Paper Code: MCA-312 **Roll No.** | | | | | | | | | | |

MCA

(SEM III) ODD SEMESTER EXAMINATION 2015-2016

DESIGN & ANALYSIS OF ALGORITHMS

[Time : 3 hrs.] **[Max. Marks: 100]**

Note – Attempt All Questions. All Questions carry equal marks:-

Q.1. Attempt any four part of the following: (5*4)

a) Let f(n) and g(n) be asymptotically nonnegative functions. Using the basic definition of Θ notation, prove that max(f(n),g(n))= Θ(f(n)+g(n))

b) Draw the recursion tree for T(n)= 4 T(n/2)+n, and provide tight asymptotic bound on its solution.

c) Using Master method give tight asymptotic bounds for the following recurrence
T(n)= 3 T(n/4) + n log n

d) Show that the running time of **Quicksort** is $\Theta(n^2)$ when the array A is sorted in nonincreasing order.

e) How can a sorting algorithm become stable? Prove that COUNTING SORT is stable

f) Compare Merge, Quick and Bubble sorts in terms of their Best, Average and Worst time complexities.

Q.2. Attempt any two part of the following: (10*2)

a) Show the red black trees that result after successively inserting the keys 41, 38, 31, 12, 19, 8 into an initially empty red black tree.

b) Define inorder, preorder, postorder traversing of B-tree.

c) What conditions does a binomial tree satisfy? Prove that binomial tree B_k contains 2^k nodes, of which (^k_i) are at depth i, 0<=i<=k.

Q.3. Attempt any two part of the following: (10*2)

a) Write a dynamic programming solution to find out the longest subsequence of n-character string

b) i) What is the optimal Huffman code for the following set of frequencies based on the first 8 Fibonacci numbers?
a:1, b:1, c:2, d:3, e:5, f:8, g:13, h:21
ii) Write down the recursive algorithm for solving Knap Sack problem. Apply your algorithm to solve the following instance of the Knap Sack problem. Capacity of the Knap Sack is 5.

Item	Weight	Value
1	2	Rs.12
2	1	Rs.10
3	3	Rs.20
4	2	Rs.15

c) A newspaper agent drops the newspaper to the area assigned (is given below in fig 1) in such a manner that he has to cover all the houses in the respective area with minimum travel cost. Compute the minimum travel cost.

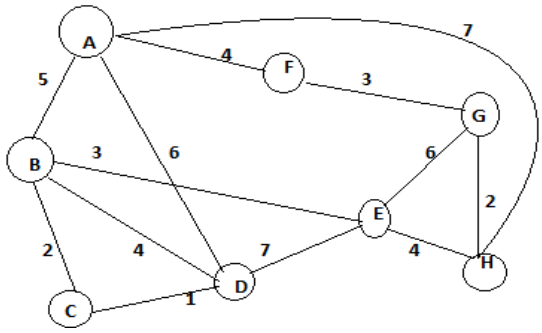


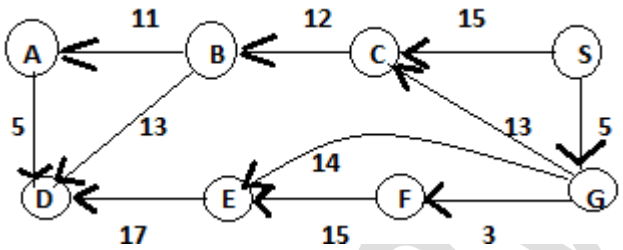
Fig 1

Q.4. Attempt any two part of the following: (10*2)

a) i) Explain BFS and show its correctness.
ii) Suppose all the weights in a graph are integers in the range of 1 to |V|. How can you make Kruskal's algorithm to run fast

b) Write an efficient algorithm to decompose a directed graph into its strongly connected components

c) Write Dijkstra's algorithm for single source shortest path. Apply it on following graph with source node (S). Write its time complexity



Q.5. Attempt any two part of the following: (10*2)

a) Write down Strassen's algorithm for multiplying two matrices. Use the algorithm to compute the product of the following two matrices. How would you modify Strassen's algorithm to multiply n x n matrices in which n is not an exact power of 2?

$$\begin{bmatrix} 2 & 8 \\ 13 & -5 \end{bmatrix} \text{ and } \begin{bmatrix} 6 & -9 \\ -3 & 4 \end{bmatrix}$$

b) Write down Knuith-Morris-Pratt(KMP) algorithm for string matching. Compute the prefix function for the pattern: ababbabbabbababbabb

c) Prove that (i) if any NP-complete problem is polynomial-time solvable, then P=NP (ii) if any problem in NP is not polynomial time solvable, then no NP-complete problem is polynomial time solvable.