Final Exam Fall 2021

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.

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 | A | F S → 0E44 | 0A A → 5A7 | 2S3 | 0S4 | ε F → ε | 5 | (5)	String: 2003+00444
b)	B→ 11BS | 0S0B | ε S→ AC01 | 0S | 1S | A1 A→ 1 | B | CA | Є C→ x| y |A	String: 011010
c)	B → 1B3 \| 1S3 \| ε S → 2BA \| 1S \| 2A A → A11 \|12AS3 | B | ε	String: 112113

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

   a) E → E + E \| A \| F
    S → 0E44 \| 0A
    A → 5A7 \| 2S3 \| 0S4 \| ε
    F → ε \| 5 \| (5)

   b) A→ 1 \| B \| CA \| Є
    B→ 1BS \| 0S0B \| ε
    C→ x\| y \|A
    S→ 1A1 \| 0S \| S \| A1

c) S→ DBC | Ba
B→ 0B1 | 01 | ε
C→ aCb | aC | Bb
D→ bD | D

d) S → X | Y
X → Xb | Ab | ε
A → aAb | ab
Y → Ya | Ba | ε
B → bBa | ba

3. Construct Push Down Automata (PDA) for the following languages **[4x2]**
   a) $L = \{0^{3n}1^n2^{3n} \mid n >= 1\}$
   b) $L = \{a^mb^nc^k \mid n >= 1$, where m=k and n=m$\}$

4. Construct a Turing Machine for the language $L = \{0^n1^n2^n$ where $n \geq 1$ $\}$ **[4x1]**