(3 Hours) [Total Marks: 80]

N.B. (1)Question No. 1 is compulsory

(2) Attempt any three out of remaining five questions

(3) Assumptions made should be clearly stated

1. (a) Explain post correspondance problem. **5**

   (b) Differentiate between FA and PDA. **5**

   (c) Define Regular Expression and obtain a regular expression such that **5**

   $L(R) = \{ w \mid w \in \{0, 1\}^* \}$ with at the most three zeros

   (d) What is ambiguous grammar? Check whether following grammar is ambiguous or not **5**

   $E \rightarrow E+E \mid E*E \mid (E) \mid id$

2. (a) Design a Finite State Machine to accept following language over the alphabet $\{0, 1\}$ **10**

   $L(R) = \{ w \mid w$ starts with 0 and has odd length or starts with 1 and has even length $\}$

   (b) Give and explain formal definition of Pumping Lemma for Regular Language and **10**
   prove that following language is not regular.

   $L = \{ 0^i \mid i$ is prime number $\}$

3. (a) Construct PDA accepting the language $L=\{a^{2n}b^n \mid n \geq 0\}$ **10**

   (b) Consider the following grammar **10**

   $S \rightarrow i C t S \mid i C t S e S \mid a$

   $C \rightarrow b$

   For the string 'ibtaeibta' find the following:

   (i)   Leftmost derivation

   (ii) Rightmost derivation

   (iii) Parse tree

   (iv) Check if above grammar is ambiguous.

4. (a) Construct PDA to check $\{wcw^R \mid w \{a,b\}^*\}$ where w^R is reverse of w & c is a constant. **10**

   (b) Convert following CFG to CNF **10**

   S-> 0A0|1B1|BB

   A->C

   B->S|A

   C->S|C

5. (a) Convert $(0+1)(10)^*(0+1)$ into NFA with ε-moves and obtain DFA. **10**

   (b) Construct Moore and Mealy Machine to convert each occurrence of 101 by 111. **10**

6. Write short note on following **(any 2)** **20**

   (a) Chomsky Hierarchy

   (b) Halting Problem

   (c) Rice's Theorem

   (e) Universal Turing Machine

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