United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

***Final Assignment*: Trimester: Spring 2020**

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

Marks: 40, Time: 2 hours

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*Answer all the (**5**) questions. Numbers to the right of the questions denote their marks.*

1. a) Consider the following context-free grammar (CFG) and answer the question that follows:

$$S \rightarrow 0S3 \mid 00S3 \mid A$$
$$A \rightarrow 0A2 \mid 0A22 \mid B$$
$$B \rightarrow 0B1 \mid \epsilon$$

Show a **leftmost** and a **rightmost** derivation of the string ***000001233***. **[4]**

b) Consider the following CFG,

$$S \rightarrow ASA \mid aB \mid C \mid AD$$
$$A \rightarrow B \mid S$$
$$B \rightarrow b \mid \epsilon$$
$$C \rightarrow aCd \mid aDd \mid \epsilon$$
$$D \rightarrow c$$

Covert the given grammar to the normal form/CNF. **[4]**

2. Design CFGs for the following languages: **[4*3=12]**

I. $\{a^n b^m c^k \mid k = 2n+m\}$

II. $\{0^i 1^j 2^k \mid i = k \text{ or } j = k\}$

III. $\{0^i 1^j \mid 0 \le i \le j \le 2i\}$

3. The 6 components of a Push down automaton is given below: **[3]**

Set of states, Q = { q_0, q_1 ,q_2, q_3 }

Set of input alphabet, Σ = { a, b }

Set of stack alphabet, Γ = { z, a, b }

Start state = { q_0 }

Set of accept states, F = { q_2 }

The transition table is given below:

	a				**b**				**ε**			
	z	**a**	**b**	**ε**	**z**	**a**	**b**	**ε**	**z**	**a**	**b**	**ε**
q_0	(q_1, az)				(q_1, bz)							
q_1		(q_2, aza)	(q_3, azb)			(q_3, bza)	(q_2, bzb)					
q_2		(q_3, aa)	(q_3, ε)			(q_3, ε)	(q_3, bb)					
q_3		(q_3, aa)	(q_3, ε)			(q_3, ε)	(q_3, bb)		(q_1, ε)			

Now show the state transition diagram for this non-deterministic push down automata.

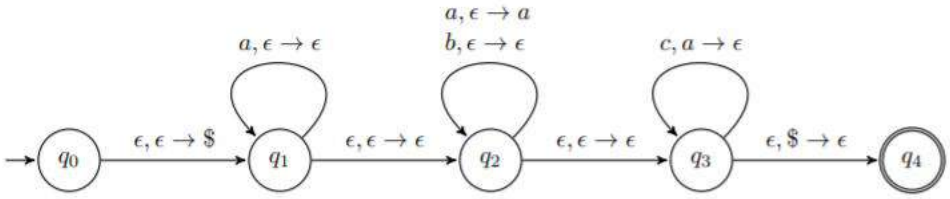
4. Design a Push Down Automata for the following languages **[3*4=12]**

a. L={ uawb | u, w ϵ {a, b}* and $|u| = |w|$ } ; here $|u|$ = represents total number of characters in string *u*

b. L = { $p^{a+b}\ q^{b+c}\ p^{c}\ q^{a}$ | a, b > 0 and c >= 0 }

c. L = { $p^{i}\ q^{j}\ r^{k}\ s^{l}$ | i == k or j == l , i >=0, j>=1 }

5. Consider the PDA as given below:



Now write **instantaneous description** for the following strings and decide whether these strings will be accepted or not by the given PDA. **[2.5+2.5]**

a. aaaababcc

b. aaabaabacc