**CS21204 : Formal Language and Automata Theory (Spring 2026)**

**Class Test 1**

29-Jan-2026 (Thursday) | Maximum Marks: 30 | 06:30pm – 07:45pm

**Roll:** ____________________ **Name:** ____________________________________________

[ *Write your answers in question paper. Answer all questions. Be brief and precise.* ]

**Q1. [ Languages – Strings and Operations ]**

Let us define languages $L_1$, $L_2$, $L_3$ as sets of strings over the singleton alphabet $\Sigma = \{c\}$. Present examples (with proper justifications) satisfying the conditions as specified below.

**(a)** Give an example of a language $L_1 \subseteq \Sigma^*$ such that $L_1^* = L_1^+$. **(2)**

**Solution:**

**(b)** Give an example of a language $L_2 \subseteq \Sigma^*$ such that $L_2 = L_2^*$. **(2)**

**Solution:**

**(c)** Give an example of a language $L_3 \subseteq \Sigma^*$ such that $L_3^*$ is finite. **(2)**

**Solution:**

**Q2. [ NFA and DFA – Construction and Properties ]**

Consider the following language over $\{a,b\}$ and answer the questions asked below.

$$L_y = \left\{\, y \;\middle|\; y \in \{a,b\}^* \text{ and } y \text{ does not start and end with the same symbol } \right\}$$

**(a)** Give a regular expression for the language $L_y$ with a brief justification. **(2)**

**Solution:**

**(b)** From the regular expression formed in part (a), *algorithmically* construct a non-deterministic finite automaton (NFA) with $\varepsilon$-transitions accepting the language $L_y$ and show stepwise how you proceed to do the same. Show state-transition diagram(s), not its mathematical definition(s). **(4)**

**Solution:**

**(c)** Present a 4-state NFA $N$ (without any $\varepsilon$ transition) accepting $L_y$. Show the state-transition diagram for $N$, not its mathematical definition. **(2)**

**Solution:**

**(d)** Apply subset construction procedure to convert the above NFA $N$, that you produced in part (c), to an equivalent DFA $D$. Show state-transition diagram for $D$, not its mathematical definition. **(3)**

**Solution:**

**(e)** Modify your DFA $D$, that you constructed in part (d), to create $\overline{D}$ so that it accepts the complement of $L_y$, i.e. $\overline{L_y} = \{a,b\}^* - L_y$. Show the state-transition diagram for $\overline{D}$, not its mathematical definition. **(2)**

**Solution:**

**Q3. [ Regular Expression and DFA ]**

Consider the following language over $\{0,1,2\}$ and answer the questions asked below.

$$L_z = \left\{ z \;\middle|\; z \in \{0,1,2\}^* \text{ and } z \text{ contains an even number of 0s, } \textbf{or } z \text{ contains exactly two 1s} \right\}$$

**(a)** Give a regular expression for the language $L_z$ with a brief justification. **(2)**

**Solution:**

**(b)** Present a DFA accepting the language $L_z$. Show the state-transition diagram for the DFA, not its mathematical definition. **(4)**

**Solution:**

**Q4. [ Regular Languages ]**

Suppose that $L \subseteq \{0,1\}^*$ is a regular language. Let us define the following language (set),

$$\mathtt{DEL}_1(L) = \{uv \mid u1v \in L \text{ and } u,v \in \{0,1\}^*\}$$

The set $\mathtt{DEL}_1(L)$ essentially consists of all strings that can be obtained from strings in $L$ by deleting *exactly* one 1. Prove that $\mathtt{DEL}_1(L)$ is also regular. (Hint: Use non-determinism) **(5)**

**Solution:**

— End of Question Paper —