Graphic Era HILL UNIVERSITY
Established by an Act of the State Legislature of Uttarakhand (Adhiniyam Sankhya 12 of 2011)
University under section 2(f) of UGC Act, 1956

End Term (Even) Semester Examination May-June 2025

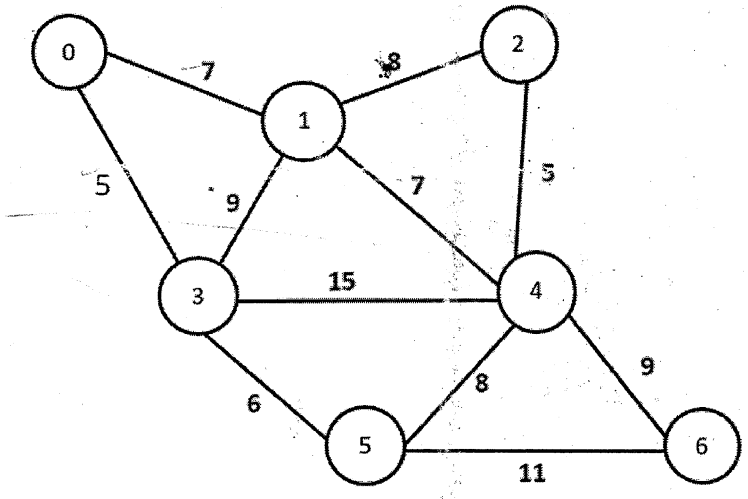
Roll no. 2319086

Name of the Program and semester: B. Tech IV
Name of the Course: Design and Analysis of Algorithms
Course Code: TCS 409
Duration: 3-hour

Maximum Marks: 100

Note:

(i) All the questions are compulsory.
(ii) Answer any two sub questions from a, b and c in each main question.
(iii) Total marks for each question are 20 (twenty).
(iv) Each sub-question carries 10 marks.

Q1	*(20 marks)*	
(a)	Solve the following Recurrence relation: (A) $T(n) = 36T(n/6) + n^2$ (B) $T(n) = \sqrt{2}T(n/2) + \log n$	**CO1**
(b)	Write the code to solve Tower of Hanoi and find its complexity using recurrence relation.	
(c)	Write a program to implement Binary search recursively. How is binary search different from linear search? Discuss the best- and worst-case time complexities for both algorithms.	
Q2	*(20 marks)*	
(a)	Consider an empty max heap, insert the following keys in the given order: **19, 22, 5, 17, 86, 13, 44, 53, 80** Show each step clearly and circle the final max heap.	**CO2**
(b)	Apply Kruskal's algorithm on the following graph, show each step clearly. 	**CO5**
(c)	Write a program to implement DFS using adjacency list? **void dfs(int src, vector<vector<int>> adj){** **//your code here** **}** Is topological sort same as DFS? Support your answer with a suitable example.	**CO3**

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<table>
<tr><td>Q3</td><td>(20 marks)</td><td></td></tr>
<tr><td>(a)</td><td>What do you understand by in-place sorting, stable sorting, external sorting, and online sorting? Explain with proper example of at least one algorithm in each of the above-mentioned sorting type.</td><td>CO2</td></tr>
<tr><td>(b)</td><td>Give the difference between fractional knapsack and 0/1 knapsack. Solve the given instance using fractional and 0/1 knapsack both for capacity = 6.
<table>
<tr><th>Item</th><th>Weight</th><th>Value</th></tr>
<tr><td>1</td><td>3</td><td>9</td></tr>
<tr><td>2</td><td>2</td><td>6</td></tr>
<tr><td>3</td><td>1</td><td>5</td></tr>
<tr><td>4</td><td>5</td><td>14</td></tr>
<tr><td>5</td><td>4</td><td>4</td></tr>
</table></td><td>CO4</td></tr>
<tr><td>(c)</td><td>Write an algorithm for insertion sort. Explain its working with an example. Why is insertion sort a better choice than quick sort for an almost sorted array?</td><td></td></tr>
<tr><td>Q4</td><td>(20 marks)</td><td></td></tr>
<tr><td>(a)</td><td>What is Rabin Karp Algorithm? Explain its working with an example. How is Rabin Karp Algorithm different from naïve string-matching algorithm?</td><td>CO6</td></tr>
<tr><td>(b)</td><td>How will you find a cycle in a graph using disjoint set data structure? Explain with a help of a suitable example and write the algorithm for the same.</td><td>CO3</td></tr>
<tr><td>(c)</td><td>Explain Bellman Ford algorithm with code. Differentiate between Bellman Ford and Djikstra.</td><td>CO5</td></tr>
<tr><td>Q5</td><td>(20 marks)</td><td></td></tr>
<tr><td>(a)</td><td>Explain P, NP, NP-hard and NP-Complete with proper examples. Using a diagram show the relation among these classes.</td><td>CO4</td></tr>
<tr><td>(b)</td><td>Define Hashing. Consider a hash table using hash function h(x) = x mod 11, insert the following keys in order (36, 55, 90, 69, 101, 19, 22, 60). Draw the resulting hash table for:
(i) Linear probing
(ii) Quadratic probing
(iii) Chaining</td><td></td></tr>
<tr><td>(c)</td><td>Complete the following function for calculating minimum no. of operation for matrix chain multiplication using dynamic programming.
int matrixChainMultiplication(int *p, int i, int j);
p is the array having information about dimensions of matrices, i = 1 and j = n-1 where n is the number of matrices.</td><td>CO5</td></tr>
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