MMTE-002

M. SC. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE)

[M. SC. (MACS)]

Term-End Examination

December, 2023

MMTE-002 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 2 Hours   *Maximum Marks : 50*

Note **:** *(i)* *There are six questions in this paper.*

(ii) *Question No.* ***6*** *is compulsory. Do any* ***four*** *questions from question nos.* ***1*** *to* ***5***.

(iii) Calculators are not allowed.

1. (a) If $f : \mathbf{N} \to \mathbf{R}^+$ and $g : \mathbf{N} \to \mathbf{R}^+$ are two functions, when do we say that $f(n) = \Theta(g(n))$? If $f(n) = \sum_{i=1}^{n} i$, show that $f(n) = \Theta(n^2)$.   3

(b) Short the following numbers using insertion sort :   3

45, 23, 75, 11, 22, 23, 9, 74

Show all the steps.

(c) Draw a binary search tree for the following inputs :   4

14, 15, 4, 9, 7, 18, 11, 16, 20

Also, give the pre-order traversal output for the binary tree you have constructed.

2. (a) Construct a Huffman code for the following data :   5

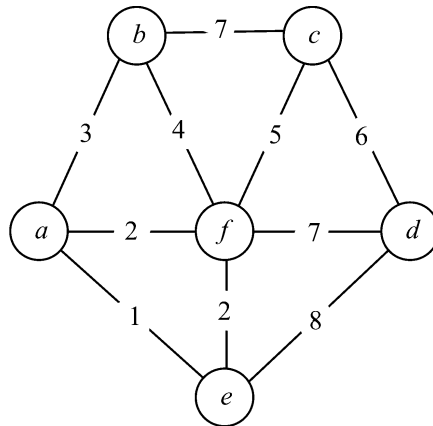| Character	A	B	C	D	E
Probability	0.3	0.2	0.2	0.15	0.15

Fig. 1

(b) Find the minimum spanning tree of the weighted graph in figure 1 using Prim's algorithm, starting with the vertex e.   5

3. (a) Find an optimal chain parenthesisation of a matrix chain product whose sequence of dimensions is (30, 40, 6, 20, 8).   7

   (b) Sort the following list of English words in alphabetical order using the Radix Sort Algorithm :   3

   BAR, CAP, ZAP, APE, TAR, DIG, BIT, TAB, ARC, TEA.

4. (a) Illustrate the steps of Rabin-Karp matcher algorithm on the text 294872235748 for the pattern P = 22. Assume that you are working with q = 13. Indicate all the spurious hits.   5

   (b) Show the results of deleting C, P and T, in that order, from the B-tree with minimum degree 3 given in figure 2 :   5
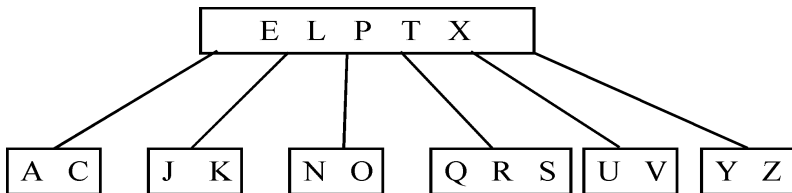

Fig. 2

5. (a) Write the steps for multiplication of two polynomials of degree n in Θ (n log n) time.   5

   (b) For the following network flow, draw the residual network. Find the augmenting path p and use it to augment the flow :   5
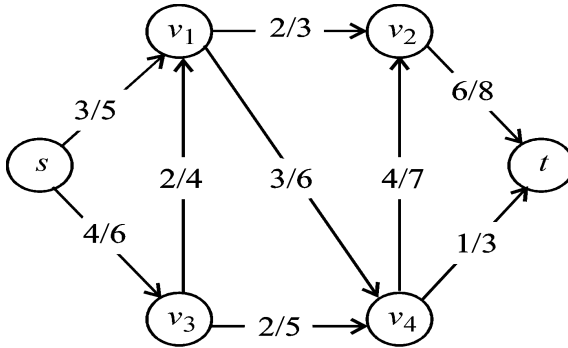

Fig. 3

6. Which of the following statements are true and which are false ? Justify your answer with short proof or a counter-example :   10

   (a) The time complexity to build a heap with n nodes is O (log n).

   (b) The time complexity of any comparison sorting algorithm is more than the Radix Sort algorithm.

(c) The Dynamic programming approach always gives a better solution to any problem in comparison with the Greedy approach.

(d) The Bellman-Ford algorithm can determine shortest paths in any directed graph.

(e) In any weighted connected graph with three vertices there is a unique minimal spanning tree up to isomorphism.