CBCS SCHEME

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15CS43

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Design and Analysis of Algorithms

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. What is an algorithm? What are the properties of an algorithm? Explain with an example. **(04 Marks)**

b. Explain the general plan for analyzing the efficiency of a recursive algorithm. Suggest a recursive algorithm to find factorial of a number. Derive its efficiency. **(08 Marks)**

c. If $t_1(n) \in O(g_1(n))$ and $t_2(n) \in O(g_2(n))$ prove that $t_1(n) + t_2(n) \in O(\max\{g_1(n), g_2(n)\})$. **(04 Marks)**

OR

2 a. Explain the asymptotic notations with examples. **(06 Marks)**

b. Distinguish between the two common ways to represent a graph. **(04 Marks)**

c. Discuss about the important problem types and fundamental data structures. **(06 Marks)**

Module-2

3 a. Discuss how quick-sort works to sort an array and trace for the following data set. Draw the tree of recursive calls made.

65	70	75	80	85	60	55	50	45

Derive the best case complexity of quick sort algorithm. **(10 Marks)**

b. Briefly explain the Strassen's matrix multiplication. Obtain its time complexity. **(06 Marks)**

OR

4 a. Explain the concept of divide and conquer. Design an algorithm for merge sort and derive its time complexity. **(10 Marks)**

b. What are the three major variations of decrease and conquer technique? Explain with an example for each. **(06 Marks)**

Module-3

5 a. Explain the concept of greedy technique for Prim's algorithm. Obtain a minimum cost spanning tree for the graph shown in Fig.Q5(a). **(08 Marks)**

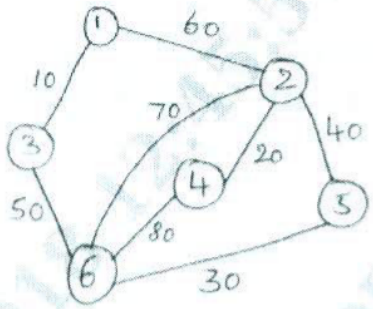

Fig.Q5(a)

b. Solve the below instance of the single source shortest path problem with vertex 6 as the source. With the help of a suitable algorithm. **(08 Marks)**

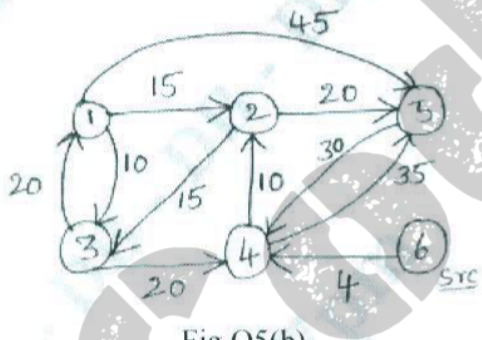

Fig.Q5(b)

OR

6 a. What are Huffman trees? Explain. Construct a Huffman code for the following data :

Character	A	B	C	D	E	–
Probability	0.5	0.35	0.5	0.1	0.4	0.2

Encode DAD_CBE using Huffman encoding. **(08 Marks)**

b. Explain transform and conquer technique. Sort the below list using Heap sort :
3, 2, 4, 1, 6, 5. **(08 Marks)**

Module-4

7 a. Define transitive closure of a graph. Write Warshall's algorithm to compute transitive closure of a directed graph. Apply the same on the graph defined by the following adjacency matrix :

$$R = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}.$$

(08 Marks)

b. Using Dynamic programming, solve the below instance of knapsack problem. **(08 Marks)**

Item	Weight	Value
1	2	12
2	1	10
3	3	20
4	2	15

Capacity w = 5

OR

8 a. Obtain a optimal binary search tree for the following four–key set. **(08 Marks)**

Key	A	B	C	D
Probability	0.1	0.2	0.4	0.3

b. Solve the following travelling sales person problem represented as a graph shown in Fig.Q8(b), using dynamic programming. **(08 Marks)**

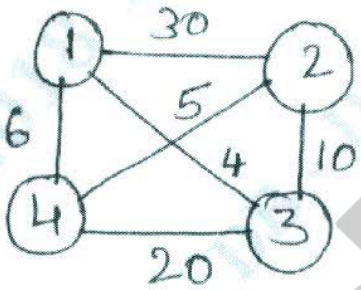

Fig.Q8(b)

