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) $L = \{W / |W| \bmod 5 <> 0\}$
      (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
$\rightarrow q_1$	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 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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