Manarat International University (MIU)

Department of Computer Science and Engineering (Evening)

Midterm Examination (Summer 2017)

Course Code: CSE-203 Course Title: Theory of Computing

Full Marks: 30 Time: 1 Hour 30 Minutes

Answer any 6 (six) question. All questions are of equal value.

1. a. Define Automata theory. [2]

   b. Let $S(n) = 1 + 2 + \cdots + n$ be the sum of the first n natural numbers and $C(n) = 1^3 + 2^3 + \cdots + n^3$ be the sum of the first n cubes. Prove the equalities $C(n) = S^2(n)$ for every n by induction. [3]

2 Consider the following two languages on the alphabet $\sum = \{a, b\}$: [5]

$L_1 = \{a^n : n \geq 1\}$

$L_2 = \{b^n : n \geq 1\}$

Describe the languages below, using either set notation or the precise definitions on English.

$L_3 = L_1^*$

$L_4 = \overline{L_1}$

$L_5 = L_1 \cup L_2$

$L_6 = L_1 L_2$

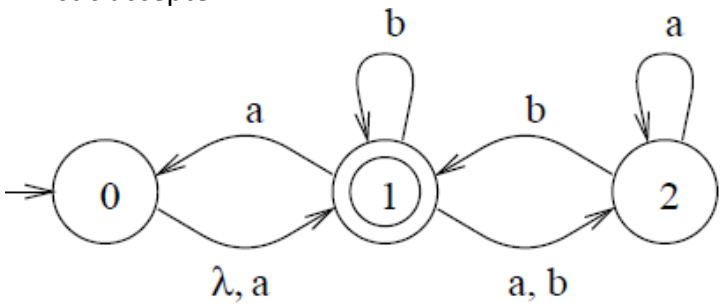
$L_7 = (L_1 \cup L_2)^*$

$L_8 = (L_1 L_2)^*$

3. For each of the following three languages on $\sum = \{a, b\}$, draw a deterministic finite automaton that accepts it: [5]

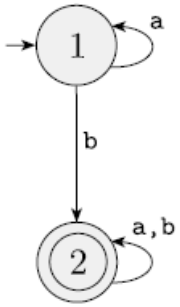
   a. Any strings with an even number of **ab** pairs
   b. All strings that have neither ***aa*** nor ***bb*** as a substring

4. For the alphabet $\sum = \{a, b\}$, draw a deterministic finite accepter that is equivalent to the following nondeterministic accepter: [5]



5. Convert the following regular expression to an NFA. [5]
   a. (ab U a)*
   b. (a U b)*aba

6. a. Write down the formal definition of regular expression. [2]
   b. Convert the following DFA into a regular expression. [3]



7. a. Write down the formal definition of context-free grammar. [2]
   b. Consider the following grammar [3]

$S \rightarrow abScB \mid \varepsilon$

$B \rightarrow bB \mid b$

What language does it generate?