United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Final Exam Summer 2021.

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

Total Marks: **25** Duration: **1 Hour and 15 Minutes**

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

Answer all questions. Figures are in the right-hand margin indicates full marks.

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1. Consider the following context-free grammars (CFG). With the help of leftmost derivation decide whether the grammars are ambiguous or not, and draw the derivation trees. **[3.5x2]**

a)	$S \rightarrow 0S3 \mid 00S3 \mid A$ $A \rightarrow 0A2 \mid 0A22 \mid B$ $B \rightarrow 0B1 \mid 2S3 \mid \varepsilon$	String: ***000001233***
b)	$E \rightarrow E + T \mid T$ $T \rightarrow T \times F \mid (a) \mid F$ $F \rightarrow (E) \mid a \mid (a)$	String: ***((a × a + a))***

2. Design context-free grammar (CFG) for the following languages **[2x2]**

a) { uvwx | u,x∈{a,b}*; v,w ∈ {0,1}*; |u| = |x|, |v| = |w| }

b) $\{x^{2n}\#y^{3n} \mid n>= 1\}$ Here, $\Sigma=\{x,y,\#\}$

3. Convert the following CFGs to Chomsky Normal Form (CNF). **[3.5x2]**

a)	$S \rightarrow 0S3 \mid 00S3 \mid A$ $A \rightarrow 0A2 \mid 0A22 \mid B$ $B \rightarrow 0B1 \mid 2S3 \mid \varepsilon$
b)	S→ AC01 | 0S | 1S | A1 A→ B | CA | Є C→ 0 | 1 B→ 11B | 00B | ε

4 Construct Push Down Automata (PDA) for the following languages **[3.5x2]**

a) $L = \{x^{2n}+x^{3n} \mid n>=1\}$

b) $L = \{0^i1^j2 \mid i,j>=1, i\neq j\}$