



# United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

## Final Exam Summer 2022

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

Total Marks: 40

Duration: 120 Minutes

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

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

1.	<p>Consider the following context-free grammars (CFG). With the help of <b>Top-Down Parse Tree</b> decide whether the grammars are ambiguous or not:</p> <p>a) <math>S \rightarrow 2BA \mid 1S \mid 2A</math> <span style="float: right;"><b>211211313</b></span>  <math>B \rightarrow 1B3 \mid 1S3 \mid \epsilon</math>  <math>A \rightarrow A11 \mid 12AS3 \mid B \mid \epsilon</math></p> <p>b) <math>B \rightarrow 11BS \mid 0S0B \mid \epsilon</math> <span style="float: right;"><b>011010</b></span>  <math>S \rightarrow AC01 \mid 0S \mid 1S \mid A1</math>  <math>A \rightarrow 1 \mid B \mid CA \mid \epsilon</math>  <math>C \rightarrow x \mid y \mid A</math></p>	3 x 2
2.	<p>Find a CFG that generates the following languages.</p> <p>a) <math>L = \{a^m b^n c^{3n} d^{2m} \mid \text{where } m, n \geq 1\}</math></p> <p>b) <math>L = \{x^i y^j z^k \mid \text{where } i=k \text{ or } j=k \text{ and } i, j, k \geq 0\}</math></p> <p>c) <math>L = \{w \text{ is consisted of } \{0,1\} \mid  w  \text{ is odd and mid symbol is } 0\}</math></p>	2 x 3
3.	<p>Convert the following CFGs into the equivalent Chomsky Normal Form (CNF) [ Show all the Steps]</p> <p>a) <math>A \rightarrow 1 \mid B \mid CA \mid \epsilon</math>  <math>B \rightarrow 1BS \mid 0S0B \mid \epsilon</math>  <math>C \rightarrow x \mid y \mid A</math>  <math>S \rightarrow 1A1 \mid 0S \mid S \mid A1</math></p> <p>b) <math>W \rightarrow 2XY \mid 1W \mid 2Y</math>  <math>X \rightarrow 1X3 \mid 1W3 \mid \epsilon</math>  <math>Y \rightarrow Y11 \mid 12YW3 \mid X \mid \epsilon</math></p>	4 x 2

4.	<p>a) Draw Push Down Automata (PDA) for the Language <math>L = \{a^m b^n c^k \mid \text{where } k=m-n \text{ and } m \geq 1 \text{ and } n \geq 1\}</math></p> <p>b) Draw Push Down Automata (PDA) for the Language <math>L = \{W \text{ which is an Odd Palindrome where } W \in \{0, 1\}^*\}</math></p>	5 + 5
5.	<p>Draw Turing Machine for the following Language and Show the Tape Traversal for the Given input</p> <p>a) <math>L = \{a^m b^n c^k \mid \text{where } m = \frac{k}{n} \text{ and } m, n, k \geq 1\}</math>   <b>Input String: aabbcccccc</b></p> <p>b) <math>L = \{W \# W^R \mid W \in \{x, y\}^* \text{ and } W^R \text{ is the reverse string of } W\}</math>   <b>Input String: xyy#yyx</b></p>	5 x 2