Formal Language And Automata Theory (CS21004) - Class Test 1
IIT Kharagpur, CSE Dept., Spring'23

Answer all questions. In case of reasonable doubt, make practical assumptions.
Marks will be deducted for sketchy proofs and claims without proper reasoning.

Marks = 20   Time = 1 hour

1. Construct a DFA for

    (a) $L = \{ab^5wb^2 \mid w \in \{a, b\}^*\}$.   **[2.5]**
    (b) $L = \{a^n \mid n \geq 0, n \neq 4\}$.   **[2.5]**

2. Let L be a regular language on some alphabet Σ and let $\Sigma_1 \subset \Sigma$ be some smaller alphabet. Prove that $L_1 = L \cap \Sigma_1^*$ is also regular.   **[5]**

3. For each of the following languages, construct a regular expression that generates it:

    (a) the set of binary strings that have both 00 and 11 as substrings;   **[2.5]**
    (b) the set of strings over the alphabet {x, y, z} in which each y is immediately followed by x; **[2.5]**

4. For languages A and B, let the perfect shuffle of A and B be the language

$$\{w \mid w = a_1b_1 \cdots a_kb_k, \text{where } a_1 \cdots a_k \in A \text{ and } b_1 \cdots b_k \in B, \text{ each } a_i, b_i \in \Sigma\}$$

    Show that the class of regular languages is closed under perfect shuffle.   **[5]**