

United International University (UIU)
 Dept. of Computer Science & Engineering (CSE)



Final Exam Spring 2023

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 indicate full marks.

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

1.	$E \rightarrow E + E \mid E - E \mid E = E$ $E \rightarrow MNV \mid MN$ $M \rightarrow - \mid \varepsilon$ $N \rightarrow 0 \mid 1 \mid 2 \mid 3 \mid 4 \mid 5 \mid 6 \mid 7 \mid 8 \mid 9 \mid NN$ $V \rightarrow x \mid y \mid z$	
a)	With the help of Top-Down Parse Trees , figure out if the grammar is Ambiguous or not for the string “ x + y + z = 2 ”	[5]
b)	Show the Right Most Derivation for the string “ -26x + 3y - 8z = -83 ”	[4]
2.	Define a Context Free Grammar for the following languages: a) $L = \{x^i y^j z^{k+1} \mid k = 2j \text{ and } i \geq 0, j > 0\}$ b) $L = \{a^m b^n c^u d^v \mid m = \frac{n}{2}, v = \frac{u}{4}, m, n, u, v > 0\}$ c) $L = \{c^p \# d^q g^r h \mid q = 4p, p, q \geq 0 \text{ and } r > 2\}$	[3 x 3]
3.	Convert the following Context Free Grammars to Chomsky Normal Form (CNF) a) $S \rightarrow ASA \mid aB$ $A \rightarrow B \mid S$ $B \rightarrow b \mid \varepsilon$ b) $S \rightarrow S + S \mid S - S \mid (S) \mid T$ $T \rightarrow x \mid y \mid z \mid X$ $X \rightarrow X * X \mid X \% X \mid Y$ $Y \rightarrow 0 \mid 1$	[3 x 4]

	c)	$S \rightarrow ASB$ $A \rightarrow aAS \mid a \mid \varepsilon$ $B \rightarrow SbS \mid A \mid bb$	
4.	Draw PushDown Automata (PDA) for the following Languages		[2 x 5]
	a)	$L = \{a^p b^q c^{2r} \mid p \neq q \text{ and } p, q, r \geq 0\}$	
	b)	$L = \{0^i 1^j 2^k \mid (i = 3j \text{ or } j = k) \text{ and } i, j, k \geq 1\}$	