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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) $\{1^n \mid n = 2, 3, 4 \ldots..\}$ **(10 Marks)**

b. State the alphabets Σ for the following languages :
(i) $L = \Sigma^* = \{\in, 0, 1, 00, 01, 11, 000, 001, 010, \ldots\ldots\ldots\}$
(ii) $L = \Sigma^+ = \{a, aa, aaa \ldots\ldots\ldots\}$
(iii) $L = \Sigma^+ = \{ \in \}$ **(05 Marks)**

c. Design a DFA that recognizes the following language :
L = { W/W 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 $\{ W \in \Sigma^* \mid W$ contains the substring 0101 ie, W = X0101Y for some X, Y $\in \Sigma^* \}$ with five states.
(ii) The language $\{ W \in \Sigma^* \mid W$ contains at least two 0's or exactly two $1^s \}$ with six states. **(10 Marks)**

b. Covert the following NFAs to DFAs [Refer Fig.Q2(b)]. **(07 Marks)**

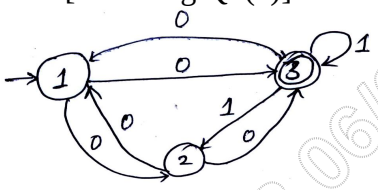

Fig.Q2(b)

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

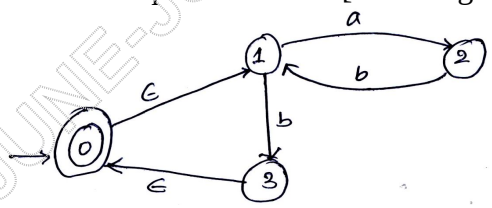

Fig.Q3(a)

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

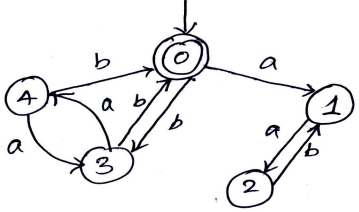

Fig.Q3(b)

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

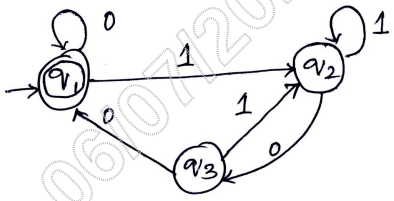

Fig.Q3(c)

4 a. Give a Context Free Grammar (CFC) 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.

$L = \{ a^i b^j c^k d^l / i + k = j + l , \quad i, j, k, l \geq 0\}$, where $\Sigma = \{ a, b, c, d \}$ **(10 Marks)**

6 a. Convert the following CFG to a PDA:

$S \rightarrow aAA, \quad A \rightarrow aS / bS / a$ **(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 :

$S \rightarrow a/aAB \mid aCb, \quad A \rightarrow aB \mid \in, \quad B \rightarrow Ba/A \mid \in,$

$C \rightarrow B \mid bCb \mid S, \quad D \rightarrow dd \mid cC$

(i) Eliminate $\in$ 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)**

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