

(2 ½ Hours)

[Total Marks: 75]

- 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. An automaton in which the output depends only on the states of the machine is called a _____ Machine
 - a) Mealy
 - b) Moore
 - c) Turing Machine
 - d) All of these
- ii. A final state is also called _____ state.
 - a) Non-accepting
 - b) key
 - c) accepting
 - d) none of these
- iii. A type 2 grammar is also called _____ grammar
 - a) Context free
 - b) Context sensitive
 - c) Free
 - d) natural
- iv. $(a+aa^*)^*$ is equivalent to
 - a) $a(a^*)^*$
 - b) a^*
 - c) aa^*
 - d) none of these
- v. A terminal string $w \in L(G)$ is ambiguous if there exists _____ or more derivation trees for w .
 - a) one
 - b) two
 - c) neither a nor b
 - d) either a or b

B. Fill in the blanks (Choose correct one from the pool)**(5M)**

(pumping lemma, pigeonhole principle, Turing machine, reduction, production, stack, PDA, finite automata, regular expression, list)

- i. _____ can be used to prove that certain sets are not regular.
- ii. A pushdown automata contains _____ besides a input tape, a input alphabet, a finite state control, a set of final states and an initial state.
- iii. Type-0 languages can be accepted by _____.
- iv. _____ describe the languages accepted by finite state automata and are useful for representing certain sets of strings in an algebraic form.
- v. Context free languages (Type-2) can be accepted by _____

C. Explain the following terms in one or two lines**(5M)**

- i. Nondeterministic finite state machine
- ii. Grammar
- iii. Regular set
- iv. Chomsky Normal Form
- v. Language generated by the grammar $L(G)$

Q.2 Attempt the following: (Any THREE) (15M)

- Explain the process of construction of minimum automaton. Give suitable example to explain the concept.
- Construct a DFA accepting all strings over $\{a, b\}$ ending in ab .
- Construct a grammar G generating $\{xx \mid x \in \{a, b\}^*\}$
- If $G = (\{S\}, \{0,1\}, \{S \rightarrow 0S1, S \rightarrow \Lambda\}, S)$, find $L(G)$.
- Define Ambiguous Grammar. Find if the grammar G with the following productions is ambiguous?

$$S \rightarrow SbS$$

$$S \rightarrow a$$
- Write a note on classification of Grammar.

Q.3 Attempt the following: (Any THREE) (15M)

- State and prove pumping lemma for regular sets.
- Give a regular expression for representing the set L of strings in which every 0 is immediately followed by at least two 1's. Also prove that the regular expression $R = \lambda + 1^*(011)^*(1^*(011)^*)^*$ also describes the same set of strings.
- Explain the steps for reduction of grammar to Chomsky normal form.
- Convert the nondeterministic systems to deterministic systems.
- State and prove Arden's theorem.
- What is a derivation tree? Generate the derivation tree for the string $aabaa$ using the grammar G with following set of productions

$$S \rightarrow aAS \mid a \mid SS$$

$$A \rightarrow SbA \mid ba$$

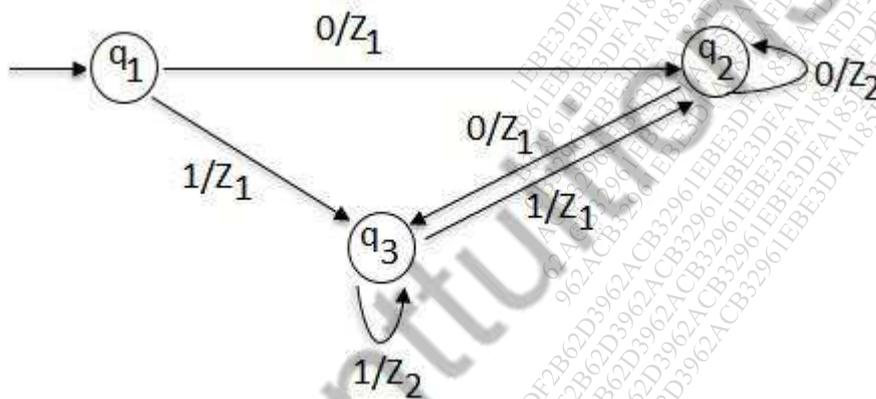
Q.4 Attempt the following: (Any THREE) (15M)

- Explain the Linear Bound Automata Model.
- Construct a PDA accepting $L = \{w cw^T \mid w \in \{a, b\}^*\}$
- Write a note on Halting problem of Turing Machine.
- Design a Turing Machine that accepts $\{0^n 1^n \mid n \geq 1\}$
- What is Turing Machine? Design a Turing Machine to recognize all strings consisting of an even number of 1's.
- Explain the structure and operation of pushdown automata.

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. Let G be the grammar with productions
 - $S \rightarrow 0B / 1A,$
 - $A \rightarrow 0 / 0S / 1AA$
 - $B \rightarrow 1 / 1S / 0BB$
 For the string 00110101, find
 - (a) the leftmost derivation
 - (b) rightmost derivation
- C. Consider a Mealy machine represented by the figure given below. Construct a Moore machine equivalent to this Mealy machine.



- D. What is regular set? Is $L = \{a^{2n} \mid n \geq 1\}$ regular?
- E. Construct the finite automaton equivalent to the regular expression $(0+1)^*(00+11)(0+1)^*$
- F. Write a note on operations on language.
