Graphic Era
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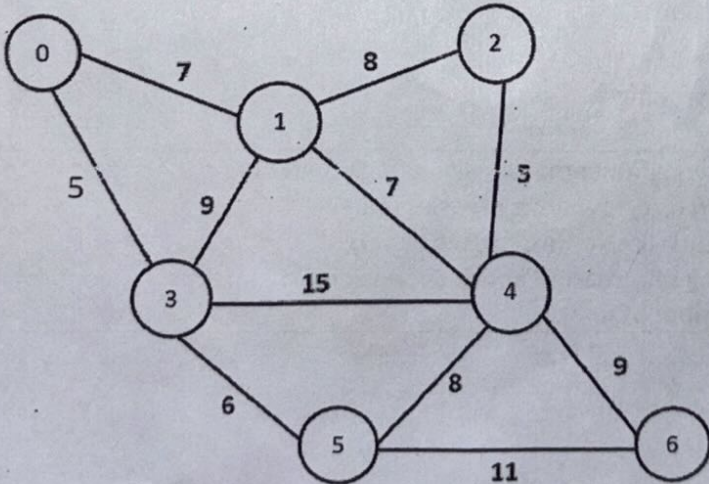## End Term (Even) Semester Examination May-June 2025

Roll no. ....

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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Q3		(20 marks)	
(a)	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.		CO2
(b)	Give the difference between fractional knapsack and 0/1 knapsack. Solve the given instance using fractional and 0/1 knapsack both for capacity = 6.		CO4

Item	Weight	Value
1	3	9
2	2	6
3	1	5
4	5	14
5	4	4

(c)	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?		
Q4		**(20 marks)**	
(a)	What is Rabin Karp Algorithm? Explain its working with an example. How is Rabin Karp Algorithm different from naïve string-matching algorithm?		CO6
(b)	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.		CO3
(c)	Explain Bellman Ford algorithm with code. Differentiate between Bellman Ford and Djikstra.		CO5
Q5		**(20 marks)**	
(a)	Explain P, NP, NP-hard and NP-Complete with proper examples. Using a diagram show the relation among these classes.		CO4
(b)	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		
(c)	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.		CO5