United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Final Exam Spring 2022

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

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

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. **[4x3]**

a)	E → E + E | E - E | (E) | F F → x | y | z | A A → A * A | A % A | C C → 0 | 1	String: (0%1*1) – z
b)	S→ AC01 | 0S | 1S | A1 B→ 11BS | 0S0B | ε A→ 1 | B | CA | Є C→ x| y |A	String: 0110111101
c)	$S \rightarrow 2BA \mid 1S \mid 2A$ $B \rightarrow 1B3 \mid 1S3 \mid \varepsilon$ $A \rightarrow A11 \mid 12AS3 \mid B \mid \varepsilon$	String: 211211313

2. Convert the following CFGs to Chomsky Normal Form (CNF). **[4x4]**

a) S → S + S | S - S | (S) | T
T → x | y | z | X
X → X * X | X % X | Y
Y → 0 | 1

b) P→ ST01 | 0P | 1P | S1
Q→ 11QP | 0P0Q | ε
S→ 1 | Q | TS | Є
T→ x| y |S

c) W → 2XY | 1W | 2Y
X → 1X3 | 1W3 | ε
Y → Y11 |12YW3 | X | ε

d) S→ AC01 | 0S | 1S | A1
A→ B | CA | Є
C→ 0 | 1
B→ 11B | 00B | ε

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

a) L = { $x^n y^{2n} z^{3m}$ | n>=1, m>=2 }

b) L = { $0^m 1^{3m} 2^{2n}$ | m,n>=1, m>n}

4. Construct a Turing Machine for the language L = {$2^n 1^m 3^n$ where n≥1 and m≥2 } **[4x1]**