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10CS56

**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  $\Sigma$  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)].

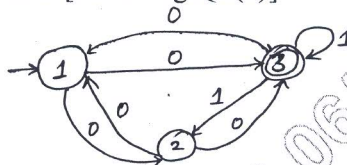


Fig.Q2(b)

- 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  $\epsilon$ NFA into an equivalent DFA [Refer Fig.Q3(a)].      (08 Marks)

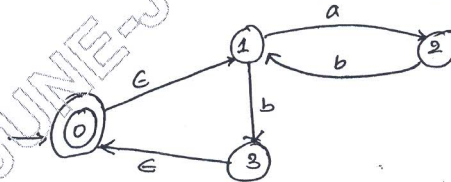


Fig.Q3(a)

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

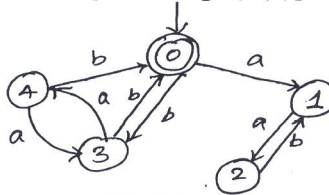


Fig.Q3(b)

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)

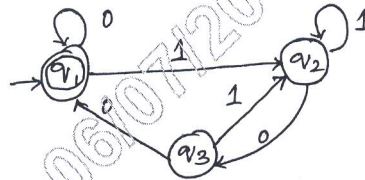


Fig.Q3(c)

- 4 a. Give a Context Free Grammar (CFG) for each of the following language over the alphabet  $\Sigma = \{a, b\}$ .
- All strings in the language  $L = \{ a^n b^m a^{2n} / n, m \geq 0 \}$
  - All non empty strings that start and end with the same symbol
  - 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 :  
 $S \rightarrow a/aAB \mid aCb, A \rightarrow aB \mid \epsilon, B \rightarrow Ba/A \mid \epsilon,$   
 $C \rightarrow B \mid bCb \mid S, D \rightarrow dd \mid cC$
- Eliminate  $\epsilon$  productions
  - Eliminate the unit productions
  - 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) :
- Post correspondence problem
  - Applications of Regular expressions
  - Multi-tape Turing machine
  - Undecidable languages
  - Chomsky Hierarchy
  - Recursively enumerable languages.
- (20 Marks)

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