Course Code : CST 252 **KOLP/RW – 19 / 9038**

Third Semester B. E. (Computer Science and Engineering) Examination

DATA STRUCTURE AND ALGORITHMS

Time : 3 Hours] [Max. Marks : 60

Instructions to Candidates :—

(1) All questions carry marks as indicated against them.
(2) Assume suitable data and show algorithm trace wherever necessary.

1. (a) Consider an Array ADT. Write algorithms or C - functions to – (1) Add an element to an array, (2) Delete an element from an array, (3) Find length of an array, (4) Merge two arrays into a third array. Ensure that on initialization length of array is zero. 5 (CO 1)

   (b) Why asymptotic notations are used to express time complexity of an algorithm ? Describe the Big - Oh and Theta notations. 5 (CO 1)

2. Attempt any **Two** :—

   (a) What is a priority queue ? What advantages are accrued when using a priority queue ? Enlist applications of priority queues. Discuss the linked representation for priority queue. 5 (CO 2)

   (b) Develop C - functions to implement a Stack ADT using array data structure. Write main( ) to integrate these functions. 5 (CO 2)

   (c) Formulate an algorithm to convert an arithmetic expression into its equivalent postfix expression. Employing your algorithm find the equivalent postfix expression for the arithmetic expression : (E + B) * (C – X ^ D). 5 (CO 2)

3. (a) Design algorithms to realize a Queue ADT using linked allocation. Ensure that all operations takes O(1) time. 5 (CO 2)

   (b) Devise a linked representation for a list in which insertions and deletions can be made at either end in O(1) time. Such a structure is called a deque. Write C - functions to insert and deletes at either end. Trace the routines. 5 (CO 2)

4. Attempt any **Two** :—

(a) Engineering Admission Authority for FYBE CAP updates the provisional merit list [PML] on receiving grievances (usually 1% records). Design an efficient algorithm to transform PML into final merit list. Comment why your algorithm is efficient. Trace your algorithm on a list, L[ ] := {33, 55, 44, 66, 99, 77, 88}. 5 (CO 3)

(b) Devise a linear time sorting algorithm capable of ordering a set of non–negative integers. Why this algorithm cannot be categorized as comparison–based sorting method ? Is your algorithm stable and in–place ? Trace your algorithm on a list, P[ ] := {57, 53, 52, 57, 56, 53, 57, 52, 55}. 5 (CO 3)

(c) A large number of keys (integral values) to be ordered increasingly are stored on a file. The processor has a limited core memory that cannot accommodate all keys on the file. Design an algorithm for this. Trace your algorithm on a list, X[ ] := {88, 55, 11, 99, 88, 44, 77, 33}. Is this a stable algorithm ? 5 (CO 3)

5. Attempt EITHER :—

(a) Enumerate the advantages of AVL tree. Develop an algorithm to remove a key from an AVL tree. Trace for all possible cases. 10 (CO 4, CO 3)

OR

(b) Consider a binary tree realized using linked representation. Develop C-Functions to – (1) Add a node, (2) Counting and printing all leaf nodes, (3) Counting and printing all nodes with exactly one child, (4) Height of the tree. Trace all your algorithms. Comment on drawbacks of binary tree. 10 (CO 4, CO 3)

6. Attempt EITHER **(a)** or **(b)**. **Part (c) is Compulsory** :—

(a) Compare Prim's MST algorithm with Kruskal's MST algorithm. For the graph in Fig. 6 (a), construct the MST using Prim's algorithm. Show intermediate stages in construction.

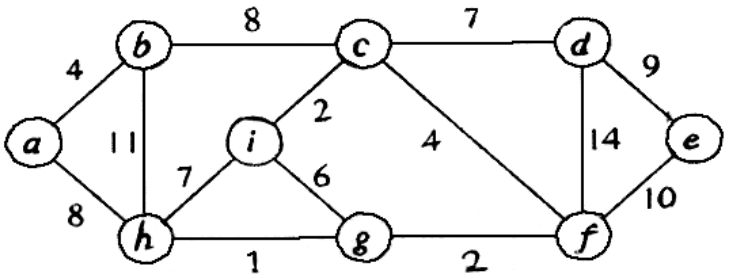

Fig. 6 (a) 5 (CO 4, CO 3)

(b) Design an algorithm to compute shortest paths originating at every vertex of the graph. For the graph in Fig. 6 (b), construct the path matrix. Show the intermediate stages.

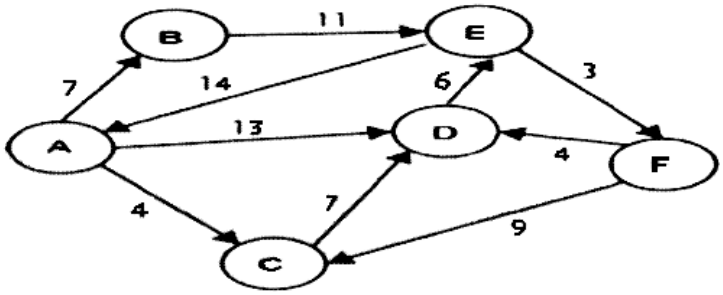

Fig. 6 (b) 5 (CO 4, CO 3)

(c) How is double hashing different from rehashing ? Describe open hashing highlighting its merits and drawbacks. Insert the keys 7, 24, 18, 52, 36, 54, 11 and 23 using closed addressing having hash table with 9 slots. Use division method. 5 (CO 3)