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Fifth Semester B.E. Degree Examination, June/July 2018
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. Find a deterministic finite automata that recognizes each of the following sets ($\Sigma=\{0, 1\}^*$)
 - (i) $\{0\}$ (ii) $\{1, 00\}$, (iii) $\{1^n \mid n = 2, 3, 4 \dots\}$ (10 Marks)
- b. State the alphabets Σ for the following languages :
 - (i) $L = \Sigma^* = \{\epsilon, 0, 1, 00, 01, 11, 000, 001, 010, \dots\}$
 - (ii) $L = \Sigma^+ = \{a, aa, aaa \dots\}$
 - (iii) $L = \Sigma^+ = \{\epsilon\}$ (05 Marks)
- c. Design a DFA that recognizes the following language :
 - $L = \{W \mid W \text{ is non-empty \& has 1 on every odd position}\}$ (05 Marks)

- 2 a. Give NFAs with specified Number of states recognizing each of the following languages in all cases, the alphabet is $\Sigma = \{0, 1\}$
 - (i) The language $\{W \in \Sigma^* \mid W \text{ contains the substring } 0101 \text{ ie, } W = X0101Y \text{ for some } X, Y \in \Sigma^*\}$ with five states. (10 Marks)
 - (ii) The language $\{W \in \Sigma^* \mid W \text{ contains at least two 0's or exactly two 1's}\}$ with six states. (07 Marks)
- b. Convert the following NFAs to DFAs [Refer Fig.Q2(b)].

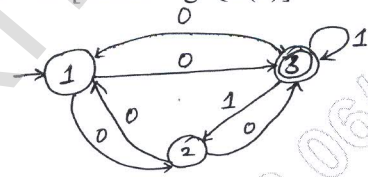


Fig.Q2(b)

- c. Write a Regular expression for the following language:
 - (i) The language $\{W \in \Sigma^* \mid |W| \text{ is odd, } \Sigma = \{a, b\}\}$ (03 Marks)
- 3 a. Convert the following ϵ NFA into an equivalent DFA [Refer Fig.Q3(a)]. (08 Marks)

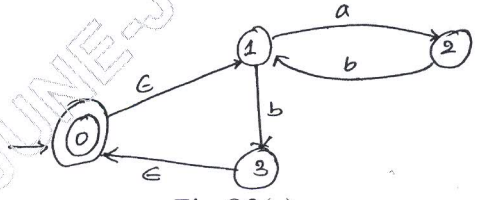


Fig.Q3(a)

- b. Minimize the following finite automata [Refer Fig.Q3(b)]: (08 Marks)

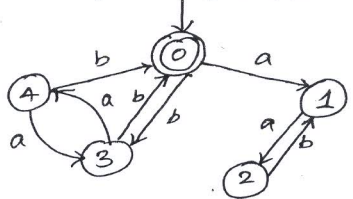


Fig.Q3(b)

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.

- c. Construct a regular expression corresponding to the Automata given below [Refer Fig.Q3(c)] : (04 Marks)

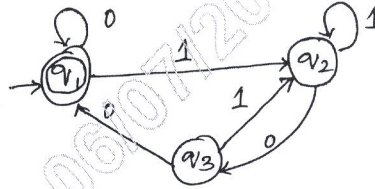


Fig.Q3(c)

- 4 a. Give a Context Free Grammar (CFG) for each of the following language over the alphabet $\Sigma = \{a, b\}$.
 (i) All strings in the language $L = \{ a^n b^m a^{2n} / n, m \geq 0 \}$
 (ii) All non empty strings that start and end with the same symbol
 (iii) All strings with more a's than b's. (07 Marks)
 b. Is the following language L is regular? Justify your answer.
 $L = \{ a^n / n \text{ is prime} \}$ (07 Marks)
 c. State and prove the pumping Lemma for Regular language. (06 Marks)

PART - B

- 5 a. Design CFG and PDA for the following language:
 $L = \{ 0^n 1^n / n \geq 0 \}$, where $\Sigma = \{0, 1\}$ (10 Marks)
 b. Design a PDA for the following languages L.
 $L = \{ a^i b^j c^k d^l / i + k = j + l, i, j, k, l \geq 0 \}$, where $\Sigma = \{a, b, c, d\}$ (10 Marks)
- 6 a. Convert the following CFG to a PDA:
 $S \rightarrow aAA, A \rightarrow aS / bS / a$ (08 Marks)
 b. What is the CNF and GNF? Obtain the following grammar in CNF:
 $S \rightarrow aBa \mid abba$
 $A \rightarrow ab \mid AA$
 $B \rightarrow aB \mid a$ (12 Marks)
- 7 a. For the CFG with productions :
 $S \rightarrow a/aAB \mid aCb, A \rightarrow aB \mid \epsilon, B \rightarrow Ba/A \mid \epsilon,$
 $C \rightarrow B \mid bCb \mid S, D \rightarrow dd \mid cC$
 (i) Eliminate ϵ productions
 (ii) Eliminate the unit productions
 (iii) Eliminate the useless symbols (10 Marks)
 b. Prove that the context free Languages are closed under Union concatenation and Kleen closure. (10 Marks)
- 8 Write short notes on the following (any four) :
 a. Post correspondence problem
 b. Applications of Regular expressions
 c. Multi-tape Turing machine
 d. Undecidable languages
 e. Chomsky Hierarchy
 f. Recursively enumerable languages. (20 Marks)
