National University of Computer and Emerging Sciences

Lahore Campus

Theory of Automata (CS3005)

Sessional-I Exam

Date: September 21st 2024, [Saturday]

Course Instructor(s)

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Mr. Hamad ul Qudous, Mr. Fraz Yousaf

Total Time (Hrs.): 1

Total Marks: 20

Total Questions: 2

Roll No _____ Section _____ Student Signature _____

Do not write below this line

1. Attempt all the questions.
2. Rough sheets are allowed but you are required to write solution in the provided space.

CLO 2	CLO 2	
Question 1 (10)	Question 2 (10)	Total Marks (20)
10	6	16

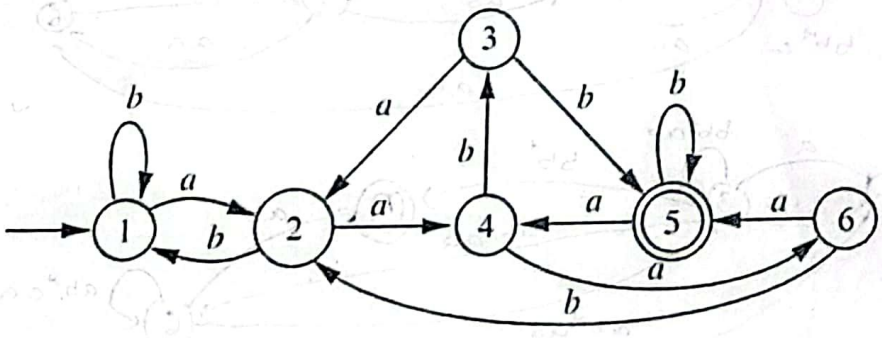
CLO #: 2 Differentiate and manipulate formal description of Languages, automata and grammars with focus on non-regular and regular automata (DFA, NFA, NFA-null)

Q1: Use the *State Elimination Method* to delete the following states only (in the order given below).

First delete State 1, then 4, and lastly 5. [10 Marks]

Add dummy states where required.

Note: you don't need to delete all states.



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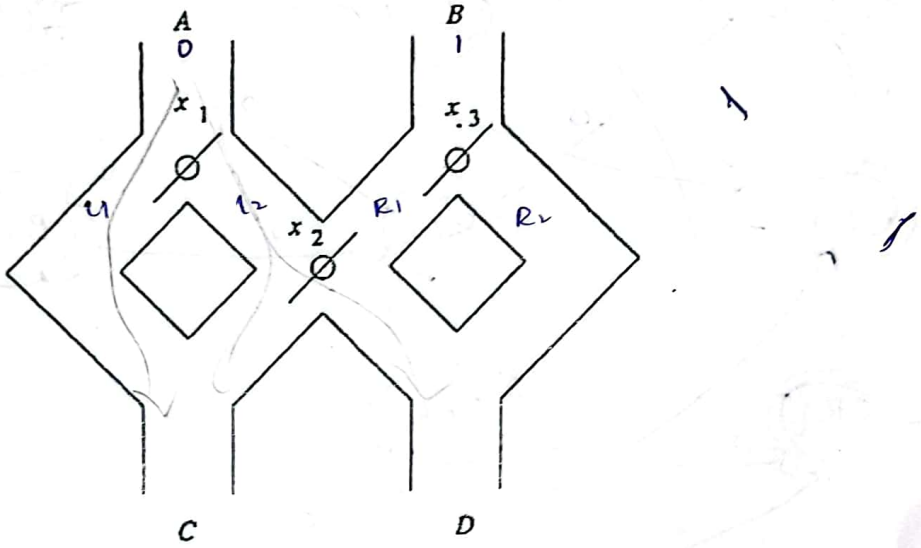
CLO #: 2 Differentiate and manipulate formal description of Languages, automata and grammars with focus on non-regular and regular automata (DFA, NFA, NFA-null)

Q2: Construct a ***Deterministic Finite Automata*** for the game given below. [10 Marks]

A Marble-rolling toy. A marble $\{0, 1\}$ is dropped at *A or B*. Levers $x1, x2, x3$ cause the marble to fall either to the left or to the right. Whenever a marble encounters a lever $(x1, x2, x3)$, it causes the lever to reverse after the marble passes, so the next marble will take the opposite branch.



A marble-rolling toy

A Deterministic Finite Automaton (DFA), with the inputs "A" and "B" passage corresponding to *0 and* 1, can be used to model the toy. When the input is 0, the marble always takes the "A" path; when the input is 1, it always takes the "B" path. In the DFA, acceptance is denoted by the marble leaving at "D," and non-acceptance is indicated by the marble leaving at "C." Moreover, a marble will move toward the left direction if it strikes the lever's left side, and the lever's directions will then reverse. This guarantees that the input sequence of 0s and 1s determines the marble's path in its entirety.

Machine Level Details:

The set of alphabet will be {0, 1}. The two directions of a lever are Left (L) and Right (R). In the initial configuration, x1, x2, and x3 will all have values of Left (L), or 'LLL' setup. For your assistance, here are a few cases of acceptance and rejection.

$L_{Accepted} = \{11, 111, 001, 0011, 0000 \ldots \ldots .\}$

$L_{Rejected} = \{\wedge, 0, 1, 00, 01, 10, \ldots\}$

Dry Run:

This is the language's first word, "11," using the initial configuration "LLL." The levers x2 and x3 will be flipped from L to R when the first character (1) passes through B path, creating a "LRR" configuration and that marble (1) will exit through C path. After the second character (1) passes through B path, the lever will be reversed x3 back to L from R, producing the resultant configuration "LRL." This time, the second character (1) exits through D passage after passing through x3 lever's right (R) direction. Thus, this word will be recognized / accepted as a result.