1. (a) Explain the following terms :

(i) Closure of Relation

(ii) Countability

(iii) Set operation

(iv) String

(v) Relation.

(b) Explain in brief diagonalization principle. 10

OR

2. (a) Explain generalized pigeonhole principle. 4

(b) Prove the following by principle of induction : 4

$$\sum_{K=1}^{n} K^2 = \frac{n(n+1)(2n+1)}{6}$$

(c) Prove that for any finite set A, 5

$$|2^A| = 2^{|A|}.$$

3. (a) Construct a Moore machine whose output is 2's complement of a binary number. Assume input to Moore machine in binary digits from MSB to LSB. 5

(b) Construct a finite automata accepting string over {0, 1} that do not contain '11' as substring but contains at least one '00' as substring. 5

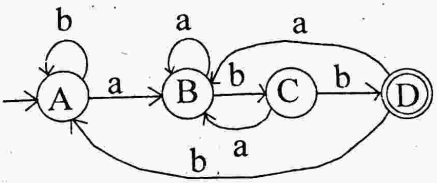
OR

4. (a) Construct a DFA accepting strings over decimal digits that represents decimal number divisible by 6.

(Hint : Number divisible by 2 and 3 are divisible by 6). 10

(b) Differentiate between NFA, NFA E-Closure and DFA. 3

5. (a) Show that the language accepted by following DFA can be represented by the regular expression (a/b)* abb.



7

(b) Give the statement of pumping lemma and prove that :

$L = \{a^P | P \text{ is prime}\}$, is not regular. 6

OR

6. (a) Reduce the following grammar :

$S \rightarrow ABC \mid BaB$

$A \rightarrow aA \mid BaC \mid aaa$

$B \rightarrow bBb \mid a$

$C \rightarrow CA \mid AC.$ 5

(b) Show that the grammar :

$$S \rightarrow aB \mid ab$$

$$A \rightarrow aAB \mid a$$

$$B \rightarrow ABb \mid b$$

is ambiguous. 5

(c) If w is in L(G), such that $|w| = l$. How long will be the derivation of w, if G is in :

(i) CNF

(ii) GNF ? 3

7. (a) Define Push Down Automata and explain acceptance of string by PDA in final state and in NULL stack. 5

(b) Construct PDA for the language

$$L = \{a^i b^i c^j \mid i, j \geq 1\}.$$ 8

OR

8. (a) Explain closure properties of CFL. 5

(b) Construct PDA for the language :

$$L = \{a^p b^q c^r \mid p, q, r \geq 1 \text{ and } q = |p - r|\}.$$ 8

9. (a) Construct a Turing Machine for the language :

$$L = \{a^n b^n c^n \mid n \geq 1\}.$$ 7

(b) Describe linear bounded automata and the language accepted by LBA. 6

OR

10. (a) Construct a Turing Machine for proper subtraction i.e. :

$$m - n = \begin{cases} m-n & , \quad m \geq n \\ 0 & , \quad \text{otherwise}. \end{cases}$$ 8

(b) Give the grammar for the language L $\{a^n b^n c^n \mid n \geq 1\}$ and derivation for the string $a^3 b^3 c^3$. 5

11. (a) Show that the halting problem is unsolvable. 6

(b) Explain the closure properties of recursive and recursively enumerable language. 8

OR

12. (a) Define Primitive Recursive function and show that :

$$\text{DIFF } (x, y) = \begin{cases} x-y & \text{if} \quad x \geq y \\ 0 & , \quad \text{otherwise} \end{cases}$$

is primitive recursive. 8