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06CS56

Fifth Semester B.E. Degree Examination, December 2010

Formal Languages and Automata Theory

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define the following terms:
i) Alphabet ii) Power of an alphabet iii) Strings iv) Language **(04 Marks)**

b. Write the DFA's for the following languages over $\Sigma = \{a, b\}$:
i) The set of all strings ending with abb
ii) The set of all strings not containing the substring aab
iii) $L = \{a\,w\,a \mid w \in (a + b)^*\}$
iv) $L = \{w \mid |w| \bmod 3 = 0\}$ **(08 Marks)**

c. Convert the following NFA to its equivalent DFA. **(08 Marks)**

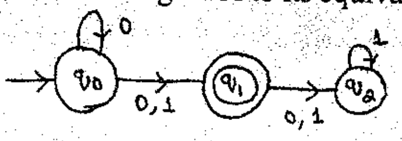

Fig.Q1(c)

2 a. Compute $\in$- closure of each state from the following $\in$ - NFA : **(04 Marks)**

	$\in$	a	b
→p	{r}	{q}	{p, r}
q	ϕ	{p}	ϕ
r	{p, q}	{r}	{p}
*s	{p}	{p}	{p}

b. Define regular expression. Write the regular expression for the following languages:
i) $L = \{a^n b^m \mid n \le 4, m \ge 2\}$
ii) Strings of 0's and 1's having no two consecutive zeros
iii) Strings of 0's and 1's whose lengths are multiples of 3. **(06 Marks)**

c. Design an $\in$-NFA for the regular expression $(a + b)^*ab$. **(04 Marks)**

d. Obtain a regular expression from the following DFA using state elimination method:

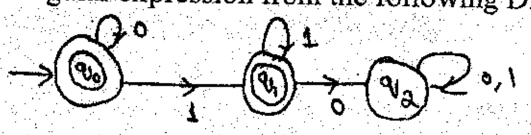

Fig.Q2(d)

(06 Marks)

3 a. Apply pumping lemma for the following languages and prove that they are not regular :
i) $L = \{ w w^R \mid w \in (0 + 1)^* \}$ ii) $L = \{ a^n b^n \mid n \ge 0 \}$ **(10 Marks)**

b. Prove that the regular languages are closed under complementation. **(04 Marks)**

c. Consider the two DFA's shown below. Using table filling algorithm, show that the language accepted by both the DFA's is same. **(06 Marks)**

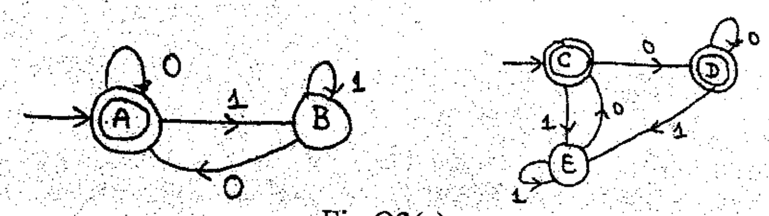

Fig.Q3(c)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

4 a. Define context free grammar. Write the grammar for the following languages :
i) $L = \{ 0^{n+2} 1^n \mid n \geq 1\}$ ii) $L = \{a^n b^m \mid m > n \text{ and } n \geq 0\}$ **(07 Marks)**

b. Consider the grammar G, with productions:
$S \rightarrow AbB$
$A \rightarrow aA \mid \epsilon$
$B \rightarrow aB \mid bB \mid \epsilon$
Give leftmost derivation, right most derivation and parse tree for the string aaabab. **(08 Marks)**

c. What is ambiguous grammar? Show that the following grammar is ambiguous.
$S \rightarrow AB \mid aaB$
$A \rightarrow a \mid Aa$
$B \rightarrow b$ **(05 Marks)**

PART – B

5 a. Define PDA. Describe the language accepted by PDA. **(04 Marks)**

b. Construct a PDA that accepts the language $L = \{a^n b^n \mid n \geq 1\}$. Give the graphical representation for PDA obtained. Show the instantaneous description of the PDA on the input string aaabbb. **(10 Marks)**

c. Obtain a PDA equivalent to the following grammar:
$S \rightarrow AS \mid \epsilon$
$A \rightarrow 0A1 \mid A1 \mid 01$ **(06 Marks)**

6 a. What are useless symbols? Explain with an example. **(04 Marks)**

b. Obtain the nullable set and hence eliminate all ϵ - productions from the following grammar:
$S \rightarrow aAa \mid AB$
$A \rightarrow BS \mid aBa \mid \epsilon$
$B \rightarrow aB \mid \epsilon$ **(06 Marks)**

c. Define CNF. Convert the following grammar to CNF:
$S \rightarrow aSb \mid ab \mid Aa$
$A \rightarrow aab$ **(10 Marks)**

7 a. Define turing machine. Explain with a diagram, general structure of multitape turing machine. **(06 Marks)**

b. Design a turing machine to accept the language $L = \{0^n 1^n \mid n \geq 1\}$. Write its transition diagram and give instantaneous description for the input 0011. **(14 Marks)**

8 Write short notes on the following : **(20 Marks)**

a. Application of regular expressions
b. Post's correspondence problem
c. Recursive languages
d. Universal turing machine

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