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06CS56

Fifth Semester B.E. Degree Examination, June/July 2018
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 DFA. Mention the difference between DFA and NFA. **(04 Marks)**

b. Design DFA for the following language over $\Sigma = \{a, b\}$
i) The set of strings containing substring abb
ii) The set of strings with exactly three a's
iii) $L = \{awa \mid w \in (a + b)^*\}$. **(10 Marks)**

c. Design NFA or $\in$ - NFA for the following languages
i) abc, abd, aacd $\{\Sigma = \{a, b, c, d\}\}$
ii) $\{ab, abc\}^*$ $\{\Sigma = \{a, b, c\}\}$. **(06 Marks)**

2 a. Compute $\in$- closure of each state from the following $\in$ - NFA : **(04 Marks)**

	$\in$	a	b
→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) $L = \{a^n b^m \mid n \le 4, m \ge 2\}$
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 $\in$-NFA for the regular expression (a + b)*ab. **(04 Marks)**

d. Obtain a regular expression from the following DFA using state elimination method [Refer Fig.Q2(d)]:

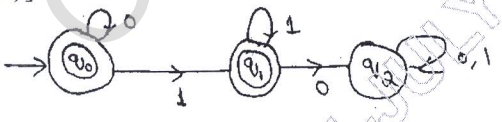

Fig.Q2(d)

(06 Marks)

3 a. State and prove pumping lemma for regular languages. **(08 Marks)**

b. Show that the language $L = \{w \mid n_a(w) = n_b(w)\}$ is not regular. **(04 Marks)**

c. Minimize the following DFA using table filling method [Refer Fig.Q3(c)] **(08 Marks)**

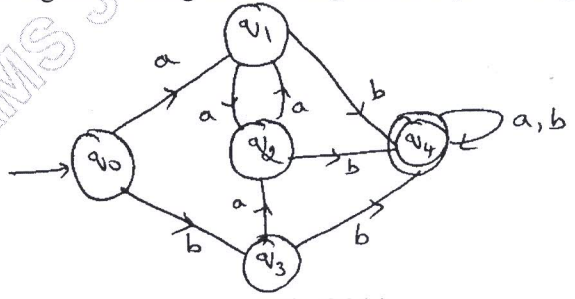

Fig.Q3(c)

4 a. Define CFG. Obtain CFG for the following :
i) $L = \{a^n b^{2n} \mid n \geq 0\}$
ii) $L = \{a^n b^{n-3} \mid n \geq 3\}$
iii) For regular expression $(a + b)^*$. **(07 Marks)**

b. Consider the grammar G with following productions $E \rightarrow +EE \mid * EE \mid - EE \mid x \mid y$
Find LMD, RMD and write parse tree for the string + * – xyxy. **(06 Marks)**

c. What is ambiguous grammar? Show that the following grammar is ambiguous on the string ibtibtaea.
$S \rightarrow iCtS \mid iCtSeS \mid a$
$C \rightarrow b$. **(07 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:
$S \rightarrow AS \mid \in$
$A \rightarrow 0A1 \mid A1 \mid 01$ **(06 Marks)**

6 a. Remove useless symbols from the following grammar:
$S \rightarrow aA \mid \beta$
$A \rightarrow aA \mid a$
$B \rightarrow bB$
$D \rightarrow ab \mid Ea$
$E \rightarrow ac \mid d$. **(08 Marks)**

b. Define CNF. Convert the following CFG to CNF:
$E \rightarrow E + E$
$E \rightarrow E * E$
$E \rightarrow (E)$
$E \rightarrow id$ **(08 Marks)**

c. Prove that context tree languages are closed under union operation. **(04 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 :
a. Multi tape Turing M/C
b. Halting problem of TM
c. Recursive language
d. Post's correspondence problem. **(20 Marks)**

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