Module-5

9 a. What is the central principle of backtracking? Apply backtracking to solve the below instance of sum of subset problem
S = {5, 10, 12, 13, 15, 18} d = 30. **(08 Marks)**

b. Solve the below instance of assignment problem using branch and bound algorithm.

$$C = \begin{array}{c} \begin{matrix} Job_1 & Job_2 & Job_3 & Job_4 \end{matrix} \\ \begin{bmatrix} 9 & 2 & 7 & 8 \\ 6 & 4 & 3 & 7 \\ 5 & 8 & 1 & 8 \\ 7 & 6 & 9 & 4 \end{bmatrix} \end{array} \begin{matrix} \\ \text{Person a} \\ \text{Person b} \\ \text{Person c} \\ \text{Person d} \end{matrix}$$

(08 Marks)

OR

10 a. Draw the state-space tree to generate solutions to 4-Queen's problem. **(04 Marks)**

b. Apply backtracking to the problem of finding a Hamiltonian circuit in the graph shown below: **(04 Marks)**

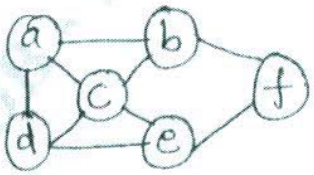

Fig.Q10(a)

c. Define the following :
i) Class P
ii) Class NP
iii) NP complete problem
iv) NP hard problem. **(08 Marks)**

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17CS43

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Design and Analysis of Algorithms

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain Asymptotic notations in detail with example. **(12 Marks)**

b. Outline an algorithm to find maximum of n elements and obtain its time complexity. **(08 Marks)**

OR

2 a. Design algorithm for tower of Hanoi problem and obtain time complexity. **(10 Marks)**

b. Prove the theorem
if $f_1(n) \in 0(g, (n))$ and $f_2(n) \in 0(g_2(n))$ Then $f_1(n) + f_2(n) \in 0(\max\{g_1(n), g_2(n)\})$. **(10 Marks)**

Module-2

3 a. Design a recursive algorithm for binary search and calculate time complexity. **(10 Marks)**

b. Write the algorithm for merge sort and Trace 60, 50, 25, 10, 35, 25, 75, 30. **(10 Marks)**

OR

4 a. Develop an algorithm for Quick sort and derive its time complexity. **(10 Marks)**

b. What is topological sorting? Apply DFS for below graph to solve topological sorting. **(10 Marks)**

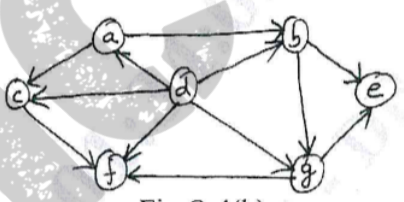

Fig.Q.4(b)

Module-3

5 a. Find the optimal solution to the knap sack instant n = 7, m = 15 using greedy method.

Object	1	2	3	4	5	6	7
Weight	02	03	05	07	01	04	01
Profit	10	05	15	07	06	18	03

(10 Marks)

b. Find the minimum spanning tree using Kruskal's algorithm.

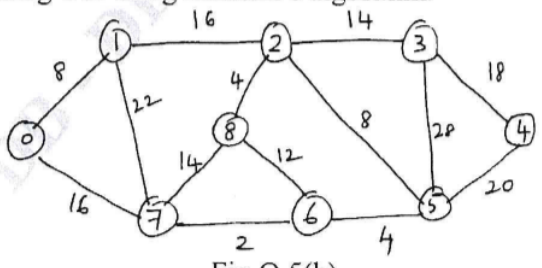

Fig.Q.5(b)

(10 Marks)

OR

6 a. Construct a Huffman code for the following data:

Characters	A	B	C	D	-
Probability	0.4	0.1	0.2	0.15	0.15

Encode the text ABACABAD and decode 100010111001010 **(10 Marks)**

b. Calculate the shortest distance and shortest path from vertex 5 to vertex 0 using Dijkstra's. **(10 Marks)**

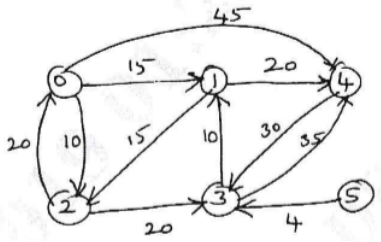

Fig.Q.6(b)

