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Daffodil International University

Faculty of Science & Information Technology

Department of Computer Science & Engineering

Final Examination, Fall 2025

Course Code: CSE228, Course Title: Theory of Computation

Level: L2 Term: T2 Batch: 66

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)**	Consider the following Context Free Grammar (CFG): $S \rightarrow S\ S\ O \mid T$ $O \rightarrow + \mid - \mid * \mid /$ $T \rightarrow x \mid y \mid z$ **Analyze** the given CFG for the input string : **xy- yxz + */** Perform the following **i)** Leftmost Derivation **ii)** Rightmost Derivation **iii)** Based on both derivations, infer whether the grammar is ambiguous or unambiguous for this input string with parse tree.	[6]	**CO3**
	b)	**i) Design** a set of production rules for a language that generates strings over {a, b} where the number of **a's** is equal to the number of **b's.** **ii) Drive** the following regular expression into **CFG**: $0^*101(0+1)^*$	[4]	
Q2		**Consider the following CFG:** **$S \rightarrow AB \mid aS \mid B$ $A \rightarrow aA \mid \varepsilon$ $B \rightarrow bB \mid C$ $C \rightarrow a \mid \varepsilon$ $D \rightarrow dD$** For the given grammar, **perform** the following transformations: **i)** Eliminate all **epsilon (ε) productions**. **ii)** Remove all **unit productions** from the grammar. **iii)** Identify and eliminate all **useless symbols.** **iv)** Convert the simplified grammar into **Chomsky Normal Form (CNF).**	[10]	**CO3**
Q3	**a)**	**Determine, with proper evaluation and justification,** whether the following language is regular or not using Pumping Lemma: $L = \{x^n y^{2n} \mid n \geq 1\}$	[5]	**CO4**
	b)	**Design** a Turing Machine that recognizes the language $L=\{x^n y^{2n} z^n \mid n \geq 1\}$	[5]	
Q4	**a)**	After designing the Push Down Automata (PDA) for the Language, $L = \{a^{3n}b^n \mid n>=1\}$, **evaluate** that for the string **"aaaaaaaaabbb"** is accepted or not in PDA.	[6]	
	b)	Consider the following PDA: $P = (\{q0, q1, q2, q3, q4, f\}, \{0,1\}, \{Z_0, A, B\}, \delta, q0, Z_0, \{f\})$. The transition functions are given below: 1. $\delta(q0, 0, Z_0) = (q1, AAZ_0)$ 2. $\delta(q1, 0, A) = (q1, AAA)$ 3. $\delta(q2, 0, B) = (q3, \varepsilon)$ 4. $\delta(q3, \varepsilon, B) = (q2, \varepsilon)$ 5. $\delta(q0, 1, Z_0) = (q2, BZ_0)$ 6. $\delta(q1, 1, A) = (q1, \varepsilon)$ 7. $\delta(q2, 1, B) = (q2, BB)$ 8. $\delta(q3, \varepsilon, Z_0) = (q1, AZ_0)$ 9. $\delta(q0, \varepsilon, Z_0) = (f, \varepsilon)$ 10. $\delta(q1, \varepsilon, Z_0) = (q0, Z_0)$ 11. $\delta(q2, \varepsilon, Z_0) = (q0, Z_0)$ 12. $\delta(q3, 1, Z_0) = (q2, BZ_0)$ **Evaluate** the execution of the given PDA and provide the sequence of Instantaneous Descriptions (IDs) to demonstrate that the strings **"101"** and **"011"** are accepted or not accepted by L(P).	[4]	**CO4**