

(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 correspondence problem. 5
 (b) Differentiate between FA and PDA. 5
 (c) Define Regular Expression and obtain a regular expression such that 5

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

 (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

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

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

$$L = \{ 0^i \mid i \text{ is prime number} \}$$
3. (a) Construct PDA accepting the language $L = \{ a^{2^n} b^n \mid n \geq 0 \}$ 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 $\{ w c w^r \mid w \in \{a, b\}^* \}$ where w^r is reverse of w & c is a constant. 10
 (b) Convert following CFG to CNF 10

$$S \rightarrow 0A0 \mid 1B1 \mid BB$$

$$A \rightarrow C$$

$$B \rightarrow S \mid A$$

$$C \rightarrow S \mid C$$
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