Duration: 3hrs   **[Max 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) Discuss Pumping lemma for regular languages with suitable example.   5
       (c) Describe variants of Turing Machines.   5
       (d) Obtain the regular expressions for the following languages over $\Sigma=\{0,1\}$:   5
                (i) All strings of 0's & 1's but not having three consecutive 0's.
                (ii) All strings of 0's & 1's with even number of 0's and 1's.

2.   (a) Convert the following grammar into GNF: 10
           $S \rightarrow AACD$, $A \rightarrow aAb \mid \in$, $C \rightarrow aC \mid a$, $D \rightarrow aDa \mid bDb \mid \in$
       (b) Design a Turing Machine to check for equal number of a's and b's
            over $\Sigma=\{a,b\}$.   10

3.   (a) Construct a PDA equivalent to the following grammar: 10
           $S \rightarrow 0Y \mid 01$, $X \rightarrow 0Y \mid 0X$, $Y \rightarrow 0 \mid 1$
       (b) Convert the following RE to $\in$-NFA & then convert it to DFA:
            $(0*1+1*0)\ 01$.   10

4.   (a) Construct NFA without $\in$ for the following $\in$–NFA: 10
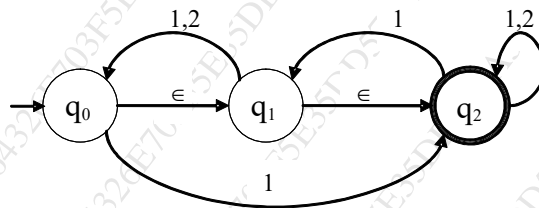
       (b) Find Leftmost derivation, Rightmost derivation and draw Parse tree for the
            following grammar. Also check if the grammar is ambiguous or not: 10
            $S \rightarrow aXbX$, $X \rightarrow aY \mid bY \mid \in$, $Y \rightarrow X \mid c \mid Z$

5.   (a) Design a Turing Machine for the subtraction of two positive integers (m ,n) in
            unary representation: if (m>n), output X; else if (m<n), output Y; else output Z on
            the tape.   10
       (b) Determine if there is a solution using PCP, for given two lists of strings A and B:
            A=\{00,001,1000\},   B=\{0,11,011\}.   10

6.   Write short notes on any **TWO**:   20
       (a) Mealy Machines   (b) Arden's Theorem
       (c) Decidability & undecidability   (d) Applications of FA

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