United International University
Department of Computer Science and Engineering

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

Final-Exam: Fall'19 Time: 2:00 Hours Marks: 40

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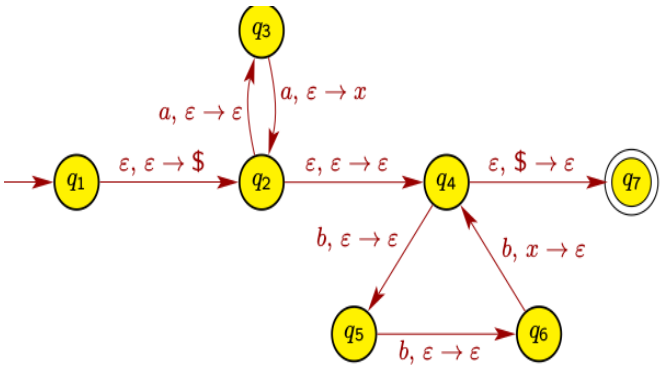
1. (a) Draw push down automaton (PDA) for the following languages: [4+4]

$$L = \{a^n b^m \mid n, m \geq 1 \; and \; n \neq m\}$$
$$L = \{a^m b^n \mid where \; n < m <= 2n\}$$

(b) Consider the following push down automaton (PDA) [4]



(i) What is the language of the PDA ?

(ii) What are the input alphabet of the PDA ?

(iii) What are the stack alphabet of the PDA ?

(iv) Write two strings that the PDA accepts.

2. Give context-free grammars (CFG) that generate the following languages : [3+3=6]

(a) L=$\{w \mid$ the length of w is odd and its middle symbol is a 0$\}$ and $\Sigma = \{0, 1\}$

(b) $A = \{a^i b^j c^k \mid where \; i = j \; or \; j = k \; and \; i, j, k >= 0\} \; and \; \Sigma = \{a, b, c\}$

3. Consider the following context-free grammar (CFG). [2+2+2=6]

$$E \to E + T \mid T$$
$$T \to T \times F \mid F$$
$$F \to (E) \mid a$$

Now give parse trees and left-most derivations for each of the following.

(a) $a + a$

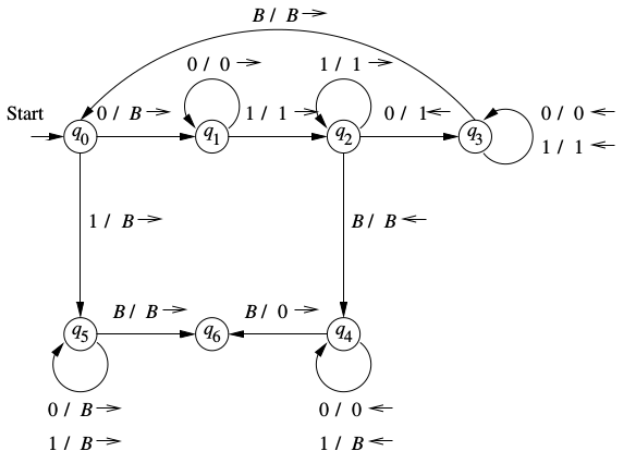
(b) $a \times a + a$

(c) $((a))$

4. Convert the followng context-free language (CFG) to Chomsky Normal Form (CNF) [6]

$$S \to ASB$$
$$A \to aAS \mid a \mid \epsilon$$
$$B \to SbS \mid A \mid bb$$

5. Consider the following Turing Machine. [2+4+4=10]



(a) Find out the language that is recognized by the Turing Machine

(b) Write down the transition table for the Turing Machine.

(c) Write down three string that the Turing Machine accepts and three strings that the machine rejects.