

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 13137

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Unique Paper Code : 32347616

Name of the Paper : Advanced Algorithms

Name of the Course : **B.Sc. (H) Computer Science (CBCS)**

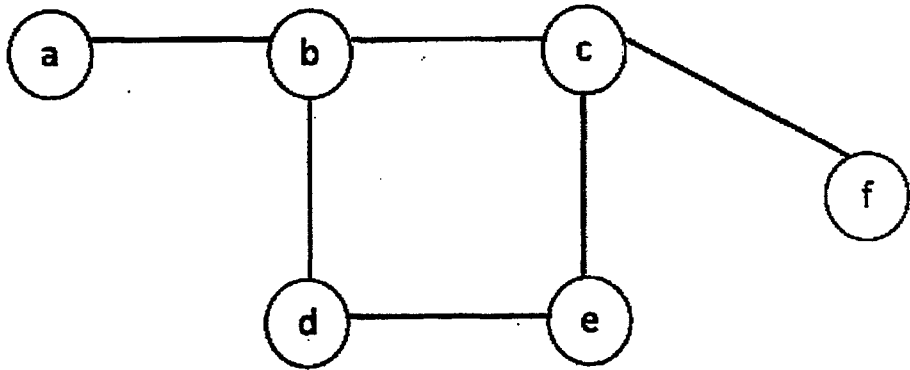
Semester : VI

Duration : 3 Hours

Maximum Marks : 75

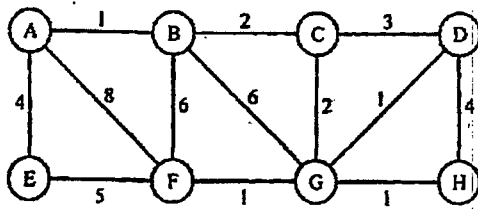
Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question No. 1 of 35 marks is compulsory.
3. Attempt any **four** questions from Q. No. 2 to Q. No. 7.

SECTION A		
1 a)	Define black-height of a Red Black tree using an example.	2
b)	Define load factor of a dynamic table T. What is the load factor of an empty dynamic table?	3
c)	Write the recurrence equation for Integer Multiplication algorithm which uses three-way branching. What is the time complexity of the algorithm?	3
d)	State max flow-min cut theorem.	2
e)	Find a minimum vertex cover for the following graph, and hence find a maximum independent set. 	3
f)	Compare the performance of skip lists and regular lists with respect to search operation.	3

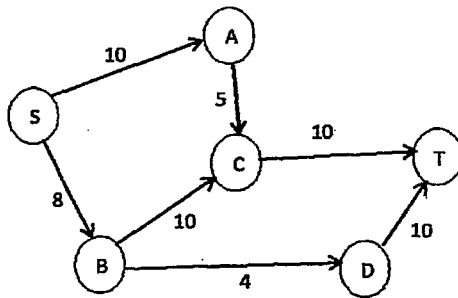
P.T.O.

g)	Write the recurrence relation for the divide and conquer algorithm for the Segmented Least Squares problem.	2
h)	Differentiate between maximum matching and perfect matching.	3
i)	Explain the structure of a Fibonacci heap.	3
j)	Given the following key-value pairs, insert them into a dictionary and show the structure: (A,10), (B,20), (C,30), (D,40).	3
k)	Differentiate between a standard trie and a compressed trie.	4
l)	Construct an optimal Huffman code for the characters A, B, C, D, E, given the following set of frequencies: B:5, D:5, A:7, C:8, F:10, E:11	4
SECTION B		
2.a)	For the following splay tree: <pre> 25 / \ 15 40 /\ /\ 10 20 35 50 </pre> Delete 15 using the splay-tree deletion algorithm. Show the intermediate splay trees after splaying and merging steps.	5
b)	Consider the elements {1, 2, 3, 4, 5, 6}. Each of the elements are in their singleton disjoint-sets. Perform the following operations and show the resulting sets after each operation. • Union(3,4) • Union(1,2) • Union(2,3) • Find(4)	5
3.a)	Show the Red Black tree which results after inserting the following keys in sequence into an initially empty tree: 40, 32, 22, 10, 17.	5
b)	Find the minimum spanning tree for the following graph using kruskal's algorithm.	5



4.a) Compute the shortest path from node 'S' to node 'T' using Dijkstra's algorithm.

5



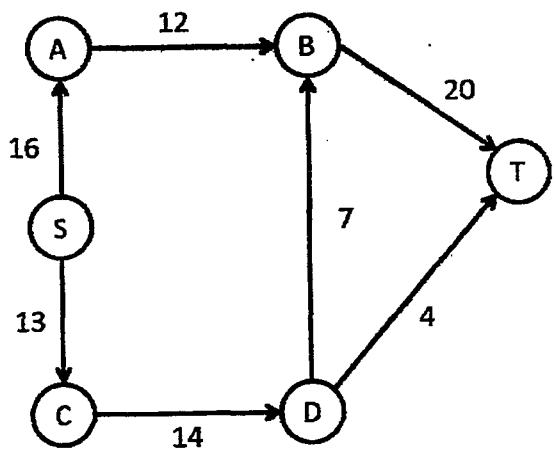
b) Does Dijkstra's algorithm work with a graph having negative edge weights? Justify your answer using appropriate arguments or example.

5

5.a) Consider the following set of intervals $\{i_1, i_2, \dots, i_n\}$, with start time s_i and finish time f_i . Determine the largest set of mutually compatible intervals.

5

Interval i	Start time s_i	Finish time f_i
1	1	4
2	3	5
3	5	7
4	5	10
5	3	10
6	6	15
7	8	16
8	9	18
9	7	20
10	10	24

b)	Generate an example of an array of size 5 with at least 7 inversions. Justify the example constructed. What is the maximum possible number of inversions that can occur in the array of size 5?	5
6.a)	Prove the following statement: Let f be any s-t flow, and (A, B) any s-t cut. Then $v(f) \leq c(A, B)$. Here $v(f)$ is the value of flow, and $c(A, B)$ denotes the capacity of the cut (A, B) .	4
b)	Find the maximum flow, from node S to node T, for the following graph.  <pre> graph LR S((S)) -- 16 --> A((A)) S -- 13 --> C((C)) A -- 12 --> B((B)) C -- 14 --> D((D)) B -- 20 --> T((T)) D -- 7 --> B D -- 4 --> T </pre> Also, identify the cut corresponding to the flow.	6
7.a)	Consider the following set of 8 points in a 2D plane: $P = \{(2,3), (5,4), (1,1), (7,2), (4,7), (6,6), (8,3), (3,5)\}$ Apply the Divide-and-Conquer Closest Pair Algorithm to this input and compute the minimum distance.	6
b)	Construct subsets decision tree that shows all the subsets of the set $\{6,2,4\}$.	4