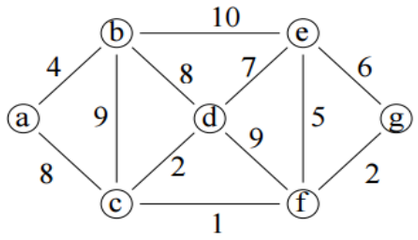
OR iii. Find minimum spanning tree of the following graph using Prim's algorithm. (start vertex=a) **7**



Q.5 i. Write a brief note on NP-completeness and the classes-P, NP and NPC. **4**

ii. Discuss any example of NP-Complete problem **6**

OR iii. Elaborate an example of an intractable problem. **6**

Q.6 Attempt any two:

i. Give the features and performance ratios for approximation algorithms. **5**

ii. How to analyse randomized algorithm? Explain **5**

iii. What is the relation between P and NP class problems? Is P=NP? If no, then what will happen if P becomes equal to NP? **5**

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Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2022

CB3CO09 Design & Analysis of Algorithms

Programme: B.Tech. Branch/Specialisation: CSBS

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. An algorithm is- **1**

(a) A piece of code to be executed

(b) A loosely written code to make final code

(c) A step by step procedure to solve a problem

(d) All of these

ii. Two main measures for the efficiency of an algorithm are- **1**

(a) Processor and memory (b) Complexity and capacity

(c) Time and space (d) Data and space

iii. Which one of the following is an application of the backtracking algorithm? **1**

(a) Finding the efficient quantity to shop

(b) Finding the shortest path

(c) Ludo

(d) Crossword

iv. Prim's algorithm for minimum spanning tree follows _____ strategies: **1**

(a) Backtracking (b) Greedy method

(c) Dynamic programming (d) Divide and conquer

v. In an unweighted, undirected connected graph, the shortest path from a node S to every other node is computed most efficiently, in terms of time complexity, by- **1**

(a) Dijkstra's algorithm starting from S

(b) Warshall's algorithm

(c) Performing a DFS starting from S

(d) Performing a BFS starting from S

P.T.O.

vi. In what manner is a state-space tree for a backtracking algorithm constructed? **1**

(a) Depth-first search (b) Breadth-first search
(c) Twice around the tree (d) Nearest neighbour first

vii. _____ is the class of decision problems that can be solved by non-deterministic polynomial algorithms? **1**

(a) NP (b) P (c) Hard (d) Complete

viii. Let X be a problem that belongs to the class NP. Then which one of the following is TRUE? **1**

(a) There is no polynomial time algorithm for X.
(b) If X can be solved deterministically in polynomial time, then P = NP.
(c) If X is NP-hard, then it is NP-complete.
(d) X may be undecidable.

ix. A randomized algorithm uses random bits as input inorder to achieve a _____ good performance over all possible choice of random bits. **1**

(a) Worst case (b) Best case
(c) Average case (d) None of these

x. All set of polynomial questions which can be solved by a turing machine using a polynomial amount of space: **1**

(a) PSPACE (b) NPSPACE
(c) EXPSPACE (d) None of these

Q.2 i. Evaluate the time, space complexity of following code: **2**

```
int a = 0, b = 0;
for (i = 0; i< N; i++)
{
   a = a + rand();
}
for (j = 0; j < M; j++)
{
   b = b + rand();
}
```

ii. How space complexity plays a vital role in deciding the efficiency of an algorithm? **3**

iii. Why do we use asymptotic notations in the study of algorithms? Briefly describe the commonly used asymptotic notations with examples **5**

OR iv. Solve the following recurrence using back substitution and recursion tree method **5**

T(n)=4T(n/2)+ c if n>1
T(1)=1 if n=1
T(n)=2T(n/2)+n
T(1)=1 if n=1
Give a bound for each one of them.

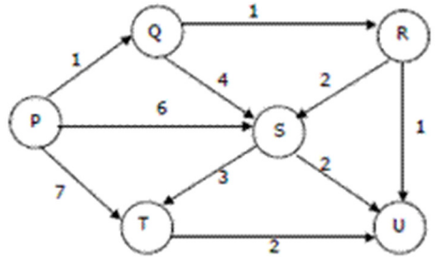
Q.3 i. List down the limitations of greedy technique. What are the advantages of dynamic programming over greedy technique? **4**

ii. You are given a knapsack that can carry a maximum weight of 60. There are 4 items with weights {20, 30, 40, 70} and values {70, 80, 90, 200}. What is the maximum value of the items you can carry using the knapsack problem? Explain. **6**

OR iii. Solve sum of subsets problem for the given set S [ ] = {1, 3, 9, 2} using backtracking technique. Also find out the time complexity of the approach **6**

