B.Sc. Engg. (CSE) 7th Semester — 7 March 2019 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION — **WINTER SEMESTER, 2018-2019**

DURATION: 1 Hour 30 Minutes — **FULL MARKS: 75**

CSE 4703: Theory of Computation

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **4 (four)** questions. Answer any **3 (three)** of them.

Figures in the right margin indicate marks.

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1. a) In ancient Japan, there was a game called Janken which had the three symbols, Snake, Slug and Frog. In this game, hand gestures were made to represent the three symbols. In a two player setting, Snake would beat Frog, Frog would beat Slug and Slug in turns would beat Snake. Show this relationship as a directed graph. 3

   b) Prove that, "For each even number n greater than 2, there exists a 3-regular graph with n nodes". 7

   c) Draw the state diagram for the DFAs that accept the following languages [in all of the problems, $\Sigma = \{a, b\}$]: 3x5

      i. {w| w is any string that does NOT contain exactly two a's}
      ii. {w| w begins with an 'a' and ends with 'ab'}
      iii. {w| w does NOT contain the substring aab}

2. a) Prove by construction that "the class of regular languages are closed under the union operation". Your proof should construct a DFA as part of the proof. Also, show what needs to be changed if we wanted to proof that the "the class of regular languages are closed under the intersection operation". 15

   b) Using the proof above, draw the state diagram for the DFAs that accept the following languages [in all of the problems, $\Sigma = \{a, b\}$]: 2x5

      i. {w| w has exactly two a's and at least two b's}
      ii. {w| w has an even number of a's and each a is followed by at least one b}

   Hint: Each of these languages are the combination of two simpler regular languages.

3. a) Draw NFAs for the following regular expressions [in all of the problems, $\Sigma = \{a, b\}$: 2x9

      i. $(a \cup b^+)a^+b^+$
      ii. $a^+ \cup (ab)^+$

   b) Why can't we prove "the class of regular languages is closed under the concatenation operation" using DFAs? How does non-determinism help us in proving this theorem? 7

4 a) Draw the equivalent DFA for the following NFA. Make sure to get rid of extraneous states: 16

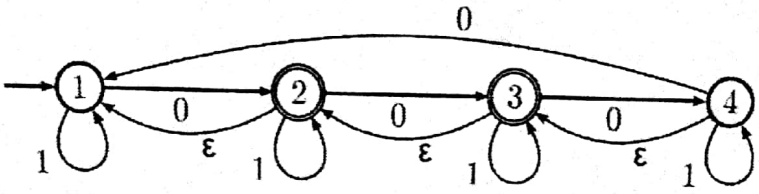

Figure 1: NFA for question 4 (a)

b) Prove that "If a language is described by a regular expression, then it is regular." 9