বাংলাদেশ আর্মি ইন্টারন্যাশনাল ইউনিভার্সিটি অব সায়েন্স এন্ড টেকনোলজি, কুমিল্লা
BANGLADESH ARMY INTERNATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY (BAIUST), CUMILLA

**Mid Term Examination, Fall 2025**
**Department of Computer Science and Engineering**
Level-3 Term-I
**Course Code:** CSE-319
**Course Title: Theory of Computation**
**Credit Hour:** 03
**Exam Duration:** 1 hour 30 Minutes
**Full Marks:** 90

**Notes:**

a. Figures on the right of each question indicate the marks for the respective question.
b. Answer all **Three** questions.
c. The Course Outcomes are:

**CO1:** Strengthen the understanding of the mathematical foundations of computation, including automata theory, which is crucial for solving computational problems in computer engineering.

**CO2:** Establish a solid foundation in formal languages, grammars, algorithms, and computational complexity, which are vital for analyzing software systems and algorithm design.

**CO3:** Develop the ability to design and analyze finite automata, pushdown automata, Turing machines, and formal languages, essential for constructing efficient computational models.

**CO4:** Enhance the capacity to explain and apply mathematical proofs for computation and algorithms, crucial for ensuring the correctness and efficiency of complex software systems.

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1. **a.** What is the significance of ε-transitions in NFAs? **[CO1 → C1]** **5**

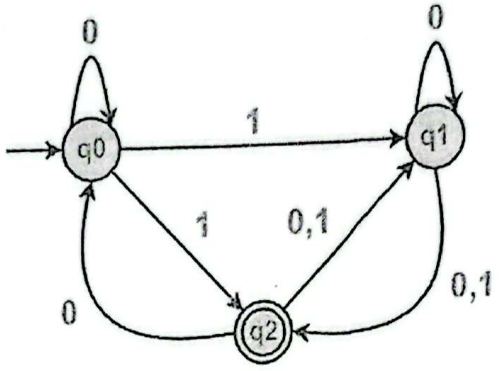
**b.** Differentiate between a Deterministic Finite Automaton (DFA) and a Non-deterministic Finite Automaton (NFA). **[CO1 → C1]** **5**

**c.** Construct a DFA that accepts all strings over Σ = {a, b} that **start with 'a' and end with 'b'**. For the DFA you constructed, list all the components of the 5-tuple. **[CO3 → C3]** **10**

**Or**

Construct a DFA that accepts all strings over Σ = {0, 1} where **every '1' is immediately followed by at least one '0'**. For the DFA you constructed, list all the components of the 5-tuple. **[CO3 → C3]**

**d.** Convert the following NFA to its equivalent DFA. **[CO3 → C3]** **10**




2. a. Explain the concepts of a "Theorem" and a "Proof" in the context of computation theory. **[CO4 → C2]** **5**

b. Prove that "The sum of two even numbers is always even." using a clear, step-by-step logical argument. **[CO4 → C2]** **5**

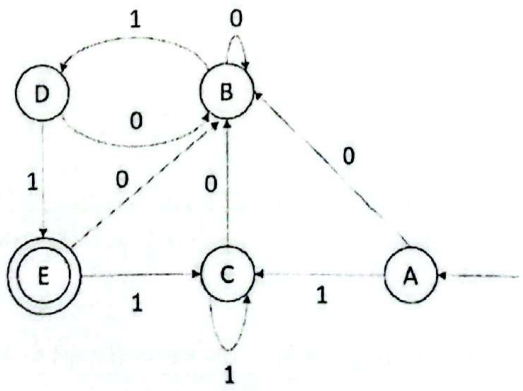
c. Design an NFA that accepts all strings over $\Sigma = \{a, b\}$ of length at most 2, and then convert this NFA into an equivalent DFA using the subset construction method. Provide the transition table for the resulting DFA. **[CO3 → C3]** **10**

d. Construct a DFA for the language $L = \{w \mid w$ **starts and ends with the same symbol**$\}$ over $\Sigma = \{a, b\}$. **[CO3 → C3]** **10**

3. a. What is the Myhill-Nerode Theorem? How does it relate to the minimal DFA for a language? **[CO1 → C1]** **5**

b. List three real-world applications of Finite Automata. **[CO1 → C1]** **5**

c. Minimize the following DFA using Table filling method. **[CO3 → C3]** **10**



**d.** Construct a DFA over $\Sigma = \{a, b\}$ that accepts all strings where the **total number of 'a's is divisible by 3. [CO3 → C3]** **10**

**Or**

Construct a DFA over $\Sigma = \{0, 1\}$ that accepts all strings that contain **an even number of 0's and an even number of 1's. [CO3 → C3]**