

(3 Hours)

[Total Marks : 100

N.B. (1) Question No. 1 is **compulsory**.(2) Attempt any **four** questions from remaining **six** questions.(3) **Figures** to the **right** indicate **full** marks given to the question.(4) Assume **suitable** data, if **necessary**.

1. (a) Explain halting problem of Turing machine. 4
 (b) Design a FSM to determine whether a binary number is divisible by 4. 4
 (c) Design DFA accepting the language containing 101 as substring. 6
 (d) Design a PDA to accept $0^n 1^n$ over an alphabet $\Sigma = \{ 0, 1 \}$ where $n \geq 1$. 6

2. (a) Explain with examples the classification of various grammars. 10
 (b) State and explain pumping Lemma for regular languages. Using Pumping lemma, 10
 show that following grammars are not regular :—
 (i) $L = \{ 1^n \mid n \text{ is prime number} \}$
 (ii) $L = \{ a^n b^n \mid n > 0 \}$

3. (a) Design a Moore and Mealy to compute 2's complement of binary number. 10
 (b) Write Regular Expression and Construct DFA accepting the following 10
 language :—
 (i) String ending with ab or ba
 (ii) String containing at least two 0's.

4. (a) Explain GNF and CNF. Convert the following grammar into GNF and CNF — 10
 $S \rightarrow 01S \mid 01$
 $S \rightarrow 10S \mid 10$
 $S \rightarrow 00 \mid \wedge$
 (b) Let G be the grammar 10
 $S \rightarrow aAS \mid a$
 $A \rightarrow SbA \mid ba$
 Find leftmost derivation, rightmost derivation and parse tree for the string
 (i) "aabbba" (ii) "abaabaa"

5. (a) Construct ϵ -NFA and then minimized DFA from R.E. $(aa^* + bb^*)$. 10
 (b) Design a PDA to accept a string containing equal number of 0's and 1's. 10

6. (a) Explain the operator precedence parser with example. 10
 (b) Design a TM to find $\log_2 n$ of unary numbers. 10

7. Write short notes on (any **four**) :— 20
 (a) Power of UTM
 (b) Ambiguity in grammar
 (c) Closure properties
 (d) NP-Hard and NP-Complete problem.