Module-4

7 a. Explain the general procedure to solve a multistage graph problem using backward approach with an example. **(10 Marks)**

b. Construct an optimal binary search tree for the following:

Items :	A	B	C	D
Probabilities :	0.1	0.2	0.4	0.3

(10 Marks)

OR

8 a. Design Floyd's algorithm to find shortest distances from all nodes to all other nodes. **(10 Marks)**

b. Apply Warshall's algorithm to compute transitive closure for the graph below. **(10 Marks)**

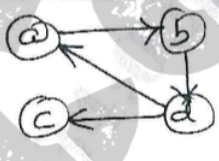

Fig.Q.8(b)

Module-5

9 a. What is Hamiltonian circuit problem? What is the procedure to find Hamiltonian circuit of a graph? **(10 Marks)**

b. Explain the classes of NP-Hard and NP-complete. **(10 Marks)**

OR

10 a. Apply the branch and bound algorithm to solve the travelling salesman problem for the graph below.

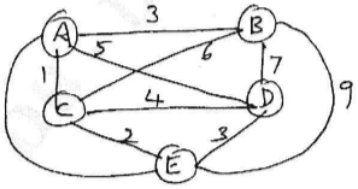

Fig.Q.10(a)

(10 Marks)

b. Obtain the optimal solution assignment problem given:

	J_1	J_2	J_3	J_4
a	9	2	7	8
b	6	4	3	7
c	5	8	1	8
d	7	6	9	4

(10 Marks)

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15CS43

Fourth Semester B.E. Degree Examination, June/July 2018
Design and Analysis of Algorithms

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Write an algorithm to find the maximum element in an array of n element. Give the mathematical analysis of this non-recursive algorithm. **(06 Marks)**

b. Explain the asymptotic notations BigO, BigΩ and big theta used to compare orders of growth of an algorithm. **(06 Marks)**

c. Explain with an example how a new variable count introduced in a program can be used to find the number of steps needed by a program to solve a particular problem instance. **(04 Marks)**

OR

2 a. Write a recursive function to find and print all possible permutations of a given set of n elements. **(05 Marks)**

b. Solve the recurrence relation : $M(n) = 2M(n-1) + 1$. Take $M(1) = 1$, $M(n)$ is given for $n > 1$. **(05 Marks)**

c. Define algorithm. What are the criteria that an algorithm must satisfy? **(06 Marks)**

Module-2

3 a. Write a function to find the maximum and minimum elements in a given array of n elements by applying the divide and conquer technique. **(06 Marks)**

b. Explain the divide and conquer technique. Give the general algorithm DAndC(P)[Where P is the problem to be solve] to illustrate this technique. **(04 Marks)**

c. Apply source removal method to obtain topological sort for the given graph in Fig.Q3(c). **(06 Marks)**

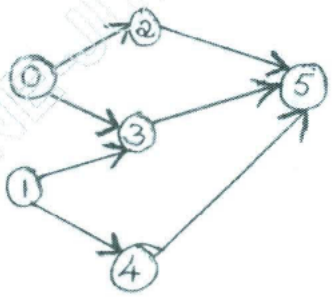

Fig.Q3(c)

OR

4 a. Explain the merge sort algorithm. Illustrate with an example and give the worst case efficiency of merge-sort. **(08 Marks)**

b. Apply quick sort algorithm to the following set of numbers.
65, 70, 75, 80, 85, 60, 55, 50, 45. **(08 Marks)**

Module-3

5 a. Apply greedy method to obtain an optimal solution to the knapsack problem given M = 60, $(w_1, w_2, w_3, w_4, w_5) = (5, 10, 20, 30, 40)$ $(p_1, p_2, p_3, p_4, p_5) = (30, 20, 100, 90, 160)$. Find the total profit earned. **(04 Marks)**

b. Explain Huffman algorithm. With an example show the construction of Huffman tree and generate the Huffman code using this tree. **(06 Marks)**

c. Apply Prim's algorithm to obtain a minimum spanning tree for the given weighted connected graph. [Fig.Q5(c)]. **(06 Marks)**

