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10CS56

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
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. Define the following with an example :
(i) Alphabet (ii) Strings (iii) Languages (iv) Power of an alphabet **(06 Marks)**

b. Define DFA. Construct the DFA for the following languages:
(i) String of a's and b's ending with abb.
(ii) L = { w / |w| mod S = 0 } on Σ = { a }. **(06 Marks)**

c. Convert the following NFA into equivalent DFA [Refer Fig.Q1(c)]. **(08 Marks)**

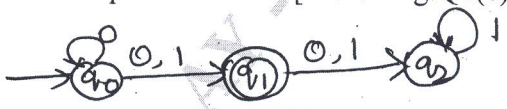

Fig.Q1(c)

2 a. Write the Regular expressions for following languages:
(i) L(R) = { w | w ∈ {0, 1}* with atleast 3 consecutive zeros }
(ii) L = {$a^n b^m$ | m + n is even} **(06 Marks)**

b. Prove that every language defined by regular expression is also defined by finite automata. **(08 Marks)**

c. Convert the following regular expressions to NFA with ∈-Transitions:
(i) $ab(a + b)^*$ (ii) $aa(b + a)^*$ **(06 Marks)**

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

b. Prove that the following languages are not regular :
(i) {$a^i b^j$ | i > j }
(ii) L = { w | $n_a(w) = n_b(w)$ } **(08 Marks)**

c. Show that if L_1 and L_2 are regular, so is $L_1 \cap L_2$. **(04 Marks)**

4 a. Define context free grammar. Obtain the CFG for following languages:
(i) L = { $a^n b^m c^k$ | n + 2m = k for n ≥ 0, m ≥ 0}
(ii) L = { ww^R / w ∈ {a, b}* } **(08 Marks)**

b. Construct the left most derivation, right most derivation and parse trees for the grammar.
E → E + E | E – E | E * E | id for input string "id + id * id". **(06 Marks)**

c. Is the following grammar ambiguous?
S → aS | X
X → aX | a **(06 Marks)**

PART – B

5 a. Define PDA. What are languages of PDA? Construct the PDA to accept language L.
L = { w ⊂ w^R / w ∈ (a+b)* } where w^R is reverse of w. Show the moves made by PDA for string "aabcbaa". **(10 Marks**

b. Define DPDA. Construct DPDA for language
$L = \{a^n b^n \mid n \geq 1\}$ **(05 Marks)**

c. Obtain the PDA for the grammar
$S \rightarrow aABC$
$A \rightarrow aB|a$
$B \rightarrow bA|b$
$C \rightarrow a$ **(05 Marks)**

6 a. Define useless symbols, $\in$-production and unit productions. Simplify the following grammar:
$S \rightarrow aA \mid a \mid Bb \mid cC$
$A \rightarrow aB$
$B \rightarrow a \mid Aa$
$C \rightarrow cCD$
$D \rightarrow ddd$ **(08 Marks)**

b. Define CNF. Convert the following grammar to CNF
$S \rightarrow 0A \mid 1B$
$A \rightarrow 0AA \mid 1S \mid 1$
$B \rightarrow 1BB \mid 0S \mid 0$ **(06 Marks)**

c. Show that language $L = \{ a^n b^n c^n \mid n \geq 0 \}$ is not context free. **(06 Marks)**

7 a. Define Turing machine. Instantaneous description of Turing machine. Obtain a TM for language
$L = \{ 0^n 1^n 2^n \mid n \geq 1 \}$ **(10 Marks)**

b. Explain the following :
(i) Multi-tape turing machines
(ii) Non-deterministic Turing machines
(iii) Simulating a Turing machine by computer. **(10 Marks)**

8 Write short notes on :
a. Halting problem
b. Post's correspondence problem
c. Un-decidable problem
d. Decidability **(20 Marks)**

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