

SEMESTER END EXAMINATION, APRIL-MAY, 2025

Course Name: - B. Tech

Semester: - IV

Paper Name: - Design & Analysis of Algorithms

Paper Code: - TCS-402

Time - 3 Hrs + 20 minutes per hour extra time for V.I. & examinees with writer.

Max Marks-70

Additional 30 Minutes for Mid-Test.

समय- 3 घण्टे + 20 मिनट प्रति घंटे अतिरिक्त-दृष्टिबाधित एवं सह लेखक परीक्षार्थियों के लिए।
30 मिनट अतिरिक्त मिड-टेस्ट के लिए।

अधिकतम अंक-70

Instructions:

- The question paper consists of three sections namely A, B, C. All sections are compulsory.
- Section A- Each question carries 3 marks. All questions are compulsory.
- Section B- Answer any 5 out of 7 given questions. Each question carries 7 marks.
- Section C- Answer any 2 out of 3 given questions. Each question carries 10 marks.
- Section D- Each question carries 02 mark. All questions are compulsory.

Section - A (खण्ड-अ)

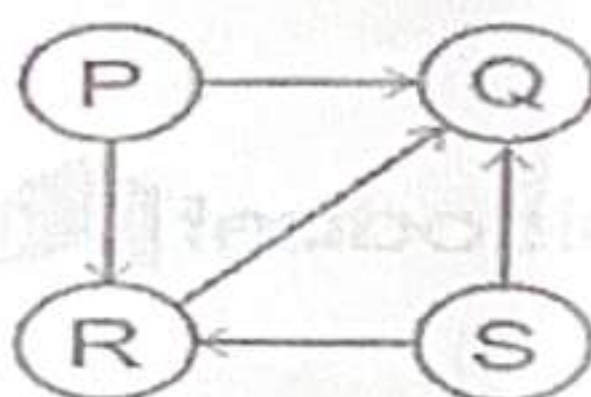
Objective Questions (वस्तुनिष्ठ प्रश्न)

1. Answer all the following questions.

5×3 =15

निम्नलिखित सभी प्रश्न अनिवार्य हैं।

- i) Which of the following is solution to 8 queen problem
- a) (1,5,8,6,3,7,2,4)
 - b) (1,2,3,4,5,6,7,8)
 - c) (8,7,6,5,4,3,2,1)
 - d) (2,7,5,8,4,2,3,1)
- ii) Kruskal's algorithm is based on method
- a) Divide and conquer
 - b) Greedy
 - c) Dynamic
 - d) Branch and bound
- iii) Which of the following shows the correct relation
- a) $O(\log n) < O(n) < O(n \log n) < O(2^n) < O(n^2)$
 - b) $O(n) < O(\log n) < O(n \log n) < O(2^n) < O(n^2)$
 - c) $O(n) < O(\log n) < O(n \log n) < O(n^2) < O(2^n)$
 - d) $O(\log n) < O(n) < O(n \log n) < O(n^2) < O(2^n)$
- iv) Consider the directed graph



Which of the following is true

- a) The graph does not have any topological order
- b) Both PQRS and SRQP are topological ordering
- c) Both PSRQ and SPRQ are topological ordering
- d) None of these

v) Recurrence relation of quicksort in worst case is

- a) $T(n)=T(n-1)+1$
- b) $T(n)=T(n-1)+n$
- c) $T(n)=2T(n/2)+1$
- d) $T(n)=2T(n/2)+n$

Section - B (खण्ड-ब)

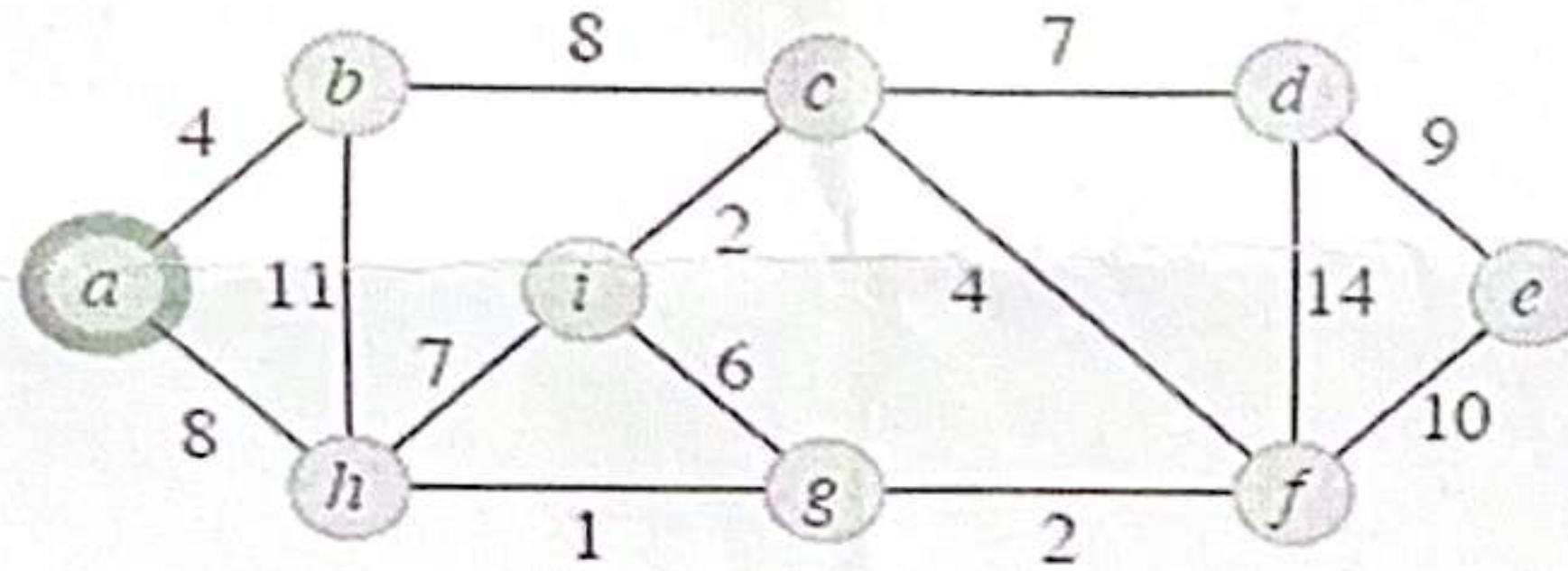
Short Answer Questions (लघुउत्तरीय प्रश्न)

