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MMTE-002

M.Sc. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE)
M.Sc. (MACS)
Term-End Examination

00934 **December, 2016**

MMTE-002 : DESIGN AND ANALYSIS OF ALGORITHMS

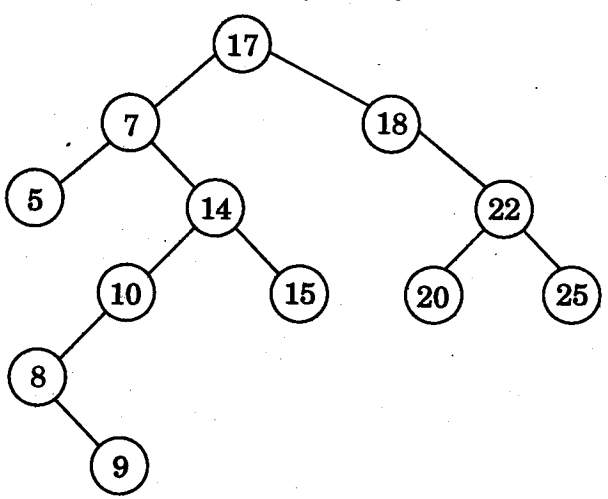
Time : 2 hours *Maximum Marks : 50*

Note : *Question no. **6** is **compulsory**. Answer any **four** questions from questions no. 1 to 5.*

1. (a) Sort the following numbers using the Quick Sort algorithm : *5*

35, 23, 38, 22, 11, 47

(b) Consider the following binary search tree :



Explain, with all the steps, the process of deleting the nodes with values 15, 18 and 8. *5*

2. (a) Illustrate the steps of the algorithm BUILD-MAX-HEAP for the following data :

16, 14, 10, 18, 7

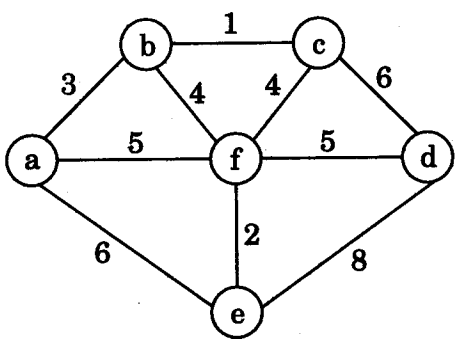
Also compute the running time of the BUILD-MAX-HEAP algorithm. 5

(b) Explain, with steps, the algorithm for finding the longest common subsequence of the sequences X = ⟨ B, C, D, C, E, B, C ⟩ and Y = ⟨ C, E, D, B, C, B ⟩ using Dynamic programming. 5

3. (a) Illustrate, with all the steps, the operation of COUNTING-SORT on the array

A = ⟨7, 1, 3, 1, 2, 4, 5, 7, 2, 4, 3⟩. 5

(b) Find the minimum spanning tree for the following graph using Prim's algorithm, explaining all the steps : 5



4. (a) Illustrate the steps of the Rabin-Karp matcher algorithm on the text

T = 3 1 4 1 5 9 2 6 5 3 5 8 9 7 8 3

for the pattern P = 26. Assume you are working with q = 11. Indicate all the spurious hits. 5

(b) Consider the knapsack instance with n = 3, with the cost array

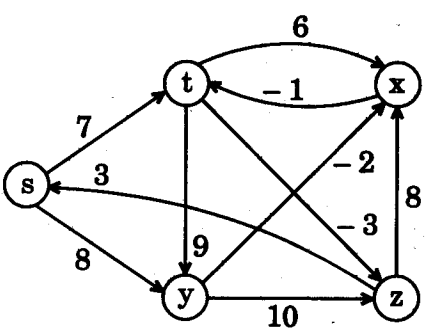
$(p_1, p_2, p_3) = (60, 100, 120)$, weight array $(w_1, w_2, w_3) = (10, 20, 30)$.

The knapsack can hold a weight of 50 units. Solve the 0 – 1 knapsack problem and the fractional knapsack problem for the data above with the most efficient algorithm.

You should also explain why your choice of algorithm is most efficient. *5*

5. (a) Compute the Discrete Fourier Transform (DFT) of the vector (1, 2, 0, 3). *4*

(b) Run the Bellman-Ford algorithm on the directed graph given below, using the vertex s as the source. Explain all your steps. *6*



6. Which of the following statements are *True*, and which are *False* ? Justify your answers. *5×2=10*

(a) Merge Sort algorithm is a stable sorting algorithm.

(b) Every binary heap is a B-tree.

(c) In the dynamic programming approach, the value of an optimal solution of an optimisation problem is determined in a bottom-up fashion.

(d) In any directed graph with negative weights, Dijkstra's algorithm can be used to find the shortest path.

(e) For any integer $k \geq 1$, if $a > b \geq 1$, $a, b \in \mathbf{N}$, and $b < F_{k+1}$, the call EUCLID (a, b) makes fewer than k recursive calls, where F_{k+1} is the $(k+1)^{th}$ Fibonacci number.