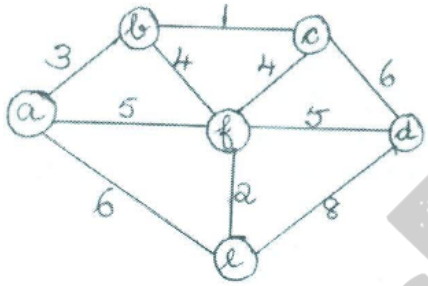

Fig.Q5(c)

OR

6 a. Explain the bottom up heap construction algorithm with an example. Give the worst case efficiency of this algorithm. **(08 Marks)**

b. Apply single source shortest path problem assuming vertex a as source.[Refer Fig.Q6(b)]. **(08 Marks)**

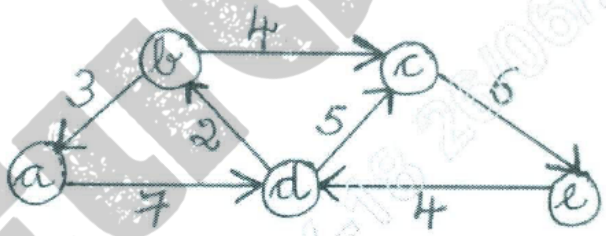

Fig.Q6(b)

Module-4

7 a. Explain multistage graph with an example. Write multistage graph algorithm using backward approach. **(08 Marks)**

b. Apply Floyd's algorithm to solve all pair shortest path problem for the graph given below in Fig.Q7(b). **(08 Marks)**

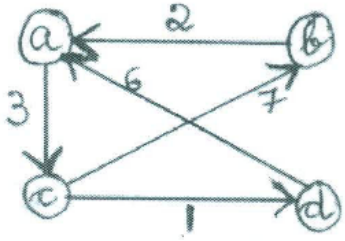

Fig.Q7(b)

OR

8 a. Explain Bellman Ford al to find shortest path from single source to all destinations for a directed graph with negative edge cost. **(08 Marks)**

b. Apply Warshall's algorithm to the digraph given below in Fig.Q8(b) and find the transitive closure. **(08 Marks)**

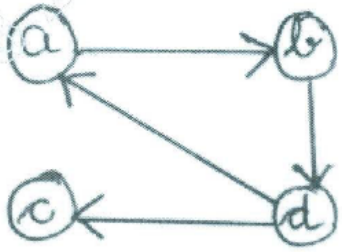

Fig.Q8(b)

Module-5

9 a. Apply backtracking method to solve subset–sum problem for the instance d = 30 and S = {5, 10, 12, 13, 15, 18}. Give all possible solutions. **(08 Marks)**

b. Explain how travelling salesman problem can be solved using branch and bound technique. **(06 Marks)**

c. Define deterministic and non deterministic algorithms. **(02 Marks)**

OR

10 a. What is Hamiltonian cycle? Explain the algorithm to find the Hamiltonian cycle in a given connected graph. Write the functions used for generating next vertex and for finding Hamiltonian cycles. **(09 Marks)**

b. Apply the best-first branch-and-bound algorithm to solve the instance of the given job assignment problem. **(07 Marks)**

Job1	Job2	Job3	Job4	
9	2	7	8	Person a
6	4	3	7	Person b
5	8	1	8	Person c
7	6	9	4	Person d

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17CS43

Fourth Semester B.E. Degree Examination, June/July 2019
Design and Analysis of Algorithms

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Design an algorithm to search an element in a array using sequential search. Discuss the worst case, best case and average case efficiency of this algorithm. **(08 Marks)**

b. Discuss adjacency matrix and adjacency list representation of a graph with suitable example. **(06 Marks)**

c. Give the recursive algorithm to solve towers of Hanoi problem. Show that the efficiency of this algorithm is exponential. **(06 Marks)**

OR

2 a. Give the general plan for analyzing time efficiency of non recursive algorithms. Derive the worst case analysis for the algorithm to check whether all the elements in a given array are distinct. **(08 Marks)**

b. List and define any three asymptotic notations. What are the various basic asymptotic efficiency classes? **(06 Marks)**

c. Explain the following types of problems:
(i) Combinatorial problems (ii) Graph problems. **(06 Marks)**

