B.Sc. Engg. SWE 3ʳᵈ Semester   5 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 4309: Theory of Computing

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) Explain the terms in one sentence: 2
        i.   Decidability
        ii.   Intractability

    b) Give the formal description of the finite automata pictured in Figure 1. What is the language   6+2
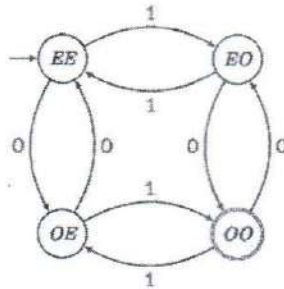   of the automata?

Figure 1: State diagram of a finite automaton for question 1.b

    c) A vending machine is an automated machine that provides items such as snacks, beverages,   15
        lottery tickets to consumers after money, a credit card or specially designed card is inserted
        into the machine. Consider a very simple vending machine which provides pen at a cost of
        10tk each. The machine takes 2tk, 5tk and 10tk only, and does not return changes even if you
        pay more than the price of a pen. It accepts payment only if you pay at least the rate for a pen
        otherwise rejects. There is a reset button in the machine which someone can press anytime to
        start a new purchase. Now design a DFA (state diagram) for the vending machine.

2. a) What are the differences between a DFA and an NFA?   4
    b) Design an NFA to accept the set of strings over alphabet {0, 1} such that there are two 0's   9
        separated by a number of positions that is a multiple of 4. Note that 0 is a multiple of 4.
    c) Convert the NFA represented by Table 1 to its equivalent DFA.   12

Table 1: Transition table of a DFA for question 2.c.

	0	1
→ p	{p, q}	{p}
q	{r, s}	{t}
r	{p, r}	{t}
* s	∅	∅
* t	∅	∅

3. a) Figure 2 is the state diagram of an ε-NFA. Describe the language it accepts. Also describe   2+8
        (with diagram) the states the automata will transit through during the processing of input
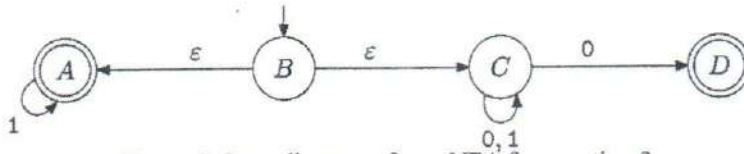
string 0010.

Figure 2: State diagram of an ε-NFA for question 3.a

c) Compute the ε-closure of each state and convert the ε-NFA of Table 2 to its equivalent DFA.　　15

Table 2: Transition table of an ε-NFA for question 3.c

	ϵ	a	b	c
→ p	$\emptyset$	{p}	{q}	{r}
q	{p}	{q}	{r}	$\emptyset$
* r	{q}	{r}	$\emptyset$	{p}

4. a) What are the operators of regular expression? Mention the order of precedence followed by the operators.　　2+1

b) Let A and B are two regular languages and their alphabet is the standard 26 letters $\{a, b, .., z\}$. $A = \{good, bad\}$ and $B = \{boy, girl\}$. Now what will be the sets of $B \cup A$ and $B \circ A$?　　4

c) Describe the languages of the following regular expressions:　　2x3

   i.　$\Sigma^*011\Sigma^*$

   ii.　$(1^*01^*0)^*1^*$

d) Write regular expressions for the following languages:　　2x6

   iii.　The set of all strings over alphabet {0, 1} whose tenth symbol from the right end is 1.

   iv.　The set of strings over alphabet {a, b} consisting of even number of a's followed by odd number of b's.