

**Premier University, Department of CSE**  
**Spring 2025, 7th Semester, Assignment, September 13, 2025**  
**Course Title: Theory of Computation, Course Code: CSE 309**  
**Course Outcome: CO3, Total Marks: 10**

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### **Problem Scenario: Username Validation**

You are tasked with implementing a username validation system for a new messaging app. The system should ensure that usernames are easy to remember and meet specific formatting requirements.

The username requirements are as follows:

1. The username must be exactly 5 characters long.
2. It must start with a capital letter.
3. It can only contain letters (A-Z, a-z) and digits (0-9).
4. It must contain at least one digit.

#### **Examples of Valid Usernames:**

- User1
- A1b2C
- Z9xY8

#### **Examples of Invalid Usernames:**

- Hey (less than 5 characters)
- longUsername (more than 5 characters)
- 12345 (does not start with a letter)
- NoDigits (no digits)
- Invalid! (contains a special character like #,&,@,\*,,\$)

#### **Now, answer the following questions for the given scenario and constraints:**

1. How will you design an NFA state transition diagram for username validation during sign-in or sign-up?
2. Convert the NFA for username validation into an equivalent DFA.

#### **Objectives:**

- Demonstrate advanced knowledge of formal computation for email validation.
- Apply the basic concept of DFA to design the related state transition diagram.
- Distinguish the approach of NFA from DFA through NFA to DFA conversion.

#### **Evaluation:**

- Follow the rules for drawing DFA state transition diagram and ensure all possible paths to validate a acceptable username or invalidate otherwise.
- Provide step-by-step process to convert email validation NFA to its equivalent DFA.

#### **Design:**

Students' solution design must achieve the given objectives.

**Deliverables:**

A hand-written assignment reporting the following tasks:

- (i) Provide clear explanations of your work, including the graphical representations of the social network graph, implementation details, test results, and analysis addressing the given assignment tasks.
- (ii) Briefly address the complex problem-solving questions:
  - a. Does the solution need in-depth engineering knowledge?
  - b. Does the solution involve wide-ranging or conflicting technical, engineering, and other issues?
  - c. Is the solution well-known, or does it require abstract thinking and analysis to formulate?
  - d. Does the solution involve infrequently encountered issues?
  - e. Does the solution need adherence to standards and codes of practice?
  - f. Does the solution involve stakeholders with conflicting technical requirements?
  - g. Does the solution involve interdependence between sub-problems or parts?

**Rubrics for Assignment marking:**

| Task | Criteria         | Good (4-5)                                       | Moderate (2-3)                      | Poor (1)                     |
|------|------------------|--|-------------------------------------|------------------------------|
| i.   | Problem solution | Properly or near appropriately reasoned solution | Appropriate solution for some cases | Inappropriate or no solution |
| ii.  | Problem analysis | In-depth analysis                                | Shallow analysis                    | Incomplete analysis          |