IV_IT_CB 29.05.2019

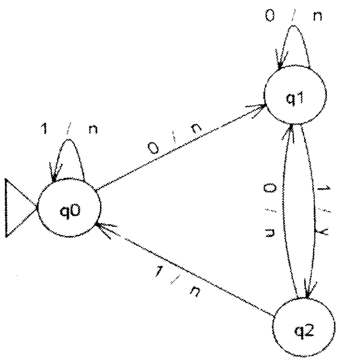
Paper / Subject Code: 41005 / Automata Theory

(3 Hours) **[Total Marks: 80]**

1. Question No. **1** is **compulsory**.
2. Out of remaining questions, attempt any **three** questions.
3. Assume **suitable** data wherever required but **justify** the same.
4. **All** questions carry **equal** marks.
5. Answer to each new question to be started on a fresh page.
6. **Figure** to the **right** in brackets indicate **full** marks.

1. Solve any four from the followings.

(a) Construct Moore machine equivalent to following Mealy machine. **[05]**



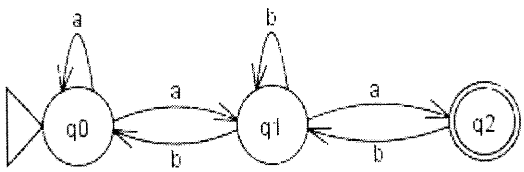
(b) Construct a PDA for the following Context Free Grammar (CFG). **[05]**

$S \rightarrow CBAA$ $\quad A \rightarrow 0A0 \mid 0$ $\quad B \rightarrow 0B \mid 0$ $\quad C \rightarrow 0C1 \mid 1C0 \mid \varepsilon$

(c) Construct right linear grammar and left linear grammar for the regular expression $1(01)^*0(0 + 1)^*$. **[05]**

(d) Explain the concepts, acceptance by final state and acceptance by empty stack of a Pushdown automata with suitable example. **[05]**

(e) Construct regular expression for the following FA using state elimination method. **[05]**

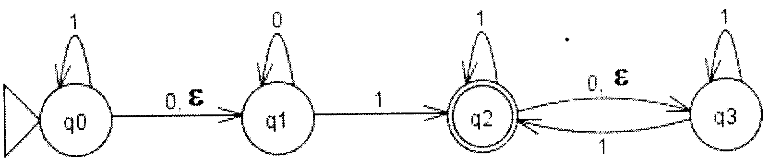


2. (a) Write down the regular expressions for the following language. **[04]**

i. L is the language of all strings over {0, 1} having odd number of 0's and any number of 1's.

ii. L is the language of all strings over {0, 1} having number of 1's multiple of three.

(b) Construct DFA for the following NFA with ε-moves. **[10]**



(c) Construct NFA with ε-moves for the regular expression $ab^*(a + b)^* + ba^*$ **[06]**

3. (a) Covert the following context free grammar into Chomsky normal form. **[10]**

$S \rightarrow A \mid C \qquad A \rightarrow aA \mid a \mid B \qquad B \rightarrow bB \mid b \mid \varepsilon \qquad C \rightarrow cC \mid c \mid B$

(b) Construct a Context Free Grammar (CFG) for the following PDA. **[10]**

$M = (\{q_0, q_1\}, \{(,), [,]\}, \{(, [, Z_0\}, \delta, q_0, Z_0, \Phi)$ and δ is given by:

$\delta(q_0, (, Z_0) = (q_0, (Z_0)$

$\delta(q_0, [, Z_0) = (q_0, [Z_0)$

$\delta(q_0, (, () = (q_0, (()$

$\delta(q_0, [, [) = (q_0, [[)$

$\delta(q_0, (, [) = (q_0, ([)$

$\delta(q_0, [, () = (q_0, [()$

$\delta(q_0,), () = (q_0, \varepsilon)$

$\delta(q_0,], [) = (q_0, \varepsilon)$

$\delta(q_0, \varepsilon, Z_0) = (q_1, \varepsilon)$

4. (a) Construct a PDA for $L = \{a^n b c^m \mid n, m \geq 1 \text{ and } n < m\}$. **[10]**

(b) Design a DFA over $\{0, 1\}$ which accepts all strings that contain substring '11' and do not contain the substring '00'. **[06]**

(c) Give context free grammar for the following languages. **[04]**

i. $L = \{0^n 1^m 0^k \mid m > n + k \text{ and } n, m, k \geq 0\}$

ii. $L = \{a^{2n} b^{3m} c^m d^n \mid n, m \geq 1\}$

5. (a) Construct Turing Machine to accept language $L = \{a^n b^{2n+1} \mid n \geq 1\}$. **[10]**

(b) Find the equivalent NFA with ϵ-moves accepting the regular language defined by the following grammar. **[05]**

$S \rightarrow 01S \mid 0A \qquad A \rightarrow 10 \mid 1B \mid 00A \qquad B \rightarrow 1S \mid 1B \mid \epsilon$

(c) Let G be the grammar having following set of production. **[05]**

$S \rightarrow ABA \qquad A \rightarrow aA \mid bA \mid \epsilon \qquad B \rightarrow bbb$

For the string "ababbbba", find a leftmost derivation and rightmost derivation.

6. (a) Minimize the following DFA $M = (\{q_0, q_1, q_2, q_3, q_4, q_5\}, \{0, 1\}, \delta, q_0, \{q_3, q_5\})$, where δ is given in the following table. **[06]**

	$\rightarrow q_0$	q_1	q_2	$*q_3$	q_4	$*q_5$
0	q_1	q_3	q_5	q_3	q_5	q_3
1	q_2	q_4	q_1	q_4	q_1	q_4

(b) Construct Turing Machine wherein given an input 1^n leaves 1^{3n+1} on the tape. Covert the TM design into equivalent function. **[10]**

(c) What do you understand by closure property? State the various set theoretic operations under which regular languages are closed. Give suitable example. **[04]**
