Roll No									

NATIONAL INSTITUTE OF TECHNOLOGY GOA

Department of Computer Science and Engineering

B.Tech V Semester-Mid Examination

Course Name: **Theory of Computation** Course Code: **CS303**

Date: **October 07, 2021** Time: **2 PM**

Duration: **90 Minutes** Max. Marks: **50**

Note:

- Be legible. Keep the rough work separate from the space you write the answer.
- The notations used should be consistent as mentioned in the class.
- Unnecessary details attracts penalty.
- The question paper is of *three* pages.
- Attach rough work at the end of the answer script.

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1. Let $\Sigma = \{a, b\}$. Prove that there is no string x in Σ^* such that $ax = xb$. **(3)**

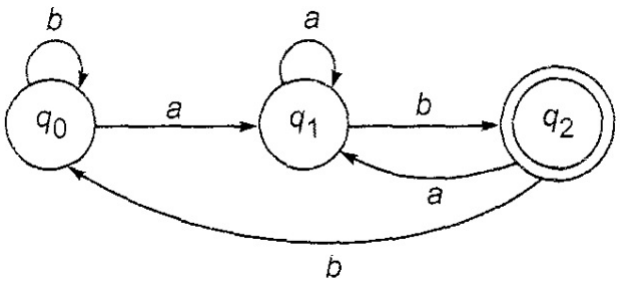
2. Let $\Sigma = \{a, b\}$. Prove that "If x in Σ^* satisfies the relation $abw = wab$, then $|w|$ is even". **(3)**

3. Construct a non-deterministic finite automaton accepting $\{ab, ba\}$, and use it to find a deterministic automaton accepting the same language. Note that $\Sigma = \{a, b\}$. **(3)**

4. Prove that, "If $\delta^*(q, x) = \delta^*(q, y)$, then $\delta^*(q, xz) = \delta^*(q, yz)$ for all strings $z \in \Sigma^+$". δ is a transition function of any DFA. **(3)**

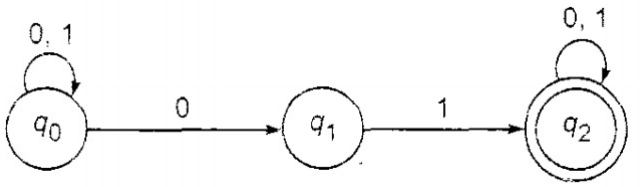
5. Design a DFA accepting all strings w over $\{0, 1\}$ such that the number of $1's$ in the string w is 3 mod 4.**(4)**

6. Consider the following DFA A. Describe $L(A)$ of A. **(3)**



7. Prove the statement, "*If* $D = (Q_D, \Sigma, \delta_D, \{q_0\}, F_D)$ *is the DFA constructed from NFA* $N = (Q_N, \Sigma, \delta_N, q_0, F_N)$ *by the subset construction, then* $L(D) = L(N)$." **(5)**

8. Consider the following Automata A. State whether the following statements are true or false with justification. **(0.5+0.5+0.5+0.5+0.5+0.5+0.5+0.5+1+1)**



a) A is a Non-deterministic Finite Automata

b) $\delta(q_1, 1)$ is defined.

c) 0100111 is accepted by A.

d) 010101010 is not accepted by A.

e) $\delta^*(q_0, 01001) = \{q_1\}$.

f) $\delta^*(q_0, 011000) = \{q_0, q_1, q_2\}$.

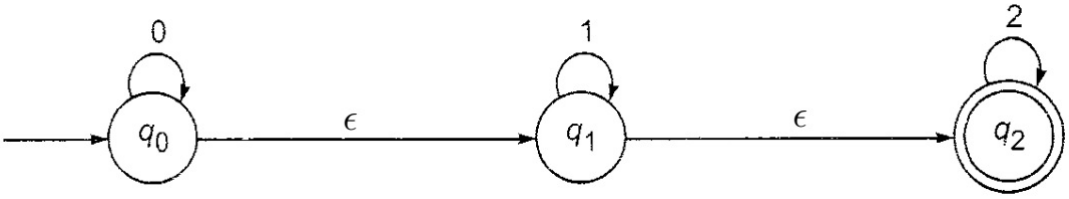
g) $\delta^*(q_1, 11001) \neq \phi$.

h) $\delta^*(q_2, w) = \{q_2\}$ for any string $w \in \{0, 1\}^*$.

i) $L(A) = \{w | w = x00y$, where $x, y \in \{0, 1\}^*\}$.

j) A string having an even number of $0's$ is accepted by A.

9. Obtain the Finite Automata without $\epsilon-$ moves equivalent to the following $\epsilon - NFA$. **(4)**



10. Design a DFA to recognize the following languages.

a) Given $\Sigma = \{0, 1\}$, design the DFA that recognizes the empty language.**(2)**

b) $L = \{w | w$ does not contain more than one $0\}$. **(3)**

11. Let $\Sigma = \{0, 1\}$. Consider the following language.

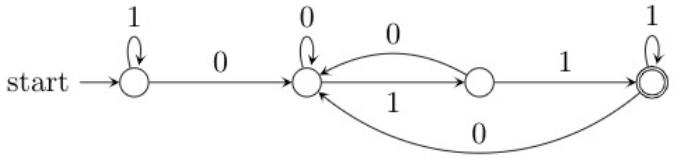
$$L = \{w | w \text{ begins and ends with the same symbol with total length at least } 2\}.$$

a) Construct the DFA to recognize L.**(3)**

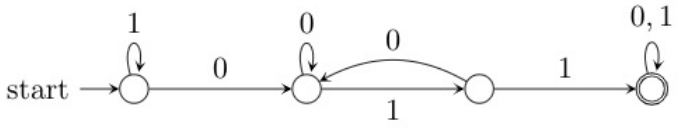
b) Construct NFA that makes the most use of non-determinism to recognize L. **(3)**

12. Consider the language $L = \{w \in \{0,1\}^* | w$ ends with the substring $011\}$. Which one of the following deterministic finite automata accepts L? You have to provide justification for not choosing any options as correct answer. **(2)**

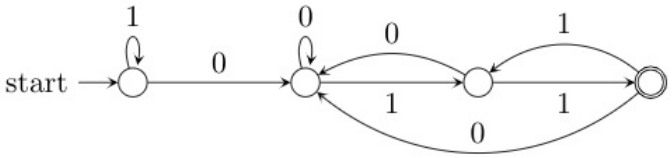
A:



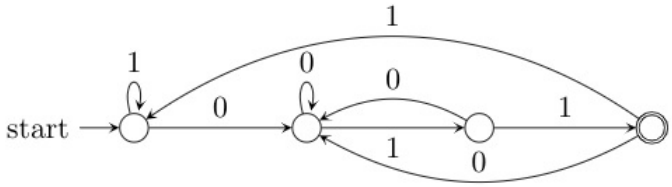
B :



C:



D:



13. Consider the language $L = \{w \in \{0,1\}^* |$ number of $0's$ is divisible by 2 but not divisible by $3\}$. What is the minimum number of states in a DFA that accepts L. Justify.**(3)**

**********All the Best**********