## Jharkhand University of Technology, Ranchi

## **B.Tech. 3rd Semester Examination, 2019**

**Subject: Data Structures and Algorithms** 

Subject Code: CS-301

Time Allowed: 3 Hours

Full Marks: 70

Candidates are required to give their answer in their own words as far as practicable.

The figures in the right margin indicate full marks.

Answer any five questions.

1. There are SEVEN objective type questions and each carries two marks. Select the correct answer:  $2 \times 7 = 14$ 

- (a) Assume elements of lower triangular matrix  $A_{m \times m}$  are stored in one dimension array representation whose base address in  $B_0$  number of memory location required for an element is W. If storing takes place in row major where elements of the row one are stored first then which of the following is true for calculating the address of element A(i, j).
  - (i)  $B_0 + \left[ \frac{i(i-1)}{2} + j \right] \times W$
- (ii)  $B_0 + \left[ \frac{i(i-1)}{2} + j 1 \right] \times W$
- (iii)  $B_0 + \left[\frac{i(i-1)}{2} + j + 1\right] \times W$  (iv)  $B_0 + \left[\frac{j(i-1)}{2} + j\right] \times W$
- (b) For merging two unsorted list of size p and q into sorted list of size (p+q). The time complexity in terms of number of comparison is:
  - (i)  $O(\log p + \log q)$
- (ii) O(p+q)
- (iii)  $O(p \log p + q \log q)$
- (iv) None
- (c) Linked lists are not suitable data structures of which one of the following problems?
  - (i) Insertion sort

(ii) Binary search

(iii) Radix sort

- (iv) Polynomial manipulation
- (d) Which one of the following correctly determines the solution of the recurrent relation given below with  $T(1) = 1? T(n) = 2T(\frac{n}{4}) + n^{1/2}$ 
  - (i)  $O(n^2)$

(ii) O(n)

(iii)  $O(n^2 \log n)$ 

- (iv)  $O(\log n)$
- (e) In the worst case, the number of comparisons needed to search a singly linked list of length n for a given element is
  - (i)  $\log_2 n$

(ii) n/2

(iii)  $\log_2 n - 1$ 

(iv) n

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Please Turn Over

- (f) Which of the following sorting algorithms has the highest best case time complexity using array data structure?
  - (i) Heap sort

(ii) Insertion sort

(iii) Bubble sort

- (iv) Selection sort
- (g) What is the time complexity of recursive function:  $T(n) = 4T(\frac{n}{2}) + n^2$ 
  - (i)  $O(n^2)$

(ii) O(n)

(iii)  $O(n^2 \log n)$ 

- (iv)  $O(n \log n)$
- (a) Explain the different asymptotic notations with proper mathematical definition and suitable examples with help of graph.
  - (b) Write an algorithm to perform Binary search. Analyze it's complexity in all the cases.
  - 3. (a) Write the algorithm to convert an Infix expression to it's Prefix.

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- (b) Write in C program to implement the linked list which takes two lists, each of which is sorted in increasing order, and merges the two together into one list which is in increasing order. Assume list A contains 1, 2, 4, 6, 9 and list B has 2, 3, 5 and 7 in their data fields.
- 4. (a) Evaluate the following postfix expression with help of Stack and show the stack content during evaluation. Consider the expression: 6 2 3 + 3 8 2 / + \* 2 % 3 + where operators represent their standard meaning.
  - (b) Explain array implementation of priority queue.

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5. (a) For the given graph in Fig. 1 find the MST using Prim's Algorithm, starting from vertex 4. 7

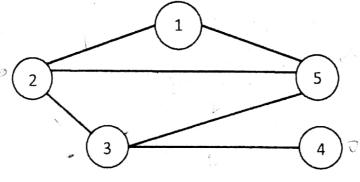


Figure 1

- (b) Define balance factor with respect to AVL Tree. What are the four different rotations, explain them with proper example.
- (a) Sort the following numbers with help of Quick Sort algorithm. Consider last element as the *pivot number* and write the output for each intermediate step. {7, 2, 13, 19, 11, 0, 1, 5}.
  - (b) What are the advantages of threaded binary tree? Explain one-way and two-way threaded binary trees with suitable example.

- 7. (a) What is Hashing and re-hashing? Consider a Hash table with nine slots. The hash function is h(k) = k mod 9. The collisions are resolved by chaining. The following nine keys are inserted in the order: 5, 28, 19, 15, 20, 33, 12, 17 and 10. Find the maximum, minimum and average chain lengths in the hash table.
  - (b) Write the BFS traversal for the given graph in Fig. 2. Start with the vertex A and show the addition of each vertex with appropriate data structures.

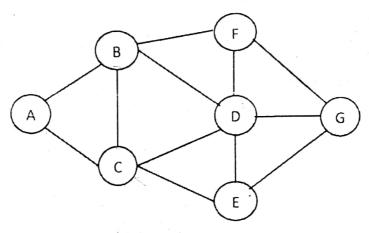


Figure 2

**%:** Write short notes on the any two:

 $7 \times 2 = 14$ 

- (a) Dijkstra Algorithm
- (b) Floyds Warshall Algorithm
- (e) Collision Resolution in Hashing
  - (d) Dangling reference