BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations (January 2020 Term)

Sub: **CSE 211** (Theory of Computation)

Full Marks: 180, Section Marks: 90, Time: 2 Hours (Sections A + B)

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Given an instance of the Dominating Set problem, desctibe how the certificate can determine whether the Dominating Set problem is in NP. (6)

   (b) After learning the pumping lemma (difficult to understand, easy to go astray when applying it), Surcharged Skye got very excited and came up with his very personal opinions regarding a number of languages as follows: (12)

   i. For $\Sigma = \{0, 1\}$, $L_1 = \{ww \mid w \in \{0, 1\}^*\}$, we choose the string 0^p0^p, take $x = \epsilon$, $y = (00)^k$, $k \leq \frac{p}{2}$. Now, since $\forall i \geq 0$, $xy^iz \in L_1$, L_1 is regular.

   ii. For $\Sigma = \{0, 1\}$, $L_2 = \{w \in \Sigma^* \mid n_0(w) = 3n_1(w)\}$ ($n_a(w)$ denotes the number of a's in w), we choose the string $0^{3p}1^p$, take $y = 0001$. Since $\forall i \geq 0$, $xy^iz \in L_2$, we have failed to demonstrate that L_2 contradicts pumping lemma.

   Explain clearly whether you find anything wrong in each of the opinions expressed by Skye.

   (c) Consider the NFA given below: (12)

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

   Give, with necessary explanations, general forms of all the strings of length three or less accepted by the automaton.

2. (a) State informally, the language accepted by the DFA shown in the figure. (7)

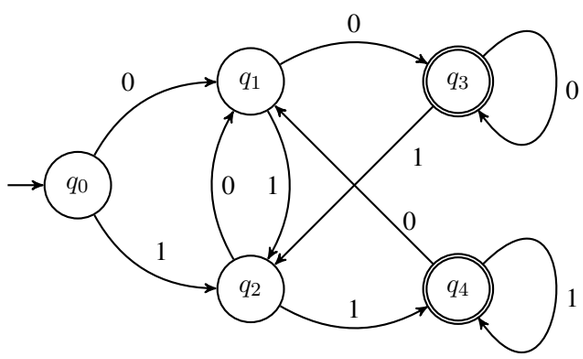

Figure for Question 2(a).

   (b) For the DFA in Question 2(a), draw the equivalent NFA for the corresponding language. (13)

   (c) For the DFA in Question 2(a), write down the regular expression for the strings that *do not* belong to the corresponding language. (10)

Contd P/2

CSE 211

3. (a) Evaluate the following regular expressions. Show the detailed computations. (10)

   i. $\emptyset^*\emptyset^*\emptyset^*\emptyset^*$

   ii. $\emptyset^* \cup \{\epsilon\}$

   iii. $(\emptyset^* \cup 1)\{0, 1\}$

   iv. $(11)^*\emptyset(00)^*$

   v. $(\emptyset^* \cup 0)\{0, 1, 11\}$

   (b) We have got an NFA $N_1 = (Q_1, \Sigma, \delta_1, q_1, F_1)$ which recognizes the language L_1. (20)
   We want to construct $N = (Q, \Sigma, \delta, q_0, F)$ to recognize L_1^*.

   In this process, we define δ for N such that for any $q \in Q$ and any $a \in \Sigma_\epsilon$,

$$\delta(q,a) = \begin{cases} \delta_1(q,a) & q \in Q_1 \text{ and } q \notin F_1 \\ \delta_1(q,a) & q \in F_1 \text{ and } a \neq \epsilon \\ \delta_1(q,a) \cup \{q_1\} & q \in F_1 \text{ and } a = \epsilon \\ \{q_1\} & q = q_0 \text{ and } a = \epsilon \\ \emptyset & q = q_0 \text{ and } a \neq \epsilon \end{cases}$$

   Explain clearly in plain English (stressing on the purpose) each of the conditions (at right) in the above transition function.

4. (a) Give a description in English of the language of the regular expression: (10)
   $(1 + \epsilon)(00^*1)^*0^*$.

   (b) Convert the NFA shown in the figure to an equivalent DFA. Show the computations. (20)

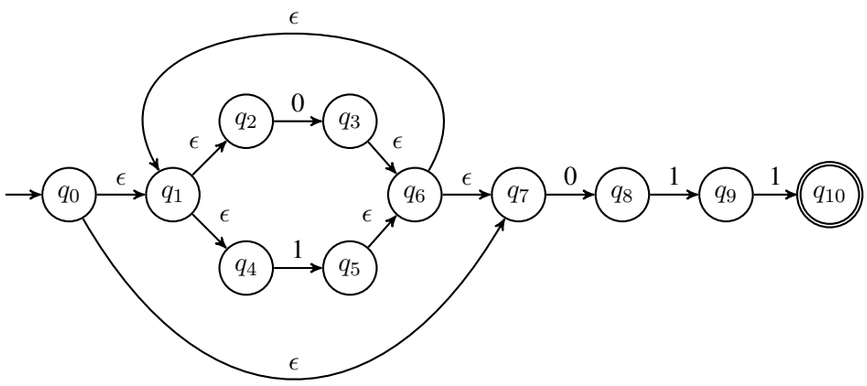

Figure for Question 4(b).

— THE END —