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Fifth Semester B.E. Degree Examination, June/July 2015
Formal Languages and Automata Theory

Time: 3 hrs.

Max. Marks: 100

**Note: Answer any FIVE full questions, selecting
atleast TWO questions from each part.**

PART - A

1. a. Design a DFA to read strings made up of letters "CHARIOT" and recognize these strings that contains the word "CAT" as a substring. (08 Marks)
- b. Draw DFA to accept the language $L = \{\omega : \omega \text{ has odd number of 1's and followed by even number of 0's. Completely define DFA and transition function. (06 Marks)}$
- c. Convert the following NFA to its equivalent DFA. (06 Marks)
2. a. Prove that if $L = L(A)$ for some DFA, then there is a regular expression R such that $L = L(R)$. (06 Marks)
- b. For the following DFA, obtain regular expressions $R_{ij}^{(0)}$ and $R_{ij}^{(1)}$. (09 Marks)

States	Σ	
	0	1
$\rightarrow q_1$	q_2	q_1
q_2	q_3	q_1
q_3	q_3	q_2

- c. Construct NFA for regular expression $V = (01 + 10)^+$. (05 Marks)
3. a. State and prove pumping Lemma for regular languages. (05 Marks)
- b. Show that $L = \{A^{n!} \mid u \geq 0\}$ is not regular. (05 Marks)
- c. Construct 0 minimum automation equivalent to given automation 'M' whose transition table given below :

States	input	
	0	1
$\rightarrow q_0$	q_0	q_3
q_1	q_2	q_5
q_2	q_3	q_4
q_3	q_0	q_5
q_4	q_0	q_6
q_5	q_1	q_4
q_6^*	q_1	q_3

4. a. What is a grammar? Explain the classification of grammars with examples. (07 Marks)
- b. Obtain the grammar to generate the following languages :
 - i) $L = \{\omega : n_a(\omega) \bmod 2 = 0 \text{ where } \omega \in (a, b)^*\}$
 - ii) $L = \{\omega : \omega \text{ is a palindrome, where } \omega \in (a, b)^*\}$
 - iii) $L = a^n b^{2n} \mid u \geq 1$. (06 Marks)
- c. Show that the following grammar is ambiguous :
 $S \rightarrow a \mid Sa \mid bSS \mid SSb \mid SbS$. (07 Marks)



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PART – B

- 5 a. Construct PDA for the language and simulate this PDA
 $L = \{a^i b^j c^k \mid j = i + k, i, k \geq 0\}$. (10 Marks)
b. Define PDA. Explain the language accepted by PDA. (05 Marks)
c. Explain the PDA with two stocks. (05 Marks)
- 6 a. Simplify the grammar by eliminating useless productions.
S AB
A \rightarrow a
B \rightarrow C | b
C \rightarrow D
D \rightarrow E | bC
E \rightarrow d | Ab. (06 Marks)
b. Convert the following CFG to CNF.
S \rightarrow aB | bA
A \rightarrow a | aS | bAA
B \rightarrow b | aS | aBB. (06 Marks)
c. Prove that context free languages are closed under union, concatenation and star. (08 Marks)
- 7 a. Explain the programming techniques for turing machine. (10 Marks)
b. Construct a TM for $L = \{a^u b^u c^u \mid u \geq 1\}$. Give the graphical representation for the obtained TM. (10 Marks)
- 8 Explain the following :
a. Post correspondence problem
b. Recursively enumerable language
c. Recursive languages
d. Universal languages. (20 Marks)

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