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10CS56

Fifth Semester B.E. Degree Examination, May 2017
Formal Language and Automata Theory

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define following terms:
   i) DFA (Deterministic finite automata).
   ii) NFA (non-deterministic finite automata). **(04 Marks)**

b. Design finite automata for following languages:
   i) Set of all strings with exactly three consecutive 1's over $\Sigma = \{0, 1\}$.
   ii) Set of all strings that end with ab or ba over $\Sigma = \{a, b\}$.
   iii) $L = \{W/W \in (a + b)^*$ such that $n_a(w) \bmod 3 = 0$ and $n_b(w) \bmod 2 = 0\}$.
   iv) Design an NFA to recognize language $L = \{W / W \in 0101^n \text{ or } 010^n \text{ where } n >= 0\}$. **(08 Marks)**

c. Convert the following NFA to its equivalent DFA: **(08 Marks)**

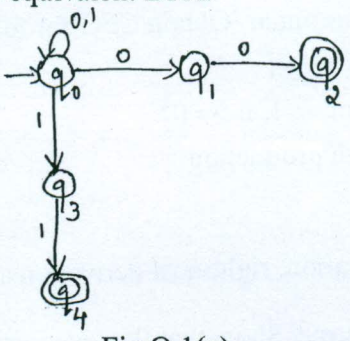

Fig.Q.1(c)

2 a. Define $\in$-closure. Consider $\in$ - NFA over $\Sigma = \{\in, +, -, 0-9, \cdot\}$. **(08 Marks)**

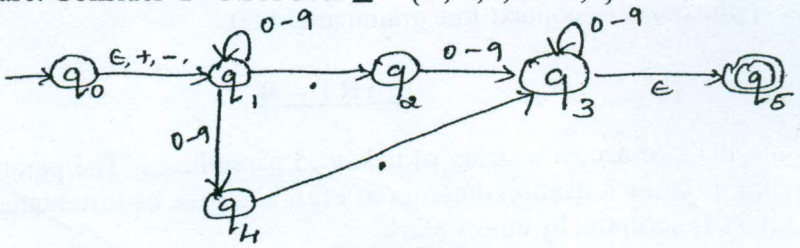

Fig.Q.2(a)

   i) Compute $\in$ - closure of each state.
   ii) Convert the automata to DFA.

b. Define regular expression. Write regular expressions for following languages:
   i) Set of all strings that begin with 1011 over $\Sigma = \{0, 1\}$.
   ii) $L = \{ a^n b^m c^p \mid n <= 4, m >= 2, p <= 2 \}$. **(04 Marks)**

c. Define $\in$-NFA for regular expression aa* (a + b)*. **(04 Marks)**

d. Obtain regular expression from finite automata using state elimination method. **(04 Marks)**

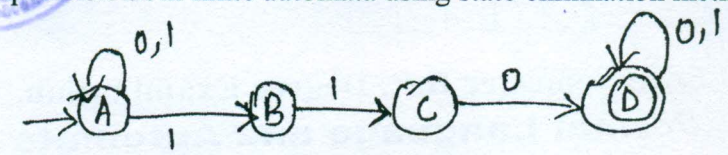

Fig.Q.2(d)

3 a. State pumping lemma for regular language. Prove that $L = \{a^{n!} \mid n >= 0\}$ is not regular language. **(07 Marks)**

b. If h is homomorphism from alphabet Σ to alphabet T and L is regular language over T, then $h^{-1}(L)$ is also regular language. **(05 Marks)**

c.

δ	0	1
$\rightarrow q_1$	q_2	q_3
q_2	q_3	q_5
$*q_3$	q_4	q_3
q_4	q_3	q_5
$*q_5$	q_2	q_5

i) Draw table of distinguish abilities for this automata.

ii) Construct minimum state equivalent DFA. **(08 Marks)**

4 a. Define context free grammar. Obtain CFG for following language:

i) $L = \{a^n b^{n+2} \mid n >= 0\}$

ii) $L = \{0^m 1^m 2^n \mid m >= 1, n >= 0\}$. **(06 Marks)**

b. Given a grammar with production

$S \rightarrow AS/\in$

$A \rightarrow aa/ab/ba/bb$

Obtain leftmost derivation, rightmost derivation and parse tree for string a a b b b a. **(06 Marks)**

c. Define yield of parse tree. Show that the given grammar is ambiguous for string a + b * c

$E \rightarrow E + E / E * E / (\varepsilon) I$

$I \rightarrow a / b / c.$ **(06 Marks)**

d. Write applications of context free grammar (LFG). **(02 Marks)**

PART – B

5 a. Obtain a PDA to accept a string of balanced parentheses. The parentheses to be considered are (,),], [. Draw transition diagram of PDA and give its instantaneous description (ID) for string [( ) ( )] accepted by empty stack. **(10 Marks)**

b. Define deterministic PDA. Is the PDA to accept the language $L = \{a^n b^{2n} / n >= 1\}$ is deterministic? **(04 Marks)**

c. Convert the following PDA to CFG:

$\delta(q_0, q, z) = (q_0, AZ)$

$\delta(q_0, b, A) = (q_0, AA)$

$\delta(q_0, a, A) = (q_1, \in)$. **(06 Marks)**

6 a. Define GNF and CNF grammar. Reduce grammar into CNF.

$S \rightarrow AaB/aaB$

$A \rightarrow \in$

$B \rightarrow bbA/\in$.

b. Define nullable, useless variable. Consider the grammar. **(07 Marks)**

$S \rightarrow AC / aB / AD$

$A \rightarrow \in / ab / s$

$B \rightarrow Aa / AB$

$C \rightarrow AAa / \in$

$D \rightarrow EbD$

$E \rightarrow bb$

i) Eliminate $\in$ production.

ii) Eliminate any unit production in resulting grammar.

iii) Eliminate any useless production in resulting grammar. **(08 Marks)**

c. If L is context free language, then so is L^R. Prove. **(05 Marks)**

7 a. Design a turning machine to recognize language $L = \{0^n 1^n / n >= 1\}$ and write its transition diagram and give its ID for string 0011. **(10 Marks)**

b. Explain working of turning machine with neat diagram and instantaneous description (ID) for turning machine. **(05 Marks)**

c. Write a note on multitape turning machine. **(05 Marks)**

8 Write a note on:

a. Post correspondence problem.

b. Application of regular expression.

c. L is recursive language, so is $\overline{L}$

d. Universal language. **(20 Marks)**

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