

- N.B.** 1) All questions are **compulsory**.
 2) **Figures** to the **right** indicate marks.
 3) **Draw** suitable **diagrams** and illustrations **wherever necessary**.
 4) **Mixing** of sub-questions is **not allowed**.

Q. 1 Attempt All the Questions

A. Choose the correct alternative

(5M)

- i. The next state of an automaton at any instant of time is determined by the present _____ and the present _____.
 - a) state, output
 - b) input, output
 - c) state, input
 - d) output, start state
- ii. A type 1 grammar is also called _____.
 - a) context dependent
 - b) natural grammar
 - c) context free
 - d) regular grammar
- iii. Turing machines can accept _____ languages.
 - a) type-0
 - b) type-1
 - c) type-2
 - d) type-3
- iv. If L is context-sensitive language, then L is _____ by linear bound automata. The converse is _____.
 - a) rejected, true
 - b) accepted, true
 - c) rejected, false
 - d) accepted, false
- v. The set of all strings of 0's and 1's ending in 00 can be described by the regular expression
 - a) $(01)^*00$
 - b) 01^*00
 - c) $(0+1)^*00$
 - d) $(0+1)^*(00)^*$

B. Fill in the blanks (Choose correct one from the pool)

(5M)

{moore, tree, terminal, accepting, non-regular, regular, mealy, pumping lemma}

- i. Final state is also called _____ state.
- ii. The set $L = \{0^i 1^i \mid i \geq 1\}$ is _____.
- iii. An automaton in which the output will depend on both the present input and the present state is called _____ machine.
- iv. Context free grammar can be represented using _____.
- v. A _____ gives a necessary condition that can be used to show that certain sets are regular.

(5M)

C. Explain the following terms in one or two lines

- What does the language L represented by $(11)^*$ describe?
- What are equivalent states?
- Find if the following statement is true or false.
"The language $L = \{a^n b^n \mid n \geq 1\}$ is context free language but not regular"
- If G is $S \rightarrow aS \mid a$, then what is $L(G)$?
- Prove that $A + (AB^*)B = AB^*$.

Q.2 Attempt the following: (Any THREE)

(15M)

- Define Grammar. Obtain the grammar generating $\{a^i b^j c^n \mid n \geq 1, j \geq 0\}$?
- Find the deterministic acceptor equivalent to $M = (\{q_0, q_1, q_2\}, \{a, b\}, \delta, q_0, \{q_2\})$ where δ is given in the table below.

states/ Σ	a	b
$\rightarrow q_0$	q_0, q_1	q_2
q_1	q_0	q_1
q_2		q_0, q_1

- Briefly explain the steps of construction of minimum automaton.
- If $G = (\{S\}, \{0,1\}, \{S \rightarrow 0S1, S \rightarrow \lambda\}, S)$, find $L(G)$.
- Write a note on Chomsky Classification of Grammar.
- Write a note on operations on languages.

Attempt the following: (Any THREE)

(15M)

Q.3

- What is derivation tree? Give example.
- Prove $(a+b)^* = a^*(ba^*)^*$. Also draw the transition system for $a^*(ba^*)^*$.
- Write a note on Normal forms for context free grammar.
- Define Regular Expression. Also prove that $(1 + 00^*1) + (1 + 00^*1)(0+10^*1)^*(0+10^*1) = 0^*1(0+10^*1)^*$
- State and prove Arden's theorem.
- Explain the pumping lemma for CFG.

(15M)

Q.4 Attempt the following: (Any THREE)

- Write a note on the model of a linear bound automata.
- What is the halting problem of a Turing machine? Explain.
- Write a note on unsolvable problems.
- Write a note on Variants of Turing Machine.
- Design a Turing machine that accepts $\{0^n 1^n \mid n \geq 1\}$
- Write a note on halting problem of Turing Machines.

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Q.5 Attempt the following: (Any THREE)

(15M)

- A. Construct a DFA with reduced states equivalent to the regular expression:
 $10+(0+11)0^*1$
- B.
 - a. Null productions: Production of the form $A \rightarrow \lambda$
 - b. Unit productions: Production of the form $A \rightarrow B$
 - c. Empty string: String of length zero
 - d. Terminal symbols: cannot appear on left side of production, cannot be further derived....
 - e. Natural language: language generated by type 0 grammar.
- C. What are ambiguous grammar? Give example.
- D. Construct a PDA A accepting $L = \{wcw^T \mid w \in \{a,b\}^*\}$ by final state.
- E. Define NFA. Give an example.
