



# COMSATS Institute of Information Technology Lahore

## Terminal- Fall 2016

|                    |                                   |        |                |                       |                 |        |
|--------------------|-----------------------------------|--------|----------------|-----------------------|-----------------|--------|
| Course Title:      | Digital Logic and Design          |        | Course Code:   | ELE 241               | Section/Module: | 4(J.1) |
| Course Instructor: | Amna Arif, Ramsha Bukhari         |        | Program Name:  | BS (CS, EE)           |                 |        |
| Semester:          | 2 <sup>nd</sup> / 3 <sup>rd</sup> | Batch: | Section:       | Date:                 |                 |        |
| Time Allowed:      | 180 Minutes                       |        | Maximum Marks: | 100                   |                 |        |
| Student Name:      | <del>XXXXXXXXXX</del>             |        | Reg. No.:      | <del>XXXXXXXXXX</del> |                 |        |

### Important Instructions / Guidelines:

- All answers must be given on the answer books.
- The exam is closed book, closed notes.
- Mobile phones are not allowed in the examination room.
- There will be no negative marking.
- Sharing of Calculator is not allowed. (Use your own calculator).
- No table or formula sheet will be provided.

### Question No. 1:

[20 = 3+3+4+10] Marks

- a) The control logic for a simple alarm system in a house has three inputs and a single output, which activates an alarm. The three inputs are windows sensor, doors sensor and master key.

The sensors operate as follows:

- |                   |                                                           |
|-------------------|-----------------------------------------------------------|
| window sensor (W) | 0 = all windows closed<br>1 = a window is open            |
| door sensor (D)   | 0 = all doors closed<br>1 = a door is opened              |
| master key (K)    | 0 = alarm system is disarmed<br>1 = alarm system is armed |

If the alarm system is disarmed then the logic signals from the sensors are ignored and the alarm will not sound. The alarm is activated by a logic 1 from the output of the control logic.

Design the circuit to meet the requirements of this control logic. Your design should include the following:

- truth table
- Boolean logic expression
- logic diagram

- b) Design a circuit that takes a four-bit input  $A = a_3 a_2 a_1 a_0$  which checks if  $A$  is a prime number. Use a 16-to-1 MUX in your design. Recall that a number  $A$  is prime if the only numbers that divide it with no remainder are 1 and  $A$  itself. (0 and 1 are defined as not prime).

### Question No. 2:

[20=10+10] Marks

- a) Implement the following function using 4\*1 MUX.

$$F(a, b, c, d) = ab + bc'd + abc$$

- b) Simplify the function  $F$  using Boolean algebra only.

TRAID C

[20+5+10+5] Marks

Question No.



- Derive the next-state equations and the output equation of the circuit.
- Show the state table.
- Show the state diagram for the machine.

[20 = 8+12] Marks

- a) Draw the state diagram for a synchronous sequential circuit to detect a start of a message sequence of 111 an 1101. It outputs a 1 when the sequence 111 or 1101 is detected.
- b) Design the sequential circuit specified by the following state diagram, you can use any type of flip flop.

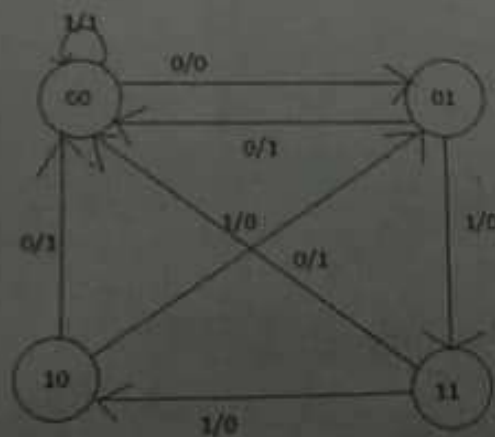


Figure 2

4/11/11

Question No. 5:

[20 = 2 + 12 + 6] Marks

Design a counter that counts in the following pattern while handling unused states and repeat

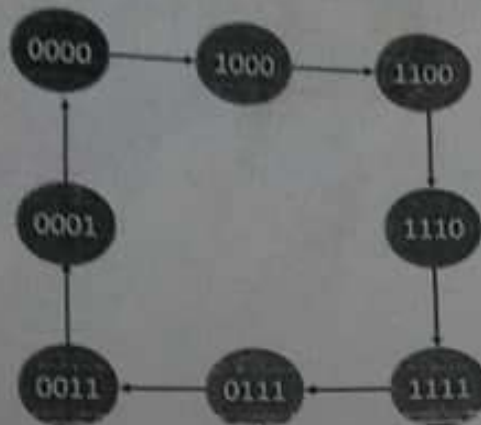


Figure 3

- Determine the number of flip flops required for implementation.
- Determine the associated state transition table.
- Implement the corresponding circuit using only T flip flops.

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