

*Note: All questions are compulsory. Marks are indicated against each question in square brackets.*

**Q1. a)** What do you understand by automata theory, computability theory and complexity theory in theory of automata? [2][CO-1][CO-2][CO-3]

**b)** Find the truth values for the following propositions along with its explanations:

(i) If 3 is not an integer, then  $\frac{1}{3}$  is an integer.

(ii) If 3 is an integer, then  $\frac{1}{3}$  is an integer.

[1][CO-1]

**Q2. a)** Define Relation (R) and reflexive, symmetric and transitive properties of relations. Find  $R^+$  and  $R^*$  for following two relations.

(i) Let  $R = \{(5,6), (6,7), (7,5)\}$ .

(ii) Let  $R = \{(1,2), (2,3), (1,4), (4,2), (3,4)\}$

[3][CO-1]

**b)** Let a function  $f: Z \rightarrow Z$  given by  $f(n) = 2n$ , where  $Z$  is a set of all integers. Is this function one-to-one or onto or both. Explain.

[0.5][CO-1]

**c)** Let  $N = \{1,2,3, \dots\}$ , then function  $f: N \rightarrow N$  given by  $f(n) = n + 1$ , is one-to-one or onto or both. Explain.

[0.5][CO-1]

**Q3 a)** What is Kleene Closure and positive closure? For alphabet set  $\Sigma = \{a, b\}$ , how many bit strings of length ten either start with 'a' or end with 'bb'?

[2][CO-1]

**b)** Consider the string  $w = 'ZZZA'$ . Find

(i)  $|w|$  (ii)  $w^r$  (iii)  $w^2$

(iv) Total number of substrings possible (v) Trivial substrings

(vi) Prefix and suffix

[3][CO-1]

**Q4 a)** When does a graph called a tree? For  $n=9$ , make binary trees with maximum and minimum heights.

[1.5][CO-1]

**b)** For the given tree in below Fig., answer the following questions:

[1.5][CO-1]

(i) Is T a binary tree?

(ii) What is the height of T?

(iii) Which vertices are the leaves of T?

(iv) How many internal vertices are in T?

(v) What is the left-to-right ordering of leaves?

(vi) Which vertices are son of T?

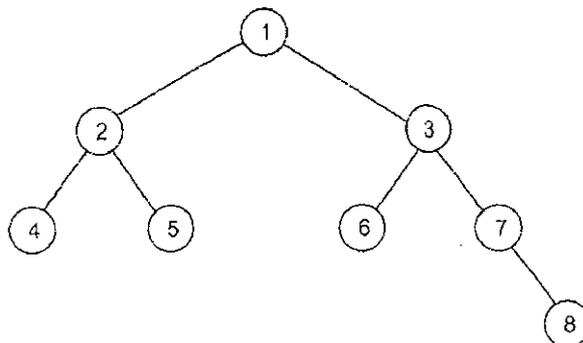


Fig.