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**MCA**  
**(SEM III) THEORY EXAMINATION 2018-19**  
**DESIGN & ANALYSIS OF ALGORITHM**

Time: 3 Hours

Total Marks: 70

**Note:** 1. Attempt all Sections. If require any missing data; then choose suitably.

**SECTION A**

1. Attempt *all* questions in brief.

2 x 7 = 14

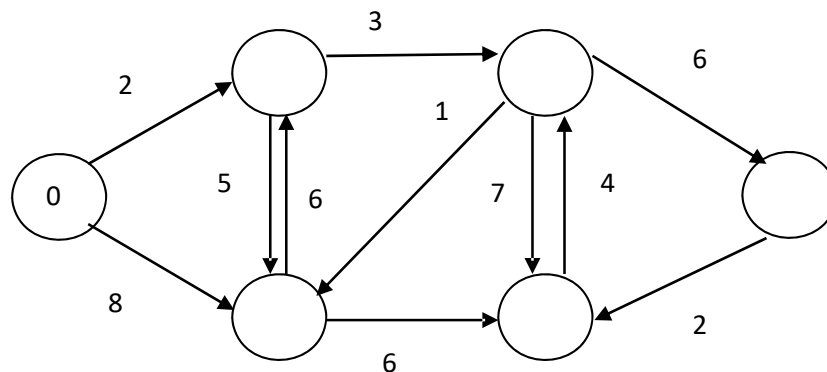
- a. Discuss the basic steps in the complete development of an algorithm.
- b. Define the Longest common subsequence (LCS).
- c. If the height of a heap is  $h$ , what will be the maximum and minimum no. of elements in a heap?
- d. What do you understand by 'stable' sort?
- e. Define various asymptotic notations in short.
- f. Explain NP hard problems and NP complete.
- g. What are randomized algorithms?

**SECTION B**

2. Attempt any *three* of the following:

7 x 3 = 21

- a. What is divide and conquer strategy and explain the binary search with suitable example.
- b. Distinguish between Quick sort and Merge sort, and arrange the following numbers in increasing order using merge sort  
**18, 29, 68, 32, 43, 37, 87, 24, 47, 50.**
- c. What is single source shortest path problem? Solve the shortest path problem using Dijkstra's algorithm.



- d. What are approximation algorithms? Give an approximation algorithm for travelling salesman problem (TSP).
- e. Write the short note of the following-

- (1) What is convex hull?
- (2) Minimum weight spanning tree.
- (3) Hamiltonian cycles.

### SECTION C

3. **Attempt any *one* part of the following:** **7 x 1 = 7**
  - (a) State algorithm of quick sort and prove that Quick sort algorithm takes  $O(n^2)$  time to sort the array of  $n$  elements in the worst case?
  - (b) State master's theorem and find the time complexity for the following recurrence:  

$$T(n) = 2T(n^{1/2}) + \log n$$
4. **Attempt any *one* part of the following:** **7 x 1 = 7**
  - (a) Prove that if  $f(n) = a_m n^m + a_{m-1} n^{m-1} + \dots + a_1 n + a_0$ . Then  $f(n) = O(n^m)$ .
  - (b) Define a red black tree. Draw the red black tree resulting from inserting the numbers 41, 38, 31, 12, 19, 8 into an initially empty RB Tree.
5. **Attempt any *one* part of the following:** **7 x 1 = 7**
  - (a) Let  $A = \langle 7, 2, 4, 17, 1, 11, 6, 8, 15, 10, 20 \rangle$ 
    - i) Draw a binomial heap whose keys are elements of  $A$ .
    - ii) Apply the extract min operation on the resulting heap.
  - (b) What do you understand by amortized analysis? What are different methods used for it. Explain one of them with suitable example.
6. **Attempt any *one* part of the following:** **7 x 1 = 7**
  - (a) Describe the Warshall's and Floyd's algorithm to finding all pair shortest path. Also, give the time complexity of both algorithm
  - (b) Define knapsack problem and describe its formation. Find the optimal solution to the knapsack instance  $n=5$   $W=[20,30,40,10,7]$ ,  $P=[7,8,9,1,6]$  and  $C=80$  using greedy method.
7. **Attempt any *one* part of the following:** **7 x 1 = 7**
  - (a) Write the prim's algorithm to find the minimum cost spanning tree of a undirected graph and compare their time complexity
  - (b) Discuss the string matching algorithm. Can we put it into the problem category?