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10CS56

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 111 are not. **(06 Marks)**

c. Convert the following NFA to DFA using subset construction method: **(08 Marks)**

δ	0	1
→ p	{p, q}	{p}
q	ϕ	{r}
* r	{p, r}	{q}

2 a. Consider the following ∈-NFA:

δ	∈	a	b
→ p	{r}	{q}	{p, r}
q	ϕ	{p}	ϕ
* 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) $L = \{a^n b^m : n \leq 4,\ m \geq 2\}$; ii) $L = \{w : w \in (0, 1)^*$ and $|w| \bmod 3 = 0\}$. **(04 Marks)**

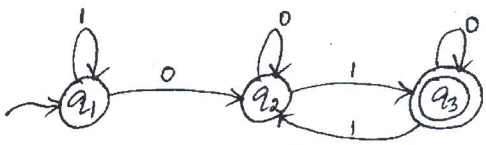
c. Mention the applications of regular expressions. **(02 Marks)**

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
→ 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:
i) $L = \{a^i b^j c^k$, where $i = j + k, i, j, k \geq 0\}$.
ii) $L = \{0^{n+2}\ 1^n : n \geq 1\}$. **(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 $\in$, unit and useless productions from the following grammar:
$A \rightarrow bA/Bba/aa$
$B \rightarrow aBa/b/D$
$C \rightarrow CA/AC/B$
$D \rightarrow a/\in$. **(10 Marks)**

b. Define Chomskey 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)**

8 Write short notes on:
a. Recursive languages.
b. Universal turing machine.
c. Post's correspondence problem.
d. Applications of context free grammars. **(20 Marks)**

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