```

```
// Stimulus
 initial begin
  $display("Time\t\tHours:Minutes:Seconds");

// Apply reset
  reset = 1;
  #2;
  reset = 0;

// Simulate for 100 seconds
  repeat (100) begin
   @(posedge clk);
   $display("%t\t%0d:%0d:%0d", $time, hours, minutes, seconds);
  end

  $finish;
 end

endmodule
```

WAVEFORM


Wave - Default
Msgs
/rtc_tb/uut/clk
/rtc_tb/uut/reset
/rtc_tb/uut/seconds
/rtc_tb/uut/minutes
/rtc_tb/uut/hours
1'h0
1'h0
6'h0e
6'h37
5'h15
Now
40859727500 ms
5000 ms
10000 ms
15000 ms
20000 ms
25000 ms
30000 ms


Wave - Default
Msgs
/rtc_tb/uut/clk
/rtc_tb/uut/reset
/rtc_tb/uut/seconds
/rtc_tb/uut/minutes
/rtc_tb/uut/hours
1'h0
1'h0
6'h0e
6'h37
5'h15
Now
40859727500 ms
Cursor 1
40859716409 ms
370860000 ms
370880000 ms
370900000 ms
370920000 ms
370940000 ms
370960000 ms


ColumnLayout
AllColumns
Search:
Wave - Default
Msgs
/rtc_tb/uut/clk
/rtc_tb/uut/reset
/rtc_tb/uut/seconds
/rtc_tb/uut/minutes
/rtc_tb/uut/hours
1'h0
1'h0
6'h0e
6'h37
5'h15