

Fifth Semester B.E. Degree Examination, Dec.2013/Jan.2014
Formal Languages and Automata Theory

Time: 3 hrs.

Max. Marks: 100

**Note: Answer FIVE full questions, selecting
at least TWO questions from each part.**

PART – A

- 1 a. Mention the differences between DFA, NFA and ϵ -NFA. (06 Marks)
 b. Design a DFA which accepts set of all strings of 0's and 1's, beginning with a 1 that, when interpreted as a binary integer, is a multiple of 5. For example, strings 101, 1010 and 1111 are in the language; 0, 100, 0101 and 111 are not. (06 Marks)
 c. Convert the following NFA to DFA using subset construction method: (08 Marks)

δ	0	1
$\rightarrow p$	{p, q}	{p}
q	ϕ	{r}
* r	{p, r}	{q}

- 2 a. Consider the following ϵ -NFA

δ	a	b
$\rightarrow p$	{r}	{q}
q	ϕ	{p}
* r	{p, q}	{r}

- i) Compute the ϵ -closure of each state.
 ii) Give the set of all strings of length 3 or less accepted by the automation.
 iii) Convert the automation to DFA. (08 Marks)
 b. Give the regular expressions for the following languages:
 i) $L = \{a^n b^m : n \geq 4, m \geq 2\}$; ii) $L = \{w : w \in (0, 1)^* \text{ and } |w| \bmod 3 = 0\}$. (04 Marks)
 c. Mention the applications of regular expressions. (02 Marks)
 d. Prove that every language defined by a regular expression is also defined by a finite automation. (06 Marks)
- 3 a. State and prove pumping lemma for regular languages. (06 Marks)
 b. Obtain the regular expression from the following finite automation using state elimination method. (04 Marks)

Fig.Q.3(b)



- c. When two states are equivalent or distinguishable? Minimize the following DFA using table filling algorithm. (10 Marks)

δ	0	1
$\rightarrow q_1$	q ₂	q ₃
q ₂	q ₃	q ₅
* q ₃	q ₄	q ₃
q ₄	q ₃	q ₅
* q ₅	q ₂	q ₅

- 4 a. Define CFG. Design a context free grammar for the languages:
- $L = \{a^i b^j c^k, \text{ where } i = j + k, i, j, k \geq 0\}$.
 - $L = \{0^{n+2} 1^n : n \geq 1\}$. (08 Marks)
- b. What is an ambiguous grammar? Show that the grammar shown below is ambiguous on the string "aab".
- $S \rightarrow AB/aaB$
 $A \rightarrow Aa/a$
 $B \rightarrow b$. (06 Marks)
- c. Consider the grammar:
 $E \rightarrow + EE / * EE / - EE / x / y$
 Find the left most derivation, right most derivation and parse tree for the string "+ * - xyxy". (06 Marks)

PART - B

- 5 a. Discuss the languages accepted by a PDA. Design a PDA to accept the following language:
 $L = \{0^{2n} 1^n; n \geq 1\}$. Draw the transition diagram for the constructed PDA. Also, show the moves made by PDA for the string "000011". (14 Marks)
- b. Convert the following grammar to a PDA that accepts the same language by empty stack:
 $S \rightarrow aABB/aAA$
 $A \rightarrow aBB/a$
 $B \rightarrow bBB/A$
 $C \rightarrow a$. (06 Marks)
- 6 a. What are useless productions? Eliminate ϵ , unit and useless productions from the following grammar:
 $A \rightarrow bA/Bba/aa$
 $B \rightarrow aBa/b/D$
 $C \rightarrow CA/AC/B$
 $D \rightarrow a/\epsilon$. (10 Marks)
- b. Define Chomsky normal form. Convert the following CFG to CNF:
 $S \rightarrow aSb/ab/Aa$
 $A \rightarrow aab$. (06 Marks)
- c. Prove that the context free languages are closed under union. (04 Marks)
- 7 a. Design a turing machine to accept the language $L = \{ww^R : w \in (a, b)^*\}$. Write its transition diagram. Also show the sequence of moves made by the TM for the string "aabbaa". (14 Marks)
- b. Define turing machine. Explain with a diagram general structure of multitape turing machine. (06 Marks)
- Write short notes on:
- Recursive languages.
 - Universal turing machine.
 - Post's correspondence problem.
 - Applications of context free grammars. (20 Marks)