Q.4 i. How topological sorting is different from depth first traversal of a graph? **3**

ii. Suppose we run Dijkstra's single source shortest-path algorithm on the following edge weighted directed graph with vertex P as the source. In what order do the nodes get included into the set of vertices for which the shortest path distances are finalized? Explain. **7**



Marking Scheme
CB3CO09 Design and Analysis of Algorithm

Q.1	i)	An algorithm is: a. A piece of code to be executed b. A loosely written code to make final code **c. A step by step procedure to solve a problem** d. All of the above.	**1**
	ii)	Two main measures for the efficiency of an algorithm are: a. Processor and memory b. Complexity and capacity c. **Time and space.** d. Data and space.	**1**
	iii)	Which one of the following is an application of the backtracking algorithm? a. Finding the efficient quantity to shop b.Finding the shortest path c. Ludo **d. Crossword**	**1**
	iv)	Prim's algorithm for minimum spanning tree follow_____ strategies: a. Backtracking **b. Greedy method** c. Dynamic programming d. Divide and conquer	**1**
	v)	In an unweighted, undirected connected graph, the shortest path from a node S to every other node is computed most efficiently, in terms of *time complexity*, by a. Dijkstra's algorithm starting from S. b. Warshall's algorithm c. Performing a DFS starting from S d. **Performing a BFS starting from S**	**1**
	vi)	In what manner is a state-space tree for a backtracking algorithm constructed? **a. Depth-first search** b. Breadth-first search c. Twice around the tree d. Nearest neighbour first	**1**
	vii)	_____ is the class of decision problems that can be solved by non-deterministic polynomial algorithms? **a. NP** b. P c. Hard d. Complete	**1**
	viii)	Let X be a problem that belongs to the class NP. Then which one of the following is TRUE? a. There is no polynomial time algorithm for X. b. If X can be solved deterministically in polynomial time, then P = NP. **c. If X is NP-hard, then it is NP-complete.** d. X may be undecidable.	**1**
	ix)	A randomized algorithm uses random bits as input inorder to achieve a _____ good performance over all possible choice of random bits. a. worst case b. best case **c. average case** d. none of the mentioned	**1**
	x)	All set of polynomial questions which can be solved by a turing machine using a polynomial amount of space: **a. PSPACE** b. NPSPACE c. EXPSPACE d. None of the mentioned	**1**

Q.2	i.	Evaluate the time, space complexity of following code:
		int a = 0, b = 0;
		for (i = 0; i< N; i++)
		{
		a = a + rand();
		}
		for (j = 0; j < M; j++)
		{
		b = b + rand();
		}
			2

	ii.	How Space Complexity plays a vital role in deciding the efficiency of an algorithm?	**3**

	iii.	Why do we use asymptotic notations in the study of algorithms? Briefly describe the commonly used asymptotic notations with examples	**2** **3**
OR	iv.	Solve the following recurrence using back substitution method T(n)=4T(n/2)+ c if n>1 T(1)=1 if n=1 T(n)=2T(n/2)+n T(1)=1 if n=1 Give a bound for each one of them.	**5**
Q.3	i.	List down the limitations of Greedy technique. 1 mark for each What are the advantages of Dynamic programming over Greedy technique? 1 mark for each	**2** **2**
	ii.	What is the maximum value of the items you can carry using the knapsack problem? Explanation 4 marks Answer 2 marks	**6**
OR	iii.	Solve sum of subsets problem for the given set S [ ] = {1, 3, 9, 2} using backtracking technique. Also find out the time complexity of the approach	**4** **2**
Q.4	i.	How topological sorting is different from Depth First Traversal of a graph? 1 mark for each difference	**3**
	ii.	In what order do the nodes get included into the set of vertices for which the shortest path distances are finalized? Explanation 5 marks Answer 2 marks	**7**
OR	iii.	Find minimum spanning tree of the following graph using Prim's algorithm.(start vertex=a) Algorithm 4 marks Solution 3 marks	**7**
Q.5	i.	Write a brief note on NP-completeness and the classes-P, NP and NPC.1 mark for each	**4**
	ii.	Discuss any example of NP-Complete problem	**6**
OR	iii.	Elaborate an example of an intractable problem.	**6**

Q.6		Attempt any two:	
	i.	Features and Performance Ratios for approximation algorithms. At least three points	**5**
	ii.	How to analyse Randomized Algorithm 2 marks Explanation 3 marks	**5**
	iii.	What is the relation between P and NP class problems? Is P=NP? If No, then what will happen if P will become equal to NP?	**2** **1** **2**

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