Daffodil International University

Faculty of Science & Information Technology

Department of Computer Science & Engineering

Final Examination, Spring 2025

Course Code: CSE228, Course Title: Theory of Computation

Level: L2 Term: T2 Batch: 65

Time: 02:00 Hrs **Marks:40**

Answer ALL Questions

[The figures in the right margin indicate the full marks and corresponding course outcomes. All portions of each question must be answered sequentially.]

Q1	**a)**	Apply the concept of Pushdown Automata (PDA) to **discover** a PDA that accepts the language $L = \{0^n1^{2n} \mid n \geq 1\}$ and **Analyze** that the string **000111111** is **accepted**	**[6]**	**CO3**
	b)	Consider the following PDA: $P = (\{q0, q1, q2, q3, q4, f\}, \{a,b\}, \{Z0, A, B\}, \delta, q0, Z0, \{f\})$. The transition functions are given below: 1. $\delta(q0, a, Z0) = (q1, AAZ0)$ 7. $\delta(q2, b, B) = (q2, BB)$ 2. $\delta(q1, a, A) = (q1, AAA)$ 8. $\delta(q3, \varepsilon, Z0) = (q1, AZ0)$ 3. $\delta(q2, a, B) = (q3, \varepsilon)$ 9. $\delta(q0, \varepsilon, Z0) = (f, \varepsilon)$ 4. $\delta(q3, \varepsilon, B) = (q2, \varepsilon)$ 10. $\delta(q1, \varepsilon, Z0) = (q0, Z0)$ 5. $\delta(q0, b, Z0) = (q2, BZ0)$ 11. $\delta(q2, \varepsilon, Z0) = (q0, Z0)$ 6. $\delta(q1, b, A) = (q1, \varepsilon)$ 12. $\delta(q3, b, Z0) = (q2, BZ0)$ **Analyze** the execution of the given PDA and provide the sequence of Instantaneous Descriptions (IDs) to demonstrate that the strings **"bab"** and **"abb"** are accepted by L(P).	**[4]**	
Q2	**a)**	Consider the following CFG: $E \rightarrow I / E+E / E*E / (E),\ I \rightarrow a / b / Ia / Ib / I0 / I1$ **Analyze** the given CFG for the string **(b+a11)*(b0+a00)** by performing Leftmost **Derivation, Rightmost Derivation. Also, infer** whether the above-mentioned CFG is ambiguous or not for the above strings.	**[5]**	**CO3**
	b)	**Convert** the given regular expression **$(a+b)^*bab^*$** into CFG Using the generated CFG, determine whether the following strings are accepted: **abbabb, and babbb**	**[5]**	
Q3		Consider the following grammar: $S \rightarrow AX \mid B \mid \varepsilon$ $A \rightarrow aS \mid \varepsilon$ $B \rightarrow bA \mid C$ $C \rightarrow cB \mid \varepsilon$ $X \rightarrow aB \mid b$ **Determine** the following steps: i) **Eliminate epsilon (ε)-productions** from the grammar. ii) **Remove unit productions** from the grammar. iii) **Eliminate useless symbols** from the grammar. iv) Convert the resulting grammar into **Chomsky Normal Form (CNF)**.	**[10]**	**CO4**
Q4	**a)**	**Determine** that the language $L = \{0^{2n}1^{4n}, n>=1\}$ is not regular by using pumping lemma	**[5]**	**CO4**
	b)	**Design a** Turing Machine which recognizes the language $L=\{ a^nb^nc^n \mid n \geq 1\}$	**[5]**	