(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 Chomsky Hierarchy 5
   (b) Differentiate between DFA and NFA 5
   (c) Explain Recursive and Recursively enumerable languages 5
   (d) Define Regular Expression. Design R.E. for strings ending in consecutive 1's 5
   over $\sum=\{0,1\}$.

2. (a)Design a Finite State Machine to determine whether ternary number(base 3) 10
   is divisible 5.
   (b) Give and Explain formal definition of Pumping Lemma for Regular Language and 10
   prove that following language is not regular.
   $L=\{ a^n b^n \mid n >=1 \}$

3. (a) Design a PDA that checks for well -formed parenthesis. 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 'ibtibtaea' find the following:

   (i)   Leftmost derivation
   (ii)   Rightmost derivation
   (iii) Parse tree
   (iv)   Check if above grammar is ambiguous.

4. (a) Design a Turing Machine that recognizes palindrome string where $\sum=\{a,b\}$. 10
   (b) Reduce following grammar to GNF. 10

   $S \rightarrow AB$

   $A \rightarrow BSB \mid BB \mid b$

   $B \rightarrow a$

   (i) $S \rightarrow 01S \mid 01$

   $S \rightarrow 10S \mid 10$

   $S \rightarrow 00 \mid \varepsilon$

5. (a) Convert $(0+\varepsilon) (10)*(\varepsilon+1)$ into NFA with ε-moves and obtain DFA. 10
   (b) Design a PDA to accept language $\{ a^{n-1} b^{2n+1} \mid n>=1 \}$ 10

6. Write short note on following (any 4) 20

   (a) Closure properties of Context Free Language

   (b) Applications of Regular expression and Finite automata

   (c) Rice's Theorem

   (d) Moore and Mealy Machine

   (e) Differentiation between DPDA and NPDA

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