AIML

MCKV Institute of Engineering

Paper Code :PC-IT402

Paper Name :Design and Analysis of Algorithm

Time Allotted: 1 Hour *Full Marks: 30*

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Group – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any ***five*** of the following: 5×1=5

(i)Which of the following methods can be used to solve n-queen's problem?

a) greedy algorithm

b) divide and conquer

c) iterative improvement

d) backtracking

(ii) Minimum number of unique colors required for vertex coloring of a graph is called?

a) vertex matching

b) chroı ıtic index

c) chromatic number

d) color number

(iii) Dijkstra's Algorithm cannot be applied on

a) Directed and weighted graphs

b) Graphs having negative weight function

c) Unweighted graphs

d) Undirected and unweighted graphs

(iv) In a knapsack problem, if a set of items are given, each with a weight and a value, the goal is to find the number of items that ___ the total weight and ___ the total value.

a) Minimizes, Minimizes

b) Maximizes, Maximizes

c) Maximizes, Minimizes

d) Minimizes, Maximizes

(v) How many colors will be required for vertex coloring of a complete graph having n vertices?

a) 0

b) 1

c) n

d) n!

(vi) Backtracking algorithm is implemented by constructing a tree of choices called as?

a) State-space tree

b) State-chart tree

c) Node tree

d) Backtracking tree

Group – B

(Short Answer Type Questions)

Answer any ***two*** of the following 2×5=10

2.State the formal definition of flow in a network. Clearly mention the constraints. [CO2/Remember/LOCQ]]

3. "Greedy algorithms do not ensure optimal solution of a given problem" – justify. [CO2/Analyze/IOCQ]

4. Differentiate fixed length and variable length coding schemes with example. [CO2/Analyze/IOCQ]

Group – C

(Long Answer Type Questions)

Answer any ***one*** of the following 1×15=15

5.What is the State-space search tree for a given algorithm? Draw the same for 15 puzzle problem up to level 3. [CO2/Apply/IOCQ] 5+10

6. (a) State the constraints of n-Queen problem. Give one solution of 8-queen problem starting from any initial positions of queens on the chess board. [CO3/Apply/IOCQ]

(b) For a job scheduling problem let number of job n = 4, profits associated (p1, p2, p3, p4) = (100, 10, 15, 27) and deadlines (d1, d2, D3, d4) = (2, 1, 2, 1). Find an optimal solution to this problem. [CO3/Apply/IOCQ] 2+5+8

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Design and Analysis of Algorithm

Time Allotted: **3 Hours** *Full Marks:* **70**

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Group – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following: **10×1=10**

(i) Which of the following sorting algorithm has minimum worst case time complexity?

a) Quick sort b) Heap sort c) Merge Sort d) Bubble Sort

(ii) Which of the following algorithms is NOT a divide & conquer algorithm by nature?

a) Euclidean algorithm to compute the greatest common divisor b) Heap Sort

c) Quick Sort d) Merge Sort

(iii) We use dynamic programming approach when

a) We need an optimal solution b) The solution has optimal substructure

c) Both of above d) None of them

(iv) Fractional knapsack problem is solved most efficiently by which of the following algorithm?

a) Divide and conquer b) Dynamic programming c) Greedy algorithm d) Backtracking

(v) The Data structure used in standard implementation of Depth First Search algorithm for graph traversal is

a) Stack b) Queue c) Linked List d) Tree

(vi) Kruskal's algorithm is a

a) divide and conquer algorithm b) dynamic programming algorithm

c) greedy algorithm d) approximation algorithm

(vii) Which of the following is true?

a) Prim's algorithm initializes with a vertex

b) Prim's algorithm initializes with a edge

c) Prim's algorithm initializes with a vertex which has smallest edge

d) Prim's algorithm initialises with a forest

(viii) Dijkstra's Algorithm is used to solve problem

a) All pair shortest path problem
b) Single source shortest path problem
c) Network flow problem
d) Sorting problem

(ix) Job sequencing with deadline is based on

a) Divide and Conquer method
b) Greedy Algorithm
c) Dynamic Programming method
d) Backtracking method

(x)What is the objective of the knapsack problem?

a) To get maximum total value in the knapsack
b) To get minimum total value in the knapsack
c) To get maximum weight in the knapsack
d) To get minimum weight in the knapsack

(xi) What is the running time of the Matrix Chain Multiplication Algorithm?

a) Big-oh(n)
b) Theta(n^2)
c) Big-Oh(nlogn)
d) Theta(n^3)

(xii) Bellman Ford Algorithm is used to solve problem

a) All pair shortest path problem
b) Single source shortest path problem
c) Network flow problem
d) Sorting problem

Group – B

(Short Answer Type Questions) 3×5=15

Answer any *three* of the following

2. Define different asymptotic notations with graphical presentation.
3. Compare Divide and conquer with greedy strategy.
4. Describe representing a graph by adjacency matrix and adjacency list format.
5. Why negative weighted cycles must be avoided in shortest path finding algorithms?
6. How dynamic programming technique differs from divide and conquer strategy?

Group – C

(Long Answer Type Questions) 3×15=45

Answer any *three* of the following

7. a) What do you mean by deterministic and non-deterministic algorithm?
   b) Why the time complexity of an algorithm is measured in terms of input size but not in terms of the standard unit of time, i.e. seconds?
   c) Using Recursion Tree find out the complexity of Merge Sort Method algorithm in best, worst and average cases. 4+3+8=15
8. a) Construct m-table for multiplication of the following matrices of given order:
   A1: 30X35, A2: 35X15, A3: 15X5, A4: 5X10, A5: 10X20, A6: 20X25
   b) Analyze the time and space complexities of the matrix chain multiplication algorithm. 8+7=15

9.a) Find the optimal solution using greedy criteria for a knapsack having capacity 100 kg for the following list of items having values and weights as shown in the table.

Item	Value	Weight
I_1	10	15
I_2	20	10
I_3	30	35
I_4	40	20
I_5	50	35

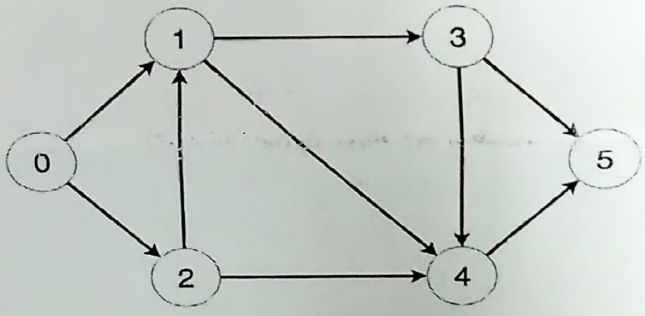
140

b) "Greedy algorithms do not ensure optimal solution of a given problem" – justify the statement. 10+5=15

10.a) Give the formal definition of flow of a network.

b) What are the roles of residual network and augmenting path in network flow algorithms?

c) For the following graph find the Breadth-First-Search traversal sequencefrom node '0' showing clearly the status of the Queue in each step. Deduce the complexity of the algorithm.



I_4 I_2 I_5
I_3 I_1

3+4+(6+2)=15

11. Write short notes on the topics give below (***any three***) : 3×5=15

(a) Recurrence Relation

(b) Huffman Coding Scheme

(c) GraphColoringProblem

(d) NP Complete set of problems

(e) Approximation Algorithms

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Design &Analysis of Algorithm

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Group – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any ***five*** of the following: 5×1

(i) Which of the following algorithms is NOT a divide & conquer algorithm by nature?

(a) Euclidean algorithm to compute the greatest common divisor

(b) Heap Sort

(c) Quick Sort

(d) Merge Sort

(ii) We use dynamic programming approach when

(a) We need an optimal solution

(b) The solution has optimal substructure

(c) Both of above

(d) None of the above

(iii) What happens when a top-down approach of dynamic programming is applied to any problem?

(a) It increases both, the time complexity and the space complexity

(b) It increases the space complexity and decreases the time complexity

(c) It increases the time complexity and decreases the space complexity

(d) It decreases both, the time complexity and the space complexity

(iv) Consider the matrices P, Q and R which are 10 x 20, 20 x 30 and 30 x 40 matrices respectively. What is the minimum number of multiplications required to multiply the three matrices?

(a) 18000

(b) 12000

(c) 24000

(d) 32000

(v) Which of the following methods can be used to solve the matrix chain multiplication problem?

(a) Dynamic programming

(b) Brute force

(c) Recursion

(d) Divide and Conquer

(vi) Which of the following sorting algorithm has minimum worst case time complexity?

(a) Quick sort

(b) Heap sort

(c) Merge Sort

(d) Bubble Sort

Group – B

(Short Answer Type Questions)

Answer any ***two*** of the following 2×5

2. Define different asymptotic notations with suitable diagram. Co-relate them with different cases of time complexities.

3. Find the recurrence relation of binary search algorithm and derive its time complexity.

4. How can we compare between two algorithms written for the same problem? Explain it for sorting algorithm.

Group – C

(Long Answer Type Questions)

Answer any ***one*** of the following 1×15

5. Find the optimal parenthesization of a matrix chain product whose sequence of dimensions is <5, 10, 3, 12, 5, 50, 6>. Give an algorithm for the above procedure. Analyse its complexity.

