

Department of Computer Science & Engineering
CSL316: Digital System Design
II Semester, 2007-2008
3rd May 2008, Major

Time: 150 minutes

Marks: 60

Name:

Group/Cycle:

Entry No.:

1. The examination is open book and open notes and thus you are permitted to use any material you are carrying to the examination hall. No sharing of material is permitted.
2. Instructor would recommend strictest possible punishment (read expulsion from the Institute) in case you are caught cheating in any form.
3. Questions 1 through 6 are related to one design described at the end and questions 7 and 8 are related.

1	5	
2	10	
3	8	
4	12	
5	5	
6	5	
7	7	
8	8	
Total	60	

1. Write the entity declaration in VHDL of the CC

(5)

2. The electronic part of the Motion Detector module is designed as an asynchronous circuit. It gets two inputs from the photo sensors (p1 and p2) and produces two outputs (lr and rl). These photo-sensors are fitted close to each other and lr or rl pulse width corresponds to the period when both inputs p1 and p2 are one. The order in which p1 and p2 becomes one determines lr or rl should produce a pulse output. If p1 becomes 1 first and then p2 becomes 1 then a pulse is produced at lr.

(10)

3. The light sensor is based on an optical device whose output is converted to a 8-bit digital output using a A to D Converter or ADC. To make the output stable (and not oscillate), "hysterisis" effect is used. When it is switching from dark to bright, it uses a higher threshold ("HTH") and when it is switching from bright to dark, a lower threshold ("LTH") is used. Write a VHDL description (entity as well as architecture) of the LS with one 8-bit input (lt-val) and one 1-bit output (lg).

(8)

4. The CC produces the REL-ON and REL-OFF outputs for controlling the street lights as per conditions described in the problem overview. To avoid "false switchings" due to temporary light blockages of the LS, the LS output is sampled three times (once every minute) and only when three consecutive samples show a consistent changed output (from dark to bright or bright to dark), then it is accepted for change. For deciding on day or night state, use the broad range of sunset and sunrise timings in Delhi in conjunction with LS and RTC outputs respectively indicating bright/dark along with time. Draw a state diagram indicating the controller. All inputs and outputs of the controller must be clearly indicated. Note controller though synchronous internally (10 MHz clock) but is asynchronous to all the other devices including RTC.

(12)

5. Draw the data path of CC corresponding to the above controller.

(5)

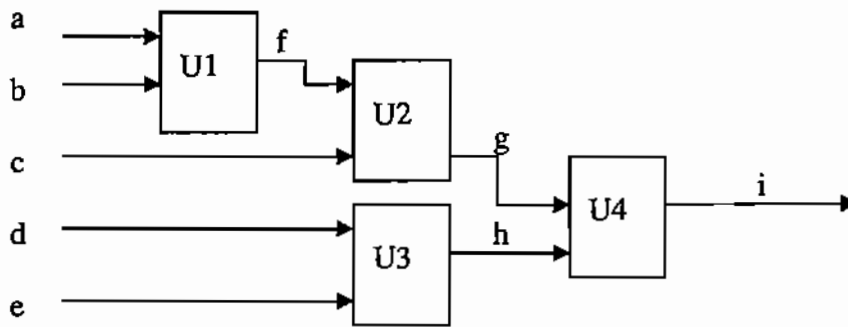
6. All the five modules are independently manufactured. In fact assume you have only designed and manufactured CC and the rest are procured off-the-shelf modules. What type of test module would you need to test the CC module after fabrication? (5)

7. Consider a new gate named U gate with two inputs (x and y) and one output (z). z is one only when x is 1 and y is 0. Derive its SC, PDCF and PDC for testing.

(7)

8. The following circuit consists of only "U" gates. Use D algorithm to generate tests for g s-a-0. Note in this gate the two inputs are not symmetric and thus always take the input on top as corresponding to x and one below as corresponding to y.

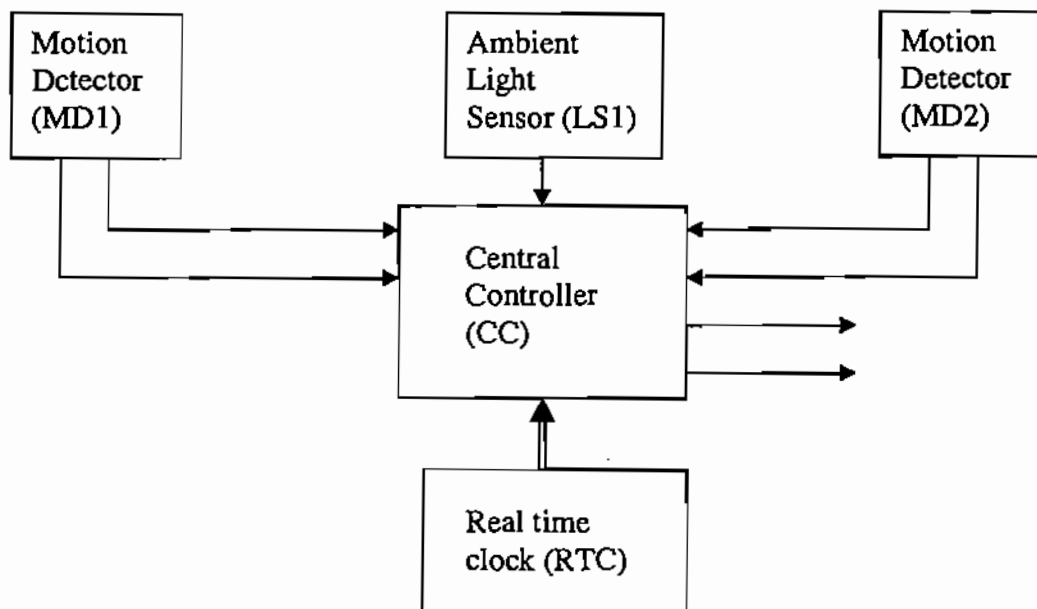
(8)



To save on electricity a new controller is to be designed to switch on and off the street lights on a long straight corridor. After considerable analysis of the traffic on the road, it has been decided to switch on the lights only under the following three conditions

1. From the time it becomes dark to 11:00 PM
2. From 11:00 PM to the dawn whenever a vehicle is in the corridor
3. Whenever it becomes dark during the day time due to weather conditions like dark clouds, heavy rain, dust storms, solar eclipse etc.

Overall block diagram of the system is shown below. It consists of five units; two motion sensors fitted at the two ends of the corridor, one ambient light sensor, one real-time clock unit and the central controller.



Motion Detector (MD): Each MD produces two pulsed outputs indicating vehicle direction being left to right (lr) or right to left (rl) in the corridor. Whether it is entry or exit depends on which side of the corridor the sensor is fitted.

Ambient Light Sensor (LS): Ambient light sensor produces a one-bit output (lg) indicating whether it is bright (lg = 1) or dark (lg = 0)

Real Time Clock (RTC): RTC is an independent clock module and produces a 19-bit output. There are four 4-bit BCD outputs corresponding to the four digits of time HH:MM. It also produces three one-bit outputs which are 10 msec pulses at every second (ps), every minute (pm) and every hour (ph) respectively.

Central Controller (CC): CC accepts inputs from all four devices (a total of 24 bits). In case of motion detectors, it takes two pairs of inputs with each input being 2-bit wide corresponding to entry (en) and exit (ex) inputs. (Note: Which side of the corridor the sensor is fitted should be taken care of during wiring of the modules). CC produces two one-bit one second pulse outputs named REL-ON and REL-OFF. These control the relays which in turn control the power to the lights.