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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)

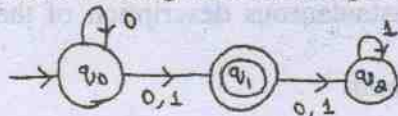


Fig.Q1(c)

- 2 a. Compute ϵ -closure of each state from the following ϵ -NFA : (04 Marks)

	ϵ	a	b
$\rightarrow p$	{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) $L = \{a^n b^m \mid n \leq 4, m \geq 2\}$
 - 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 ϵ -NFA for the regular expression $(a + b)^* ab$. (04 Marks)
- d. Obtain a regular expression from the following DFA using state elimination method:

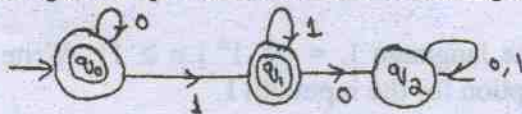


Fig.Q2(d)

(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) $L = \{a^n b^n \mid n \geq 0\}$ (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)

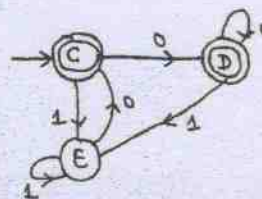
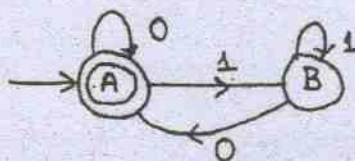


Fig.Q3(c)

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
