

Master of Computer Application (MCA)
MCAC-301: Design and analysis of algorithms

Unique Paper Code:

Semester: III

November: 2021

Year of admission: 2020

Time: 2.30 Hours

Max. Marks: 30

1. a. Consider the following function (2)

```
Int ABC(int)
{
    Int p,q,r,s,t=0;
    For( p=1; p<n; ++p)
    {
        s=0;
        For(q=n; q>1; q=q/2)
            ++s
        For( r=1; r<n; r=r*2)
            ++t;
    }
```

Find the complexity of the above function.

- b. Consider MS and INS be algorithms for merge sort and insertion sort to sort numbers in ascending order. Let c_1 and c_2 be the number of comparisons taken by the algorithms MS and INS respectively for the inputs [10,20,30,40,50] and [50,10,30,40,20]. What will be the values of c_1 and c_2 for both inputs? (4)

2. a. Solve the given recurrence relation using recursion tree method

$$T(n) = T\left(\frac{2n}{3}\right) + T\left(\frac{n}{3}\right) + O(n) \quad (3)$$

- b. Consider the input is drawn from a uniform distribution [0, 1), Determine the suitable algorithm for it and also analyze the best and worst case time complexity. (3)

3. a. Consider a complete undirected graph with vertex set {0, 1, 2, 3, 4}. Entry W_{ij} in the

matrix W below is the weight of the edge $\{i,j\}$. (3)

$$W = \begin{bmatrix} 0 & 1 & 8 & 1 & 4 \\ 1 & 0 & 12 & 4 & 9 \\ 8 & 12 & 0 & 7 & 3 \\ 1 & 4 & 7 & 0 & 2 \\ 4 & 9 & 3 & 2 & 0 \end{bmatrix}$$

Find the minimum spanning tree for the following adjacency matrix using Prim's algorithm. Also comment that it will generate a unique minimum tree or not. Justify your answer.

- b. Show the intermediate steps for multiplication of two integers 786 and 120 using divide and conquer method. (3)

4. a. How recursive activity selector is different from Greedy activity selector. Justify your answer. (2)
- b. Consider an instance of subset sum in which $w_1 = 1$, $w_2 = 3$, $w_3 = 3$, $w_4 = 5$ and $W = 9$. Draw the table of $OPT(i, w)$ values computed by dynamic programming. Also find the value of $OPT(3,6)$. (4)

5. a. Consider a Quick sort to sort the following elements in ascending order: (2)
20, 47, 15, 8, 9, 4, 40, 30, 12, 17
Then what will be the order of these elements after the second pass.
- b. Consider a Fibonacci series having n terms, to count the minimum number of comparisons required to determine if an integer appears more than $n/2$ times. (2)
- c. Draw a finite automata for the given pattern: abababac (2)