Module-2

3 a. Write an algorithm to sort 'n' numbers using Quick sort. Trace the algorithm to sort the following list in ascending order.
80 60 70 40 10 30 50 20 **(08 Marks)**

b. Discuss general divide and conquer technique with control abstraction and recurrence relation. **(06 Marks)**

c. Apply DFS based algorithm and source removal method to find the topological sequence for the graph shown in Fig.Q3(c). **(06 Marks)**

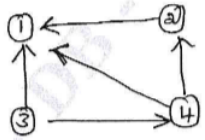

Fig.Q3(c)

OR

4 a. Apply Strassen's matrix multiplication to multiply following matrices. Discuss how this method is better than direct matrix multiplication method.

$$\begin{bmatrix} 4 & 3 \\ 2 & 1 \end{bmatrix} \times \begin{bmatrix} 2 & 5 \\ 1 & 6 \end{bmatrix}$$ **(08 Marks)**

b. Write recursive algorithm to find maximum and minimum element in an array. **(06 Marks)**

c. Write an algorithm to sort 'n' number using merge sort. **(06 Marks)**

Module-3

5 a. Write an algorithm to solve knapsack problem using Greedy technique. Find the optimal solution to the knapsack instance n = 7, m = 15
$(P_1, P_2 \ldots\ldots P_7) = (10, 5, 15, 7, 6, 18, 3)$
$(W_1, W_2 \ldots.. W_7) = (2, 3, 5, 7, 1, 4, 1)$ **(10 Marks)**

b. Apply Prim's algorithm and Kruskal's method to find the minimum cost spanning tree to the graph shown in Fig.Q5(b). **(10 Marks)**

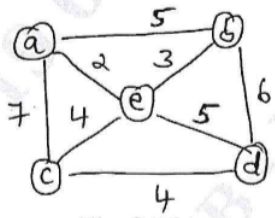

Fig.Q5(b)

OR

6 a. Write an algorithm to solve single source shortest path problem. Apply the algorithm to the graph shown in Fig.Q6(a) by considering 'a' as source. **(10 Marks)**

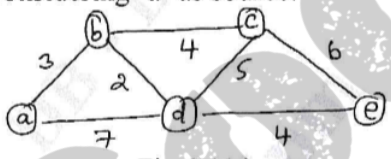

Fig.Q6(a)

b. Define heap. Write bottom-up heap construction algorithm. Construct heap for the list 1, 8, 6, 5, 3, 7, 4 using bottom-up algorithm and successive key insertion method. **(10 Marks)**

Module-4

7 a. Define transitive closure of a directed graph. Find the transitive closure matrix for the graph whose adjacency matrix is given.

$$\begin{bmatrix} 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 \end{bmatrix}$$

(10 Marks)

b. Find the optimal tour for salesperson using dynamic programming technique. The directed graph is shown in Fig.Q7(b). **(10 Marks)**

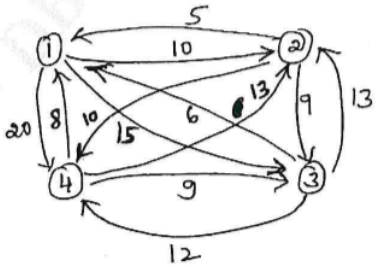

Fig.Q7(b)

OR

8 a. Write an algorithm to construct optimal binary search tree for the following data:

Key	A	B	C	D
Probability	0.1	0.2	0.4	0.3

(10 Marks)

b. Apply the bottom-up dynamic programming algorithm to the following instance of the knapsack problem. Knapsack capacity W = 10.

Item	Weight	Value
1	7	42
2	3	12
3	4	40
4	5	25

(10 Marks)

Module-5

9 a. Construct state-space tree for solving four queens problem using backtracking. **(06 Marks)**

b. Discuss graph coloring problem. Find different solutions for 4 nodes and all possible 3 coloring problem. **(06 Marks)**

c. Write a note on: (i) Non deterministic algorithms. (ii) LC branch and bound solution to solve O/I knapsack problem. **(08 Marks)**

OR

10 a. What are the two additional items required by Branch and Bound technique, compared with backtracking. Solve the following assignment problem using branch and bound technique, whose cost matrix for assigning four jobs to four persons are given

$$\begin{bmatrix} 9 & 2 & 7 & 8 \\ 6 & 4 & 3 & 7 \\ 5 & 8 & 1 & 8 \\ 7 & 6 & 9 & 4 \end{bmatrix}$$

