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

MID SEMESTER EXAMINATION **WINTER SEMESTER, 2019-2020**

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) State the differences between a DFA and an NFA. 5

   b) i. Consider a finite automaton $A = (Q, \Sigma, \delta, q_0, F)$. Explain the meaning of the elements of the 5-tuple. Explain δ for both DFA and NFA. 5+2

   ii. Suppose a DFA A is expressed as $A = (Q, \Sigma, \delta, q_0, F)$. Now, write down the values of A for the following DFA:

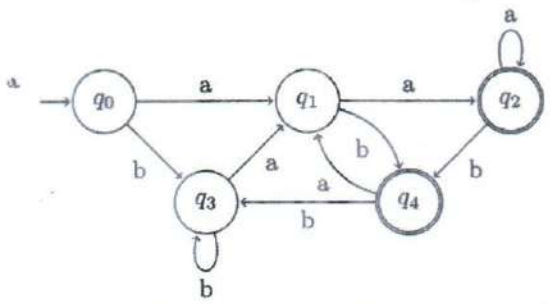

Figure 1: DFA for Question 1.b

   c) Draw state diagram and transition table of a DFA that starts with 0 and has 110 as a substring where $\epsilon = \{0,1,2\}$. 6

   d) Convert the following NFA into DFA and also draw the transition diagram of the DFA. 7

	P	Q
→A	{A,B}	{A}
B	{C}	{C}
C	{D}	Φ
*D	{D}	{D}

2. a) Define regular expression. What are the operators of regular expression? Mention the order of precedence followed by the operators. 5

   b) Convert the following Regular Expression into NFA: 8
   (A+B+CD)+(IJ)*+((E+F)GH)

   c) Construct a Regular Expression of a grammar that starts with 3 ones (1), then consists a substring of zeroes (0) and ones (1) starting and ending with zero (0) and then again 2 ones (1). 4

   d) Consider the following ε-NFA: 8

	Є	0	1	2
→A	{B,C}	Φ	{B}	{C}
B	Φ	{A}	{C}	{A,B}
C	Φ	Φ	Φ	Φ

i. Find out the ε-closure for each state
ii. Convert it into DFA
iii. Construct the Transaction Table for the converted DFA
iv. Give all the strings of length two or less accepted by the automaton

3. a) What is the difference between the strings and the words of a language? 2
b) Design NFA's for the following languages. 9
i. The NFA recognizes all strings that contain two 0's separated by a substring whose length is a multiple of 3 over the alphabet {0, 1}.
ii. The set of all strings that consist of either 01 repeated one or more times or 010 repeated one or more times over the alphabet {0, 1}.
c) The following diagram is an NFA accepting all strings that end in 01. Describe the states the NFA is in during the processing of input sequence 00101 (with diagram). 8

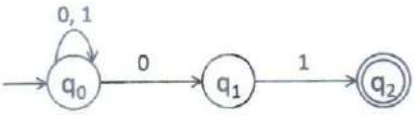

Figure 2: NFA for Question 3.c

d) Write regular expressions for the following languages 6
i. The set of strings of 0's and 1's whose tenth symbol from the right end is 1
ii. The set of strings of 0's and 1's with at most one pair of consecutive 1's.
iii. The language { w | w contains at least two a's, or exactly two b's }

4. a) Explain the language of the automaton of diagram below. 4

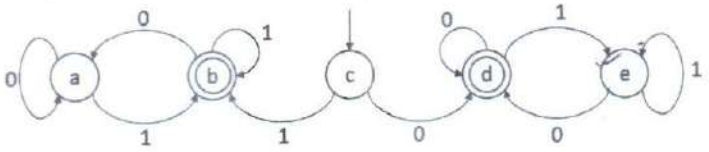

Figure 3

b) i. Explain the terms Decidability and Intractability. 9
ii. Write down the applications of finite automata
iii. What is the difference between empty string and empty language?
c) Find out the Regular Expression for the following Finite Automata: 5

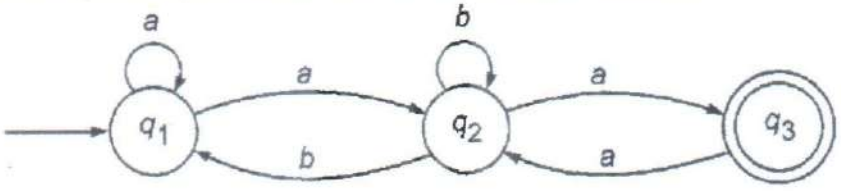

Figure 4: Finite Automata for Question 4.c

d) Draw state diagram and transition table of a DFA that accept strings where every 'a' is never followed by 'ab' over input alphabets $\sum$ = {a, b} 7