United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Final Exam (Fall 2022)

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 indicates 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. Consider the following Context-free grammars (CFG) and answer according to it: 3 x 2

a)	S → AS | BAC A→ A1 | 0A1 | 0B1 | B B → 0B | 0 | € C → 1 | €	With the help of ***Top-Down Parse Trees,*** find-out if the grammar is ***Ambiguous*** or not for the string **00011111**
b)	E → E+E | E-E | (E) | V V → p | q | r | X X → X*X | X%X | Y Y → 0 | 1	With the help of ***Leftmost derivation,*** find-out if the grammar is ***Ambiguous*** or not for the string **p+(0*1%0)-r**

2. Find a ***CFG that generates*** the following languages. 2 x 3

a) L = { x^{2n} # y^{3m} | n,m≥1 } , Here ∑ = {x,y,#}

b) L = { w is considered of {0,1} | w is of even length & w starts and ends with different symbol }

c) L = { $a^i b^j c^k$ | where i≠j and k≥1 }

3. Convert the following CFG's into equivalent ***Chomsky Normal Form (CNF)*** [Show all the Steps] 4 x 2

a) S → aSBcD | BC

A → AbCd | a

B → CBA | €

C → c | €

D → d

b) S → xP | yQ | y | RRz

P → Qxx | xyR | €

Q → yPPy | xy | zR

R → x | y | PR | €

4. Draw ***Push Down Automata (PDA)*** for the following Languages 5 x 2

a) L = $\{a^p b^q c^r \mid Where\ p - q = r\ and\ p, q, r > 0\}$

b) L = $\{x^m \# y^n z^w \mid Where\ m = 2n\ or\ w = 2m\ and\ m, n, w > 0\}$

5. Draw ***Turing Machine*** for the following Language and Show the ***Tape Traversal*** for the Given input. 5 x 2

a) L = $\{a^l b^m c^n d^k$ | where k = (m+n)*l and l, m, n, k>=1} | **Input String: aabccddddddd**

b) L = {W#W | W ∈ {0, 1}| **Input String: 010#010**