(10 Marks)

b. Discuss the following :

(i) Subset sum problem

(ii) NP hard and NP complete classes. **(10 Marks)**

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15CS43

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Design and Analysis of Algorithms

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Define an algorithm. Discuss the criteria of an algorithm with an example. **(06 Marks)**

b. Prove that : If $t_1(n) \in O(g_1(n))$ and $t_2(n) \in O(g_2(n))$ then
$t_1(n) + t_2(n) \in O(\max\{g_1(n), g_2(n)\})$ **(06 Marks)**

c. Explain the two common ways to represent a graph with an example **(04 Marks)**

OR

2 a. Consider the following algorithm

```
Algorithm GUESS (A[ ] [ ])
for i ← 0 to n – 1
    for j ← 0 to i
        A [i] [j] ← 0
```

i) What does the algorithm compute?
ii) What is basic operation?
iii) What is the efficiency of this algorithm? **(03 Marks)**

b. List and explain important problem types that are solved by computer. **(07 Marks)**

c. Design an algorithm for checking whether all elements in a given array are distinct or not. Derive its worst complexity. **(06 Marks)**

Module-2

3 a. Explain divide and conquer technique. Write a recursive algorithm for finding the maximum and minimum element from a list. **(08 Marks)**

b. Apply quick sort to sort the list E, X, A, M, P, L, E in alphabetical order. Draw the tree of the recursive calls made. **(08 Marks)**

OR

4 a. Discuss Strassen's matrix multiplication and derive its time complexity. **(08 Marks)**

b. Design merge sort algorithm and discuss its best-case, average-case and worst-case efficiency. **(08 Marks)**

Module-3

5 a. Solve the greedy knapsack problem where
m = 10, n = 4, P = (40, 42, 25, 12), W = (4, 7, 5, 3). **(06 Marks)**

b. What is job sequencing with deadlines problem? Let n = 5, profits [10, 3, 33, 11, 40] and deadlines [3, 1, 1, 2, 2] respectively. Find the optimal solution using greedy algorithm. **(05 Marks)**

c. Define minimum cost spanning tree (MST). Write Prim's algorithm to construct minimum cost spanning tree. **(05 Marks)**

OR

6 a. Design Dijkstra's algorithm and apply the same to find the single source shortest path for graph taking vertex 'a' as source of Fig. Q6(a). **(08 Marks)**

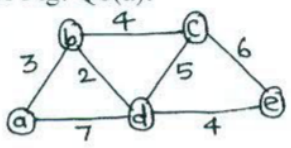

Fig. Q6(a)

b. Construct a Huffman code for the following data :

Character	A	B	C	D	-
Probability	0.4	0.1	0.2	0.15	0.15

Encode the text ABACABAD and decode the text 100010111001010, using the above code. **(04 Marks)**

c. Construct the heap for the list 2, 9, 7, 6, 5, 8 by the bottom-up algorithm. **(04 Marks)**

Module-4

7 a. Define transitive closure. Write Warshall's algorithm to compute transitive closure. Find its efficiency. **(08 Marks)**

b. Apply Floyd's algorithm to find all pair shortest path for the graph of Fig. Q7(b). **(08 Marks)**

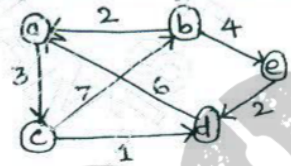

Fig. Q7(b)

OR

8 a. For the given cost matrix, obtain optimal cost tour using dynamic programming. **(08 Marks)**

$$\begin{bmatrix} 0 & 10 & 15 & 20 \\ 5 & 0 & 9 & 10 \\ 6 & 13 & 0 & 12 \\ 8 & 8 & 9 & 0 \end{bmatrix}$$

Fig. Q8(a)

b. Write a pseudocode to find an optimal binary search tree by dynamic programming. **(08 Marks)**

Module-5

9 a. Write the pseudocode for backtracking algorithm. Let w = {3, 5, 6, 7} and m = 15. Find all possible subsets of w that sum to m. Draw the state space tree that is generated. **(09 Marks)**

b. Draw the portion of the state space tree for m – colorings of a graph when n = 4 and m = 3. **(07 Marks)**

