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10CS56

# Fifth Semester B.E. Degree Examination, June/July 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.***

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.

## PART – A

1 a. Write the DFAs for the following languages over $\Sigma = \{a, b\}$
(i) The set of all strings ending with a & b.
(ii) The set of all strings not containing the substring aab.
(iii) Set of all strings with exactly three consecutive a's. **(10 Marks)**

b. Define NFA. Convert the following NFA to its equivalent DFA. [Refer Fig.Q1(b)] **(10 Marks)**

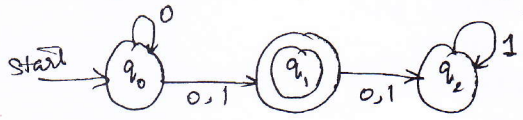


Fig.Q1(b)

2 a. Consider the following $\epsilon$- NFA:

| | $\epsilon$ | a | b | c |
|---|---|---|---|---|
| $\rightarrow$ p | $\phi$ | { p } | { q } | { r } |
| q | { p } | { q } | { r } | $\phi$ |
| * r | { q } | { r } | $\phi$ | { p } |

(i) Compute the $\epsilon$-closure of each state
(ii) Convert the $\epsilon$- NFA to DFA. **(08 Marks)**

b. Define Regular expression. Convert the following automation to a regular expression using state elimination technique. [Refer Fig.Q2(b)] **(08 Marks)**

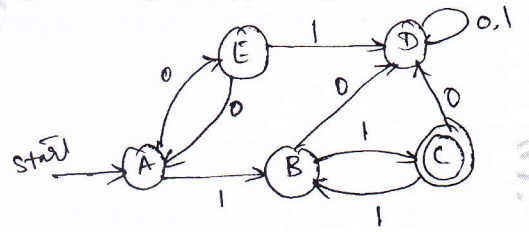


Fig.Q2(b)

c. Convert the regular expression $(0 + 1)^* \mid (0 + 1)$ to an NFA. **(04 Marks)**

3 a. State and prove pumping lemma for regular languages. **(10 Marks)**

b. Define distinguishable and indistinguishable states. Minimize the following DFA using table filling algorithm. **(10 Marks)**

| | | 0 | 1 |
|---|---|---|---|
| | A | B | F |
| | B | G | C |
| * | C | A | C |
| | D | C | G |
| | E | H | F |
| | F | C | G |
| | G | G | E |
| | H | G | C |

4 a. Define CFG. Write CFG for the following languages.
(i) $L = \{0^n 1^n \mid n \geq 1\}$
(ii) L = {String *l* of a's and b's with equal number of a's and b's } **(06 Marks)**

b. What is an ambiguous grammar? Show that the following grammar is ambiguous.
$E \rightarrow E + E \mid E - E \mid E * E \mid E / E \mid (E) \mid a$
where E is the start symbol. Find the unambiguous grammar. **(10 Marks)**

c. Discuss the applications of CFG. **(04 Marks)**

## PART – B

5 a. Define PDA. Construct PDA that accepts the language $L = \{ww^R \mid w \in (a+b)^*$ and $w^R$ is the reversal of w }. Write IDs for the string aabbaa. **(10 Marks)**

b. Convert the following CFG to PDA and give the procedure for the same.
$S \rightarrow aABB \mid aAA$
$A \rightarrow aBB \mid a$
$B \rightarrow bBB \mid A$
$C \rightarrow a$ **(10 Marks)**

6 a. Consider the following CFG:
$S \rightarrow ABC \mid BaB$
$A \rightarrow aA \mid BaC \mid aaa$
$B \rightarrow bBb \mid a \mid D$
$C \rightarrow CA \mid AC$
$D \rightarrow \in$
(i) What are useless symbols?
(ii) Eliminate $\in$-productions unit productions and useless productions from the grammar. **(10 Marks)**

b. What is CNF and GNF? Obtain the following grammar in CNF:
$S \rightarrow aBa \mid abba$
$A \rightarrow ab \mid AA$
$B \rightarrow aB \mid a$ **(10 Marks)**

7 a. Define a turing machine and explain with neat diagram, the working of a basic turing machine. **(06 Marks)**

b. Design a turing machine to accept the set of all palindromes over $\{a \cdot b\}^*$. Also, indicate the moves made by turing machine for the string aba. **(14 Marks)**

8 Write short notes on :
a. Multitape turing machine
b. Post's correspondence problem
c. Pumping lemma for CFL
d. Recursive languages. **(20 Marks)**

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