2. Answer any five of the following questions.

5×7=35

निम्नलिखित में से किन्हीं पाँच प्रश्नों के उत्तर दें।

- i. What are the elementary properties of algorithm? Briefly explain asymptotic notations with proper diagram.
- ii. Construct a backtracking algorithm to find all solutions of to the n queen problem.
- iii. Describe the importance of pivot element in quick sort. How the position of it affects the performance of quick sort. Explain with algorithm
- iv. Solve the following recurrence relation a) $T(n) = 2T(n/2) + n \log^2 n$ b) $T(n)=2T(n/4)+n^{0.51}$
- v. Define Master theorem and solve the following recursion relation by recursion tree method.
 $T(n)=T(n/2)+T(n/4)+T(n/8)+n$
- vi. Define spanning tree. Compute a minimum cost spanning tree for the graph using prim's algorithm



- vii. Does greedy approach always give optimal solution? Write an algorithm to solve fractional knapsack problem.

Section - C (खण्ड-स)

Descriptive Questions (विवरणात्मक प्रश्न)

3. Answer any two of the following question.

2×10=20

निम्नलिखित में से किन्हीं दो प्रश्नों के उत्तर दें।

- i) Define Dynamic programming approach? Find the optimal solution for the 0-1 knapsack problem
 $N=3$ $(w_1, w_2, w_3) = (2, 3, 4)$ and $(p_1, p_2, p_3) = (1, 2, 4)$
- ii) (a) Briefly explain Approximation algorithm and approximation ratio.
(b) Describe about the class P, NP, NP-Hard and NP-Complete problems. Give example for each class.
- iii) Apply Branch and Bound to solve travelling salesman problem for the graph whose cost matrix is given below

∞	7	3	12	8
3	∞	6	14	9
5	8	∞	6	18
9	3	5	∞	11
18	14	9	8	∞

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Mid-Test

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All questions are compulsory.

सभी प्रश्न अनिवार्य हैं।

2×10=20

Q1 In Randomized Quick sort the expected running time of any input is

- a) $O(n)$
- b) $O(n^2)$
- c) $O(n \log n)$
- d) None of these

Q2 The time complexity of the recurrence relation $T(n) = 8T(n/2) + n^2$ is

- a) $O(n^2)$
- b) $O(n^3)$
- c) $O(n \log n)$
- d) none of these

Q3 how many solutions of 4 queen problem are possible

- a) 1
- b) 2
- c) 4
- d) 3

Q4 Number of leaf nodes in the recurrence tree representation of $T(n)=3T(n/4) + n^2$ is

- a) $\log_4 n$
- b) $n \log n$
- c) $n^{\log_4 n}$
- d) n^n

Q5 If a problem can be solved by combining optimal solutions to non-overlapping problems, the strategy is called

- a) Dynamic programming
- b) Greedy
- c) Divide and conquer
- d) Recursion

Q6 A problem which is both _____ and _____ is said to be NP complete

- a) NP, P
- b) NP, NP hard
- c) P, P complete
- d) None of the mentioned

Q7 The big O notation for $5n + \log n$ is

- a) $O(n)$
- b) $O(\log n)$
- c) $O(n \log n)$
- d) $O(n^2)$

Q8 Bin packing algorithm is a _____

- a) divide and conquer algorithm
- b) dynamic programming algorithm
- c) greedy algorithm
- d) approximation algorithm

Q9 What is live node in context of backtracking algorithm

- a) nodes that can further generate
- b) nodes that already provided a solution
- c) nodes that have no children
- d) nodes that cannot be further generated.

Q10 The time complexity of partition function used in quick sort is

- a) $O(n)$
 - b) $O(n^2)$
 - c) $O(n \log n)$
 - d) $O(\log n)$
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