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06CS56

Fifth Semester B.E. Degree Examination, June-July 2009
Formal Languages and Automata Theory

Time: 3 hrs. Max. Marks:100

Note : *1. Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. Assume missing data if any.

PART - A

1 a. Define i) Powers of an alphabet ii) N F A. **(04 Marks)**

b. Design a DFA to accept the following language over the alphabet { 0, 1}.
i) $L = \{\omega \mid \omega \text{ is a even number}\}$ ii) $L = \{(01)^i 1^{2j} \mid i \geq 1, j \geq 1\}$
iii) The set of strings eithe start with 01 or end with 01. **(10 Marks)**

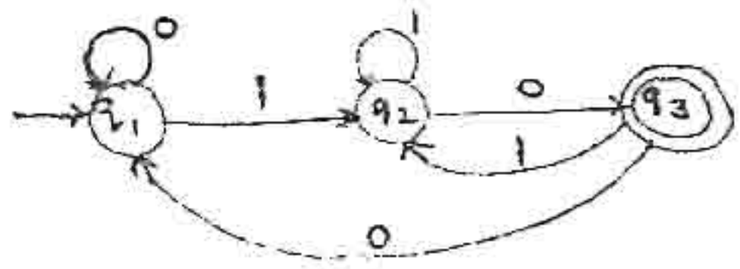
c. Consider the following ε – NFA. **(06 Marks)**

	ε	a	b	c
→ p	ϕ	{p}	{q}	{r}
q	{p}	{q}	{r}	ϕ
* s	{q}	{r}	ϕ	{p}

i) Compute the ε – closure of each state ii) Convert the automation to a DFA.

2 a. Define Regular Expression. Write the regular expression for the following languages:
i) Language of all strings ω such that ω contains exactly one 1 an even number of 0's
ii) Set of strings over {0, 1, 2} containing atleast one 0 and atleast one 1. **(10 Marks)**

b. Convert the following DFA to a regular expression using the state elimination technique. **(06 Marks)**



c. Prove that if R be a regular expression then there exists some ε - NFA that accepts L(R). **(04 Marks)**

3 a. i) State and prove pumping Lemma for regular languages.
ii) Prove that the following language is not regular : $L = \{0^n 1^{n+1} \mid n > 0\}$.
iii) Prove that if L is a regular language over alphabet Σ - then $\overline{L}$ is also a regular language. **(12 Marks)**

b. Minimize the following DFA using Table filling algorithm. **(08 Marks)**

	0	1
→ A	B	A
B	A	C
C	D	B
* D	D	A
E	D	F
F	G	E
G	F	G

4 a. Construct the CFG for the following Languages
i) $L = \{a^{2n} b^m \mid n \geq 0, m \geq 0\}$ ii) $L = \{ 0^i 1^j 2^k \mid i = j \text{ or } j = k \}$ and Generate left most derivation for the string 0 1 1 2 2. **(10 Marks)**

b. Define Ambiguous Grammar. Prove that the following grammar is Ambiguous. Find an unambiguous grammar. $S \rightarrow a\,S \mid a\,S\,b\,S \mid \varepsilon$ **(10 Marks)**

PART - B

5 a. Discuss the languages accepted by a PDA. Design a PDA for the language that accepts the strings with $n_a(w) < n_b(w)$ [number of a's less than number of b's]. Where $w \in (a + b)^*$ and show the instantaneous descriptions of the PDA on input a b b a b. **(14 Marks)**

b. Convert the following grammar to a PDA that accepts the same language by empty stack. $S \rightarrow 0\,S\,1 \mid A$; $A \rightarrow 1\,A\,0 \mid s \mid \varepsilon$. **(06 Marks)**

6 a. What are Useless Productions? Remove all useless productions, unit productions and all ε – productions from the grammar : **(10 Marks)**

$S \rightarrow a\,A \mid a\,B$; $A \rightarrow a\,a\,A \mid B \mid \varepsilon$; $B \rightarrow b \mid b\,B$; $D \rightarrow B$

b. Define CNF. Convert the follwing CFG to CNF.

$S \rightarrow A\,S\,B \mid \varepsilon$; $A \rightarrow a\,A\,S \mid a$; $B \rightarrow S\,b\,S \mid A \mid b\,b$. **(10 Marks)**

7 a. What is Turing Machine and Multi tape Turing Machine? Show that the language accepted by these machines are same. **(08 Marks)**

b. Design a Turing Machine for the language to accept the set of strings with equal number of 0's and 1's and also give the instantaneous description for the input 110100. **(12 Marks)**

8 Write short notes on:
a. Applications of CFG.
b. Homomorphism.
c. Recursive Languages.
d. Post's correspondence problem. **(20 Marks)**