United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Midterm Exam. **: : Trimester: Fall 2018**

Course Code: CSI 233 Course Title: Theory of Computing

Total Marks: **30** Duration: 1 hour 45 minutes

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

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1. a) Draw the state diagram of a DFA that accepts the strings containing exactly two consecutive 1's. (**Accepted**: 101100, 0110110011; **Rejected:** 0111100, 101010). Here, $\sum = \{0, 1\}$. Also write the components of the DFA. [2 + 2]

b) Design a DFA that accepts the strings where the number of a's is divisible by 3. Draw the state diagram only. Here, $\sum = \{ a,b \}$ [2]

2. a) Draw the state diagram of an NFA / ε-NFA which accepts strings having both **'web'** and **'security'** as substrings . Here, $\sum = \{a,b,c,d,\ldots,z\}$ [2]

b) Draw the state diagram of an NFA / ε-NFA which accepts strings having 1 at the 3rd position from the last. Here, $\sum = \{0, 1\}$ [2]

c) Draw the state diagram of an NFA / ε-NFA which recognizes leap years. Assume that, leap year occurs every 4 years starting from 0. Here, $\sum = \{0,1,2,3,4,5,6,7,8,9\}$. [2]

3. a) Draw the ε-NFA for Regular Expression $(ba^* + b^+ + \varepsilon)^*$ [2]

b) Give a regular expression for all 5-digit hexadecimal numbers (e.g. 21EFC, 31ABC). [2]

c) Write the regular expression over the alphabet {0, 1} where all strings containing no more than one (1) occurrence of the substring 00. (**Accepted:** ε, 0100, 10010, 0101; **Rejected:** 000, 100100). [2]

4. Consider the following ε-NFA:

Input / States	ε	a	b	c
→Q_0	$\{Q_1\}$	$\{Q_1, Q_3\}$	∅	∅
Q_1	∅	∅	$\{Q_3\}$	∅
Q_2	$\{Q_4\}$	$\{Q_0\}$	∅	∅
Q_3	$\{Q_1\}$	∅	∅	$\{Q_4\}$
*Q_4	$\{Q_0\}$	∅	$\{Q_2\}$	∅

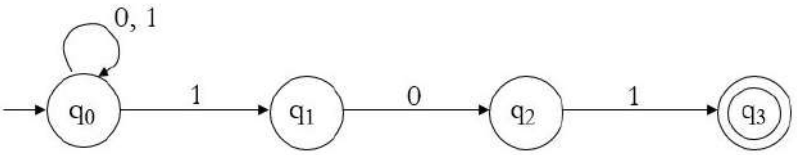
a) Compute the **ε-closure** of each state. [2]

b) Convert the ε-NFA to equivalent **DFA**. Show both **transition table** and **state diagram** of DFA [4]

5. a) For the given diagram, check whether input strings will be accepted or not. [2]

i) 101011001

ii) 101000000101



b) Write the language of regular expression $(aa)^* + (bb)^* b$. [2]

c) Suppose L= {ba, ab, bbb}. Write down the value of L^2. [2]