A On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.

USN

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 ∈-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 1111 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	ф	{r}
* r	{p, r}	{ Q }

2 a. Consider the following ∈-NF.

Ç	<u> </u>	^`	V	
		(F)	а	b
		(r)	{ q }	{p, r}
	q	ф	{p}	ф
	* r	{p, q}	{r}	{p}

- i) Compute the ∈-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) $L = \{a^n b^m : 1 \le 4, m \ge 2\}$; ii) $L = \{w : w \in (0, 1) \text{ and } |w| \mod 3 = 0\}$. (04 Marks)
- c. Mention the applications of regular expressions.

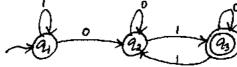
(02 Marks)

- d. Prove that every language defined by a regular expression so also defined by a finite automation. (06 Marks)
- 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)



When two states are equivalent or distinguishable? Minimize the following DFA using table filling algorithm.

(10 Marks)

δ	0	l
$\rightarrow q_1$	q_2	q_3
\mathbf{q}_2	\mathbf{q}_3	95
* q3	q_4	\mathbf{q}_3
q ₄	q ₃	q_5
* q5	\mathbf{q}_{2}	\mathbf{q}_{5}

- Define CFG. Design a context free grammar for the languages:
 - $L = \{a^i b^j c^k, \text{ where } i = j + k, i, j, k \ge 0\}.$
 - $L = \{0^{n+2} \ 1^n : n \ge 1\}.$

(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".

- Discuss the languages accepted by a PDA. Design a PDA to accept the following language: 5 $L = \{0^{2n}1^n; n \ge 1\}$. Draw the transition diagram for the constructed PDA. Also, show the moves made by PDA for the string "000011".
 - 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)

- a. What are useless productions? Elimente & unit and useless productions from the following grammar:
 - A → bA/Bba/aa
 - $B \rightarrow aBa/b/D$
 - $C \rightarrow CA/AC/B$
 - $D \rightarrow a/\epsilon$.

b. Define Chomskey formal form. Convert the following CFG to

 $S \rightarrow aSb/ab/Aa$

 $A \rightarrow aab$.

(06 Marks)

(10 Marks)

c. Prove that the context free languages are closed under union.

- (04 Marks)
- 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)

Define turing machine. Explain with a diagram general structure of multitape turing machine.

Write short notes on:

- Recursive languages.
- b. Universal turing machine.
- c. Post's correspondence problem.
- d. Applications of context free grammars.

(20 Marks)