



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.

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: $((a \times a + a))$

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

- a)** $\{ uvwx \mid u, x \in \{a, b\}^*; v, w \in \{0, 1\}^*; |u| = |x|, |v| = |w| \}$
b) $\{ x^{2n} \# y^{3n} \mid n \geq 1 \}$ 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)	$S \rightarrow AC01 \mid 0S \mid 1S \mid A1$ $A \rightarrow B \mid CA \mid C$ $C \rightarrow 0 \mid 1$ $B \rightarrow 11B \mid 00B \mid \varepsilon$

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

- a)** $L = \{ x^{2n} + x^{3n} \mid n \geq 1 \}$
b) $L = \{ 0^i 1^j 2 \mid i, j \geq 1, i \neq j \}$

