**PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004**

**Department of Applied Mathematics and Computational Sciences**

**MSc - Theoretical Computer Science - Semester 5**

**CONTINUOUS ASSESSMENT TEST 1**

**23XT51 - Theory of Computing**

**Date: 26.08.2025**

**Time: 1 Hour 30 min.** **Maximum Marks: 40**

**INSTRUCTIONS**

1. Answer **ALL** questions. Each question carries 20 Marks.
2. Subdivisions (a)(i) and (a)(ii) carry 2 marks each, subdivision (b) carries 6 marks, and subdivision (c) carries 10 marks.
3. Course Outcome Table:

| Qn. 1 | CO 1 |
|---|---|

| Qn. 2 | CO 2 |
|---|---|

**Qn.1**

(a) (i) Let $L = \{ab, aa, baa\}$. Which of the following statements correctly describes $L^*$ and $L^4$?

1. $L^*$ contains all finite concatenations of $ab$, $aa$, $baa$
2. $L^4$ contains exactly those strings that are concatenations of four elements from $L$.
3. The empty string belongs to $L^*$ but not to $L^4$
4. There exists at least one string $w$ such that $w \in L^4 - L^*$

(ii) Show by example that $(L_1 \cup L_2)^* \neq L_1^* \cup L_2^*$. **(BTL-2)**

(b) Design a minimal DFA that accepts the same language as the following finite automaton. Also, find the equivalence class of indistinguishable states. **(BTL-2)** **(BTL-6)**

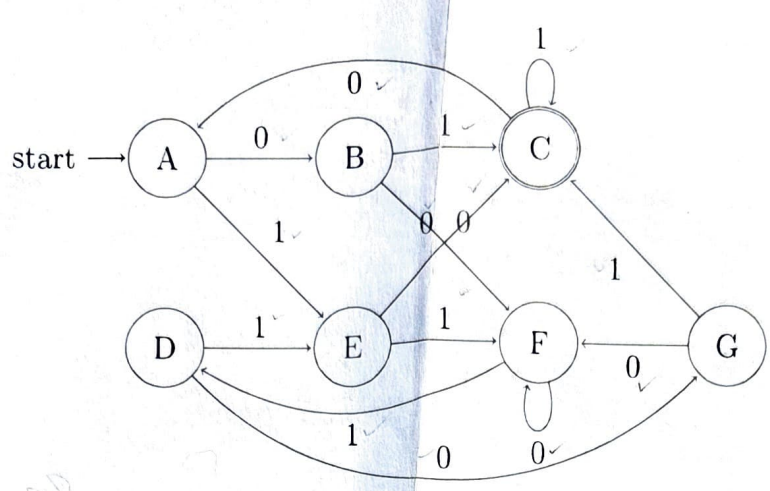


Figure 1:

(c) Differentiate between NFA and DFA. Determine whether the finite automaton given in Figure 1 is a DFA. Justify your answer. Find an equivalent DFA for the following NFA. **(BTL-4)**

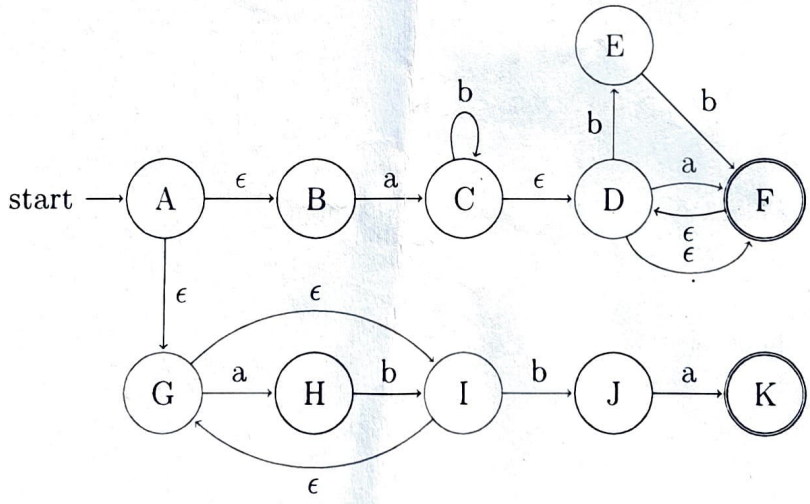


Figure 2:

**Qn.2**

(a) (i) Define mealy machine. **(BTL-1)**

(ii) Find a nfa that accepts the following language.

$$L = L(a^*b^*a) \cup L(ab^*ba)$$

**(BTL-6)**

(b) State Pumping Lemma. Is $L = \{w : w \in \{a,b\}^* \ |w|_a = |w|_b\}$ regular? Justify your answer. **(BTL-4)**

(c) Construct a left-linear grammar for the given automaton. Additionally, derive the regular expression using the state elimination method. **(BTL-6)**

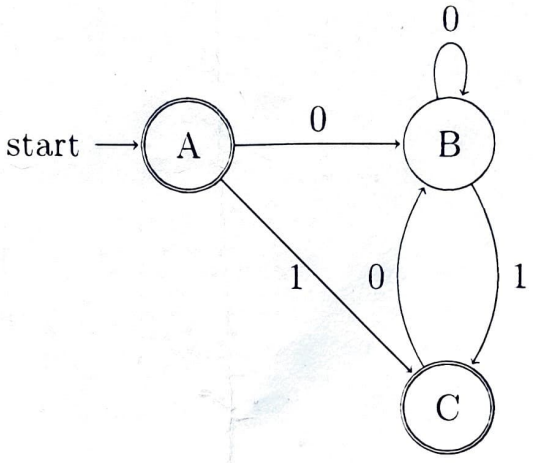


Figure 3: