HALDIA INSTITUTE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION UNDER MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL)

Paper Code: PCC-CS 404

Paper Name: Design and Analysis of Algorithm

Time Allotted: 2 Hours *Full Marks*: 70

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 from the followings: 30 x 1 = 30

(i) What is the worst case complexity of binary search using recursion?[CO2]
a) O(nlogn)
b) O(logn)
c) O(n)
d) O(n2)

(ii) Binary Search can be categorized into which of the following?[CO1]
a) Brute Force technique
b) Divide and conquer
c) Greedy algorithm
d) Dynamic programming

(iii) What is the advantage of selection sort over other sorting techniques?[CO3]
a) It requires no additional storage space
b) It is scalable
c) It works best for inputs which are already sorted
d) It is faster than any other sorting technique

(iv) Which of the following method is used for sorting in merge sort?[CO3]
a) merging
b) partitioning
c) selection
d) exchanging

(v) Which of the following is not in place sorting algorithm by default?[CO3]
a) merge sort

b) quick sort
c) heap sort
d) insertion sort

(vi) The best case behaviour occurs for quick sort is, if partition splits the array of size n into _____[CO3]
a) n/2 : (n/2) – 1
b) n/2 : n/3
c) n/4 : 3n/2
d) n/4 : 3n/4

(vii) Which of the following is false?[CO4]
a) The spanning trees do not have any cycles
b) MST have n – 1 edges if the graph has n edges
c) Edge e belonging to a cut of the graph if has the weight smaller than any other edge in the same cut, then the edge e is present in all the MSTs of the graph
d) Removing one edge from the spanning tree will not make the graph disconnected

(viii) Kruskal's algorithm is used to _____[CO4]
a) find minimum spanning tree
b) find single source shortest path
c) find all pair shortest path algorithm
d) traverse the graph

(ix) Which of the following is false about the Kruskal's algorithm?[CO4]
a) It is a greedy algorithm
b) It constructs MST by selecting edges in increasing order of their weights
c) It can accept cycles in the MST
d) It uses union-find data structure

(x) Prim's algorithm is a _____[CO4]
a) Divide and conquer algorithm
b) Greedy algorithm
c) Dynamic Programming
d) Approximation algorithm

(xi) What is the time complexity of Dijikstra's algorithm?[CO4]
a) O(N)
b) $O(N^3)$
c) $O(N^2)$
d) O(logN)

(xii) Dijkstra's Algorithm cannot be applied on _____[CO4]
a) Directed and weighted graphs
b) Graphs having negative weight function
c) Unweighted graphs
d) Undirected and unweighted graphs

(xiii) Bellmann ford algorithm provides solution for _____ problems.[CO4]
a) All pair shortest path
b) Sorting

c) Network flow
d) Single source shortest path

(xiv) What happens when the value of k is 0 in the Floyd Warshall Algorithm?[CO4]
a) 1 intermediate vertex
b) 0 intermediate vertex
c) N intermediate vertices
d) N-1 intermediate vertices

(xv) What is the source in max flow problems?[CO4]
a) Vertex with no incoming edges
b) Vertex with no leaving edges
c) Centre vertex
d) Vertex with the least weight

(xvi) Which algorithm is used to solve a maximum flow networks?[CO4]
a) Prim's algorithm
b) Kruskal's algorithm
c) Dijkstra's algorithm
d) Ford-Fulkerson algorithm

(xvii) Which algorithm is used to solve a minimum cut algorithm?[CO4]
a) Gale-Shapley algorithm
b) Ford-Fulkerson algorithm
c) Stoer-Wagner algorithm
d) Prim's algorithm

(xviii) What is vertex coloring of a graph?[CO4]
a) A condition where any two vertices having a common edge should not have same color
b) A condition where any two vertices having a common edge should always have same color
c) A condition where all vertices should have a different color
d) A condition where all vertices should have same color

(xix) How many edges will a tree consisting of N nodes have?[CO4]
a) Log(N)
b) N
c) N – 1
d) N + 1

(xx) Minimum number of unique colors required for vertex coloring of a graph is called?[CO5]
a) vertex matching
b) chromatic index
c) chromatic number
d) color number

(xxi) What will be the chromatic number for an empty graph having n vertices?[CO5]
a) 0
b) 1
c) 2
d) n

(xxii) Master's theorem is used for?[CO2]
a) solving recurrences
b) solving iterative relations
c) analysing loops
d) calculating the time complexity of any code

(xxiii) Fractional knapsack problem is also known as _____[CO3]
a) 0/1 knapsack problem
b) Continuous knapsack problem
c) Divisible knapsack problem
d) Non continuous knapsack problem.

(xxiv) What is the objective of the knapsack problem?[CO3]
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

(xxv) Backtracking algorithm is implemented by constructing a tree of choices called as?[CO3]
a) State-space tree
b) State-chart tree
c) Node tree
d) Backtracking tree

(xxvi) What happens when the backtracking algorithm reaches a complete solution?[CO3]
a) It backtracks to the root
b) It continues searching for other possible solutions
c) It traverses from a different route
d) Recursively traverses through the same route

(xxvii) The problem of placing n queens in a chessboard such that no two queens attack each other is called as?[CO4]
a) n-queen problem
b) eight queens puzzle
c) four queens puzzle
d) 1-queen problem

(xxviii) Which of the following methods can be used to solve n-queen's problem?[CO4]
a) greedy algorithm
b) divide and conquer
c) iterative improvement
d) backtracking

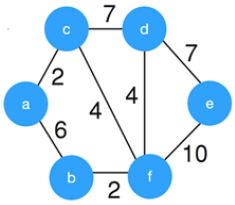
(xxix) In dynamic programming, the technique of storing the previously calculated values is called _____[CO3]
a) Saving value property
b) Storing value property
c) Memoization
d) Mapping

(xxx) Calculating the chromatic number of a graph is a[CO4]
a) P problem
b) NP hard problem
c) NP complete problem
d) cannot be identified as any of the given problem types

Group – B
(Multiple Choice Type Questions)

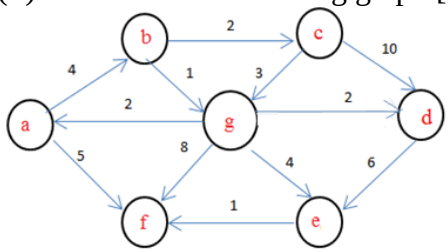
2. Choose the correct alternatives from the followings: **10 x 2 = 20**

(i) Consider the given graph.[CO4]



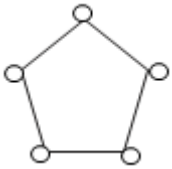
What is the weight of the minimum spanning tree using the Kruskal's algorithm?[CO4]
a) 24
b) 23
c) 15
d) 19

(ii) Consider the following graph.[CO4]



If b is the source vertex, what is the minimum cost to reach f vertex?
a) 8
b) 9
c) 4
d) 6

(iii) What will be the chromatic number of the following graph? [CO4]



a) 2
b) 3
c) 4
d) 5

(iv) Solve the following recurrence using Master's theorem.[CO2]
T(n) = 4T (n/2) + n2
a) T(n) = O(n)
b) T(n) = O(log n)
c) T(n) = O(n^2log n)
d) T(n) = O(n^2)

(v) Given items as {value,weight} pairs {{40,20},{30,10},{20,5}}. The capacity of knapsack=20. Find the maximum value output assuming items to be divisible.[CO3]
a) 60
b) 80
c) 100
d) 40

(vi) Solve the following recurrence using Master's theorem.[CO2]
T(n) = 16T (n/4) + n
a) T(n) = O(n)
b) T(n) = O(log n)
c) T(n) = O(n^2log n)
d) T(n) = O(n^2)

(vii) What is the time complexity of the recursive implementation used to find the nth fibonacci term?[CO2]
a) O(1)
b) O(n2)
c) O(n!)
d) Exponential

(viii) Consider the two matrices P and Q which are 10 x 20 and 20 x 30 matrices respectively. What is the number of multiplications required to multiply the two matrices?[CO3]
a) 10*20
b) 20*30
c) 10*30
d) 10*20*30

(ix) 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?[CO3]
a) 18000
b) 12000
c) 24000
d) 32000

(x) A simple acyclic path between source and sink which pass through only positive weighted edges is called?[CO4]
a) augmenting path
b) critical path
c) residual path
d) maximum path

Group – C
(Short Answer Type Questions)

3. Attempt any four from the followings: **4 x 5 = 20**

i) Find the minimum number of operation required for the following matrix chain multiplication using dynamic programming[CO3]
A(10 x 20) * B(20 x 50) * C(50 x 1) * D(1 x 100)

ii) Differentiate between divide and conquer and dynamic programming[CO3]

iii) Find the time complexity for the following recurrence relations[CO2]

a) $T(n) = 2T(n^{½}) + \log n$
b) $T(n) = 16T(n/4)+n$

iv) Define P, NP, NP Hard and NP complete.[CO5]

v) Define different asymptotic notations (Big-oh, Big-Omega,and Theta) with suitable examples? [CO1]

vi) Find the optimal solution using greedy method for the knapsack having capacity of 100 kg for the following items shown below[CO3]

Item	Value	Weight
I1	10	15
I2	20	25
I3	30	35
I4	40	45
I5	50	55

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Signature of the Paper Setter/~~Moderator~~

Answer Key:

Group – A

1. (i) b	(ii) b	(iii) a	(iv) a	(v) a	(vi)a
(vii)d	(viii)a	(ix)c	(x)b	(xi)c	(xii)b
(xiii)d	(xiv)b	(xv)a	(xvi)d	(xvii)b	(xviii)a
(xix)c	(xx)c	(xxi)a	(xxii)a	(xxiii)b	(xxiv)a
(xxv)a	(xxvi)b	(xxvii)a	(xxviii)d	(xxix)c	(xxx)c

Group – B

2. (i)a	(ii)d	(iii) b	(iv) c	(v)a	(vi)d
(vii)d	(viii)d	(ix)a	(x) a		

Group – C

3. (i) (ii) (iii) (iv) (v) (vi)