



- Notes :
1. Answer **three** question from Section A and **three** question from Section B.
 2. Assume suitable data wherever necessary.
 3. Use of pen Blue/Black ink/refill only for writing the answer book.

1. a) Design a DFA - 6
 - i) $L = \{x \in \{a, b, c\}^* : |X|_a = 0 \bmod 3\}$
 - ii) $L = \{x \in \{0, 1\}^* / \text{second symbol of } x \text{ is } 0 \text{ and fourth is } 1\}$
- b) Design a Mealy machine to determine residue mod 3 for each binary string treated as binary integer. 7

OR

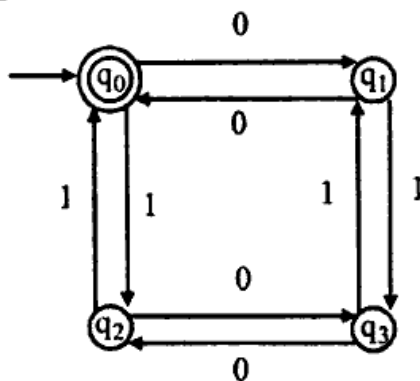
2. a) Construct a deterministic finite automation equivalent to 7
 $M = (\{q_0, q_1, q_2, q_3\}, \{0, 1\}, \delta, q_0, \{q_3\})$ where δ is defined as -

$Q \setminus \Sigma$	0	1
$\rightarrow q_0$	$\{q_0, q_1\}$	q_0
q_1	q_2	q_1
q_2	q_3	q_3
$\odot q_3$	-	q_2

- b) Design Moore machine for binary input sequence, if it ends in '101', output is A, if it ends in '110', output is B otherwise 'C'. 6
3. a) Convert the following RLG into equivalent LLG 6
 $S \rightarrow 0A / 1B$
 $A \rightarrow 0C / 1A / 0$
 $B \rightarrow 1B / 1A / 1$
 $C \rightarrow 0 / 0A$

- b) Find regular expression for given FA.

7



OR

4. a) Write a regular expression to denote a language L over $\Sigma = \{0, 1\}^*$ such that each of string does not contain '101' as substring.

7

- b) Construct RLG & LLG for -

6

i) $(0 + 1)^* 00 (0 + 1)$

ii) $L = \{0^n 1^m / n > 0 \text{ \& } m > 1\}$

5. a) Construct the CFG for the language.

8

i) $L = \{a^n b^m / n \neq m, n, m \geq 0\}$

ii) $L = \{a^n b^m c^m d^n / n \geq 1, m \geq 1\}$

- b) Convert following CFG into CNF

6

$S \rightarrow AB / aB$

$A \rightarrow aab / \epsilon$

$B \rightarrow bbA / \epsilon$

OR

6. a) Construct NPDA for the $L = \{ww^R \mid w \in \{0, 1\}^*\}$

7

- b) What is Ambiguity in grammar show that following grammar is ambiguous or not, justify your answer.

7

$S \rightarrow aB \mid bA$

$A \rightarrow a \mid aS \mid bAA$

$B \rightarrow b \mid bS \mid aBB$

7. a) Design a turing machine for $L = \{ww^r \mid w \in \{a, b\}^*\}$.

7

- b) Explain a TM with two way infinite tape and write a relation with one way infinite tape.

7

OR

8. a) Design a TM for 7
 $L = \{a^n b^n a^n / n \geq 0\}$
- b) Design a Turing machine for equal number of 0's & equal number of 1's over $\{0, 1\}$. 7
9. a) If L is CSL then L is accepted by some LBA explain. 6
- b) Explain Chomsky hierarchy in detail. 7

OR

10. a) Give context sensitive grammar for - 6
 $L = \{a^i b^i c^i / i \geq 1\}$
- b) Is the language $L = \{w \in w^R / w \in \{a, b\}^*\}$ deterministic context free. 7
11. a) Prove the following - 7
i) The complement of a recursive language is recursive.
ii) The union of two recursive language is recursive
- b) Describe in brief what is halting problem. 6

OR

12. a) Decide weather the following pair (A, B) have PCP solution or not ? If yes give a solution if no why ? 7
i) $A = \{1, 10111, 10\}$ $B = \{111, 10, 0\}$
ii) $A = \{10, 011, 101\}$ $B = \{101, 11, 011\}$
- b) Ackerman's function defined by - 6
 $A(0, y) = y + 1$
 $A(x + 1, 0) = A(x, 1)$
 $A(x + 1, y + 1) = A(x, A(x + 1, y))$
Find $A(1, 1)$, $A(1, 2)$, $A(2, 1)$
