‘I’ Grade Final Exam (Fall 2023)

**United** International **University (UIU)**

**Dept. of Computer Science & Engineering (CSE)**

#### CSE 2233/CSI 233: Theory of Computation/Theory of Computing

Total Marks: **40** Duration: **2 Hours**

**Answer all questions.** Figures in the right-hand margin indicate full marks.

***Any examinee found adopting unfair means will be expelled from the trimester/program as per UIU disciplinary rules.***

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| **1.** | |  |  | | --- | --- | | **a)** | Answer the following question based on the given CFG:  S → 2BA | 1S | 2A  B → 1B3 | 1S3 | 𝜺  A → A11 | 12AS3 | B | 𝜺  With the help of **Parse Tree** show whether the given CFG is ambiguous for the string ‘**211211313**’. | | **b)** | With the help of **Leftmost Derivation**, derive the string **“bbb2 + aa1 + b2”** from the following grammar:  S → S + S | S ∗ S | A | B  A → aA | 1  B → bB | 2 | | **3+3** |
| **2.** | Design **CFGs** that generate the following languages:   |  |  | | --- | --- | | **a)** | L = { w is considered of {0,1} | w is of odd length & w starts and ends with same symbol } | |  |  | | **b)** | L = { ax+y c3x d2y | x, y ≥ 1 and ⅀ = {a, c, d} } | |  |  | | **c)** | L = {xi yj zk | where i=k or j=k and i, j, k >=0} | |  |  | | **2x3** |
| **3.** | Showing all necessary steps, convert the following CFGs into their equivalent **Chomsky Normal Form (CNF)**.   1. S → DBC | Ba   B → 0B1 | 01 | ɛ  C → aCb | aC | Bb  D → bD | D       1. S → AC01 | 0S | 1S | A1   A → B | CA | ε  B → 11B | 00B | ε  C → 0 | 1 | **4x2** |
| **4.** | Draw the **Push Down Automata (PDA)** for the following languages:  **a)**  L = { ap by c2r  | p ≠ q and p, q, r ≥ 0}    **b)** L = { 0i 1j 2k  | ( i = 3j or j=k ) and i, j, k ≥ 1} | **5x2** |
| **5.** | Draw a **Turing Machine** for the following language and show the **Tape Traversal** to validate  the given input:  L = { al bm cn dk  | where k = (m+n)\*l and l, m, n, k ≥ 1}  Input String: aabccdddddd | **5+5** |