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10CS56

Fifth Semester B.E. Degree Examination, Dec.2017/Jan.2018
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 the following terms with an example for each,
(i) String (ii) Alphabet (iii) Power set (iv) Language **(08 Marks)**

b. Give the difference between NFA and DFA. **(06 Marks)**

c. Design DFA for the following languages on set $\sum = \{a, b\}$.
(i) Set of all strings that either begins, ends and both with the string 'ab'.
(ii) $L = \{W / |W| \bmod 3 <> 0\}$
(iii) String with even number of a's and b's. **(06 Marks)**

2 a. Write a note on applications of finite automata. **(04 Marks)**

b. Define an $\in$ –NFA and $\in$ – closure. Design an $\in$ –NFA for a language (a / b) * abb. **(08 Marks)**

c. Prove that for every regular expression their exist a Finite Automata which accepts the same language accepted by the Regular expression. **(08 Marks)**

3 a. State and prove pumping lemma for regular language and prove that the language $L = \{a^P \mid P \text{ is a prime number}\}$ is not regular. **(08 Marks)**

b. Construct the NFA for the following transition table.

δ	0	1
→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 the table of distinguishable and indistinguishable states for the Automata.
(ii) Construct minimum state equivalent DFA using Table filling algorithm. **(12 Marks)**

4 a. Define Context free Grammer. Give the CFG for the following language over set $\sum = \{a, b\}$.
(i) $L = \{a^i b^j c^k / i = j + k \mid i, j, k >= 0\}$.
(ii) $L = \{w / n_a(w) = n_b(w)\}$
(iii) $L = \{w / n_a(w) \text{ is divisible by } 3\}$
(iv) $L = \{a^{n+2} b^m / n >= 0, m > n\}$ **(10 Marks)**

b. Let G be a Grammar and the set of production are,
$S \rightarrow aB / bA$
$A \rightarrow a / aS / bAA$
$B \rightarrow b / bS / aBB$
Give the
(i) right most derivation (ii) left most derivation and
(iii) derivation tree for the string "aaabbabbba" **(06 Marks)**

c. What is an ambiguous Grammar? Prove that the following Grammar is ambiguous on string "aab"
$S \rightarrow aS / aSbS / \in$ **(04 Marks)**

PART – B

5 a. Define PDA and construct PDA that accepts the following language:
$L = \{w / w \in \{a,b\}^* \text{ and } n_a(w) = n_b(w)\}$
Write the instantaneous description for the string "aababb" **(12 Marks)**

b. Convert the following Grammar to PDA that accepts the same language by empty string,
$S \rightarrow bABC / aBaB$
$A \rightarrow aA / bBaC / a$
$B \rightarrow bBb / a$
$C \rightarrow bCA / aAC$
$C \rightarrow d$ **(08 Marks)**

6 a. Convert the following Grammar into Chomsky Normal form.
$S \rightarrow ABa$
$A \rightarrow aab$
$B \rightarrow Ac$ **(06 Marks)**

b. Eliminate useless production from the Grammar given below:
$S \rightarrow aS / A \mid C$
$A \rightarrow a$
$B \rightarrow aa$
$C \rightarrow aCb$ **(06 Marks)**

c. State and prove pumping lemma for CFL and show that $L = \{a^n b^n c^n / n >= 0\}$ is not a context Free Language. **(08 Marks)**

7 a. Explain with a neat diagram, the working of Turing machine. **(06 Marks)**

b. Design a TM to accept all sets of palindrome over $\{a,b\}^*$, also write the transition diagram, instantaneous description and give the sequence of moves made by TM for string "babab" **(14 Marks)**

8 Write short notes on:
a. Post correspondence problem.
b. Multitape TM.
c. Turing machine Halting problem.
d. Recursive language. **(20 Marks)**

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