6. Find the asymptotic upper bound of the following recurrence relation with the help of recursion tree method:

$$T(n) = T(n/4) + T(n/2) + \theta(n^2)$$

7. Analyse the best case, worst case and average case of Merge Sort Algorithm showing stepwise time requirement.

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Group – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any ***five*** of the following: 5×1

(i)Fractional knapsack problem is solved most efficiently by which of the following algorithm?

a) Divide and conquer

b) Dynamic programming

c) Greedy algorithm

d) Backtracking

(ii) What is the objective of the knapsack problem?

a) To get maximum total value in the knapsack

b) To get minimum total value in the knapsack

c) To get maximum weight in the knapsack

d) To get minimum weight in the knapsack

(iii) Job sequencing with deadline is based on

a) Divide and Conquer method

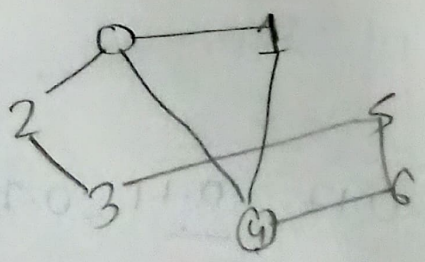
b) Greedy Algorithm

c) Dynamic Programming method

d) Backtracking method

(iv) The code length does not depend on the frequency of occurrence of characters in Huffman Code.

a) true b) false



(v) The Data structure used in standard implementation of Breadth First Search is

a) Stack

b) Queue

c) Linked List

d) Tree

(vi) The Data structure used in standard implementation of Depth First Search is

a) Stack

b) Queue

c) Linked List

d) Tree

Group – B

(Short Answer Type Questions)

Answer any *two* of the following 2×5

2. Compare and contrast BFS vs DFS graph traversal techniques.

3. Differentiate fixed length and variable length coding schemes.

4. "Greedy method does not guarantee optimal solution" – Justify.

Group – C

(Long Answer Type Questions)

Answer any *one* of the following 1×15

5. **(a)** Find the optimal solution using greedy criteria for a knapsack having capacity 100 kg for the following list of items having values and weights as shown in the table. 8

Item	Value	Weight
I1	10	15
I2	20	25
I3	30	35
I4	40	45
I5	50	40

(b) For a job scheduling problem let n = 4, (p1, p2, p3, p4) = (100, 10, 15, 27) and (d1, d2, D3, d4) = (2, 1, 2, 1). Find an optimal solution to this problem. 7

6.(a) Construct the Huffman Code for the following data: {A,B,C,D,E} with frequency {0.17, 0.11, 0.24, 0.33, 0.15} 7

(b) For the following graph find the Breadth-First-Search traversal sequence showing clearly the status of the Queue in each step. 8

0.17 0.11 0.24 0.33 0.15

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Group – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any ***five*** of the following: 5×1=5

(i) The concept of order Big O is important because

A. It can be used to decide the best algorithm that solves a given problem

B. It determines the maximum size of a problem that can be solved in a given amount of time

C. It is the lower bound of the growth rate of algorithm

D. Both A and B

(ii) The recursive versions of binary search use a ___ structure.

A. Branch and bound

B. Dynamic programming

C. Divide and conquer

D. Simple recursive

(iii) The Data structure used in standard implementation of Breadth First Search is?

A. Stack

B. Queue

C. Linked List

D. Tree

(iv) Prim's algorithm starts constructing a minimum spanning tree from

A. An arbitary root vertex

B. The shortest arc

C. The left most vertex

D. The right most vertex

(v) Kruskal's algorithm is a

A. divide and conquer algorithm

B. dynamic programming algorithm

C. greedy algorithm

D. approximation algorithm

(vi) What is the running time of the Floyd Warshall Algorithm?

A. Big-oh(V)

B.Theta(V2)

C. Big-Oh(VE)

D.Theta(V3)

Group – B

(Short Answer Type Questions)

Answer any ***two*** of the following 2×5=10

2.Define different asymptotic notations with graphical presentation. [CO1/Remember/IOCQ]

3. Describe representing a graph by adjacency matrix and list format. [CO6/Remember/IOCQ]

4. Which of the Stack and Queue operations are suitable for implementation of BFS and DFS graph traversal algorithm? Justify your answer. [CO6/Analyze/IOCQ]

Group – C

(Long Answer Type Questions)

Answer any ***one*** of the following 1×15=15

5.(a)Why the time complexity of an algorithm is measured in terms of input size but not in terms of the standard unit of time, i.e. seconds? [CO1/Analyze/IOCQ]

(b)How many steps are there in a Divide & Conquer procedure? Explain with example. [CO3/ Remember /IOCQ]

(c) Derive the time complexity of insertion sort algorithm stepwise in worst case. [CO1/Apply/IOCQ]

2+3+10

6. (a) Distinguish between Divide and Conquer and Dynamic Programming. [CO3,4/Analyze/IOCQ]

(b) Compare and contrast BFS vs DFS graph traversal techniques. [CO6/Analyze/IOCQ]

(c) Find the optimal parenthesization of a matrix chain product whose sequence of dimensions is <5, 10, 3, 12, 5, 50>. [CO5/ Apply /IOCQ]

2+3+10