United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

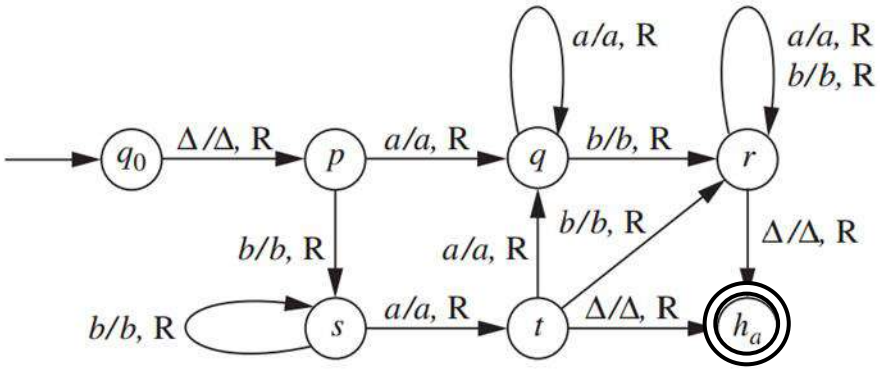
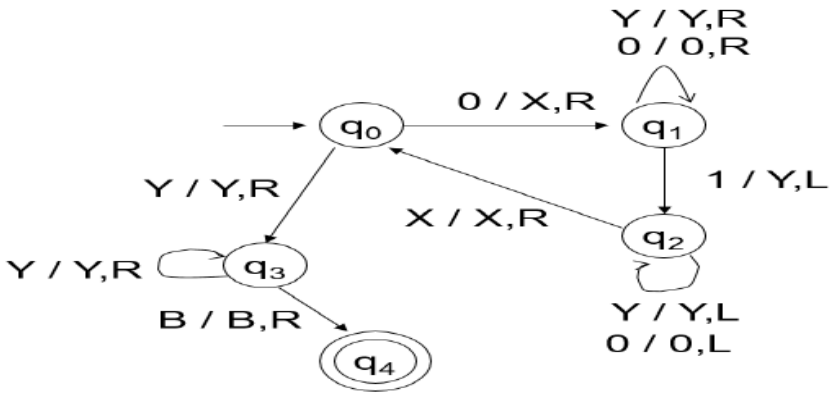
Final Exam. **: : Trimester: Fall 2018**

Course Code: CSI 233 Course Title: Theory of Computing

Total Marks: **40** Duration: **2:00** hours

Answer all the questions. Figures are in the right-hand margin indicate full marks.

1.	a) Design a Push Down Automata (PDA) for the given language - L = $\{a^i b^j c^k d^m \mid i + j = k \text{ and } i, j, k, m > 0\}$.	**[4]**
	b) Now write the components of your designed PDA.	**[2]**
	c) Write Instantaneous Description (ID) for the string **aaabccccd** for this PDA.	**[2]**
2.	a) $S \rightarrow AB \mid C$ $A \rightarrow aAb \mid ab$ $B \rightarrow cBd \mid cd$ $C \rightarrow aCd \mid aDd$ $D \rightarrow bDc \mid bc$ Can the string **'aabbccdd'** be derived from the above Context Free Grammar? If yes, show the leftmost and rightmost derivation. Is the leftmost derivation unique? If not, show the other leftmost derivation.	**[2+2+1]**
	b) $S \rightarrow ABA$ $A \rightarrow Aa \mid \in$ $B \rightarrow bB \mid \in$ Is the grammar ambiguous? Justify your answer with a suitable example. (Give parse trees)	**[3]**
3.	a) Design a Context Free Grammar (CFG) for the given language – L = $\{a^i b^j c^k \mid i, j, k > 0 \text{ and } i = j\}$. Now write the components of the CFG.	**[3+1]**
	b) Design a CFG for any valid **decimal numbers**. **Accepted**: +3.54, -4.26 **Rejected**: +2. , 7.	**[2]**
	c) Find the language of the CFG. S → aaSB| aB B→ b	**[2]**
4.	a) Convert the following CFG to Chomsky Normal Form: $S \rightarrow DBC \mid Ba$ $B \rightarrow 0B1 \mid 01 \mid \varepsilon$ $C \rightarrow aCb \mid aC \mid Bb$ $D \rightarrow bD \mid D$	**[4]**
	b) Convert the following CFG to Chomsky Normal Form: $S \rightarrow aX \mid bY \mid b \mid ZZc$ $X \rightarrow Yaa \mid abZ \mid \varepsilon$ $Y \rightarrow bXXb \mid ab \mid cZ$ $Z \rightarrow a \mid b \mid XZ \mid \varepsilon$	**[4]**
5.	a) Design Turing Machine for **odd length palindrome**. Also write the components of the Turing Machine.	**[3+1]**

	b) Determine the language for the following Turing Machine  Here, Δ represents the blank symbol. h_a is the accepting state.	**[2]**
	c) Check whether the following strings are accepted by the given Turing Machine.  i) 0101010110101010 ii) 00001111 iii) 1111000010 iv) 1110011	[2]