**B.Sc. (Honours) Examination, 2019**
**Semester-IV**
**Computer Science**
**Course : CC-8**
**(Design and Analysis of Algorithms)**

**Time : 3 Hours** **Full Marks : 40**

Questions are of value as indicated in the margin

Answer Question No.**1** and **any four** from the rest

1. a) Define asymptotic tight bound, asymptotic upper bound, and asymptotic lower bound.
   b) What is the time complexity of the following code:

```
main()
{
    int i, j, k, p, n;
    S(p), S(n); // scan
    for i = 1 to p
        for i = n/p to n
            for k = 1 to p^n changed by k* = p;
}
```

   c) Prove that in a full binary tree the number of leaf nodes is $\frac{n+1}{2}$ when $n$ is the total number of nodes.
   d) Define red-black tree. 3+1+2+2=8
2. a) Explain Divide and Conquer method.
   b) Solve the following recurrence relation by recursion tree method:
   $T(n) = \Theta(1)$ if $n = 1$ and $aT(n/b) + c$ if $n = b^p$,
   where $T(n)$ is a positive function of $n$, $p$ is a positive integer, $a \geq 1, b > 1, c \geq 1$, and $a, b, c$ are constants.
   c) Write an algorithm to multiply two matrices (or, to solve 3-way merge sort) by divide and conquer method. Analyse the time complexity of the solved problem. 1+3+(3+1)=8
3. a) Apply radix sort algorithm to solve the following list of elements:
   29, 800, 596, 323, 9, 23, 509, 323, 700.
   b) How is quicksort algorithm used to sort a list of numbers in non-increasing order? Show all the steps.
   c) Analyse its time complexity.
   d) Execute the above algorithm to sort a list of numbers mentioned in $3(a)$. 2×4=8
4. a) How does DFS algorithm work? Show all the steps.
   b) Consider a graph $G$ having 6 vertices and 8 edges represented by the following adjacency matrix:

P.T.O.

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 1 | 0 |
| 3 | 0 | 0 | 0 | 0 | 1 | 1 |
| 4 | 0 | 1 | 0 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 1 | 0 | 0 |
| 6 | 0 | 0 | 0 | 0 | 0 | 1 |

Apply DFS traversal on the above graph by taking 1 as the starting vertex.

c) Define tree edge, forward edge, back edge and cross edge.

d) Show all the edges on the graph mentioned in $4(b)$. 2×4=8

5. a) Let $A_1, A_2, ..., A_n$ be $n$ matrices of orders $p_1 \times p_2, p_2 \times p_3, ..., p_n \times p_{n+1}$, respectively. Write an algorithm to parenthesize $(A_1 \times A_2 \times ... \times A_n)$.

b) Illustrate all the steps for the matrices $A_1, A_2, A_3, A_4,$ and $A_5$ having the orders 5×10, 10×30, 30×100, 100×5, and 5×20, respectively.

c) After solving $5(b)$, is it possible to parenthesize $(A_2 \times A_3 \times A_4)$? Justify your answer. 4+3+1=8

6. a) Define $p-$ ary maxheap.

b) Write heapsort algorithm through $p-$ary maxheap.

c) Find the index of the parent node for its child indexed at $i$ and index all the $p$ children where their parent node is indexed at $i$. Assume that the root is indexed at 0.

d) Create a 5-ary maxheap for the following elements and then sort all the elements in ascending order:
mango, banana, orange, apple, grape, coconut, raisin, guava, berry, pomegranate, and watermelon. 1+2+2+3=8

7. a) Create a red-black tree for the following elements:
Ones, Tens, Hundreds, Thousands, Millions, Billions, Trillions.

b) Delete an item Trillions from the created red-black tree.

c) Write Naïve string matching algorithm and analyse its time complexity.
Execute the above algorithm on the following input:

Text : GOATGOLDGODGOTIT

Pattern: GO

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