OR

10 a. With the help of a state space tree, solve the Travelling Salesman Problem (TSP) of Fig.Q10(a), using branch-and-bound algorithm. **(08 Marks)**

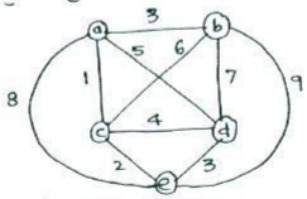

Fig. Q10(a)

b. Explain the classes of NP – Hard and NP – complete. **(08 Marks)**

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17CS43

Fourth Semester B.E. Degree Examination, June/July 2019
Design and Analysis of Algorithms

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Design an algorithm to search an element in a array using sequential search. Discuss the worst case, best case and average case efficiency of this algorithm. **(08 Marks)**

b. Discuss adjacency matrix and adjacency list representation of a graph with suitable example. **(06 Marks)**

c. Give the recursive algorithm to solve towers of Hanoi problem. Show that the efficiency of this algorithm is exponential. **(06 Marks)**

OR

2 a. Give the general plan for analyzing time efficiency of non recursive algorithms. Derive the worst case analysis for the algorithm to check whether all the elements in a given array are distinct. **(08 Marks)**

b. List and define any three asymptotic notations. What are the various basic asymptotic efficiency classes? **(06 Marks)**

c. Explain the following types of problems:
(i) Combinatorial problems (ii) Graph problems. **(06 Marks)**

Module-2

3 a. Write an algorithm to sort 'n' numbers using Quick sort. Trace the algorithm to sort the following list in ascending order.
80 60 70 40 10 30 50 20 **(08 Marks)**

b. Discuss general divide and conquer technique with control abstraction and recurrence relation. **(06 Marks)**

c. Apply DFS based algorithm and source removal method to find the topological sequence for the graph shown in Fig.Q3(c). **(06 Marks)**

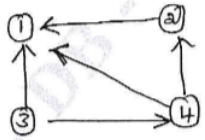

Fig.Q3(c)

OR

4 a. Apply Strassen's matrix multiplication to multiply following matrices. Discuss how this method is better than direct matrix multiplication method.

$$\begin{bmatrix} 4 & 3 \\ 2 & 1 \end{bmatrix} \times \begin{bmatrix} 2 & 5 \\ 1 & 6 \end{bmatrix}$$ **(08 Marks)**

b. Write recursive algorithm to find maximum and minimum element in an array. **(06 Marks)**

c. Write an algorithm to sort 'n' number using merge sort. **(06 Marks)**

Module-3

5 a. Write an algorithm to solve knapsack problem using Greedy technique. Find the optimal solution to the knapsack instance n = 7, m = 15
$(P_1, P_2 \ldots\ldots P_7) = (10, 5, 15, 7, 6, 18, 3)$
$(W_1, W_2 \ldots.. W_7) = (2, 3, 5, 7, 1, 4, 1)$ **(10 Marks)**

b. Apply Prim's algorithm and Kruskal's method to find the minimum cost spanning tree to the graph shown in Fig.Q5(b). **(10 Marks)**

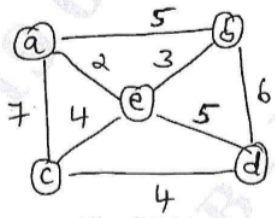

Fig.Q5(b)

OR

6 a. Write an algorithm to solve single source shortest path problem. Apply the algorithm to the graph shown in Fig.Q6(a) by considering 'a' as source. **(10 Marks)**

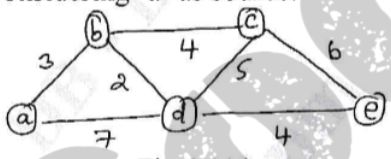

Fig.Q6(a)

b. Define heap. Write bottom-up heap construction algorithm. Construct heap for the list 1, 8, 6, 5, 3, 7, 4 using bottom-up algorithm and successive key insertion method. **(10 Marks)**

Module-4

7 a. Define transitive closure of a directed graph. Find the transitive closure matrix for the graph whose adjacency matrix is given.

$$\begin{bmatrix} 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 \end{bmatrix}$$

(10 Marks)

b. Find the optimal tour for salesperson using dynamic programming technique. The directed graph is shown in Fig.Q7(b). **(10 Marks)**

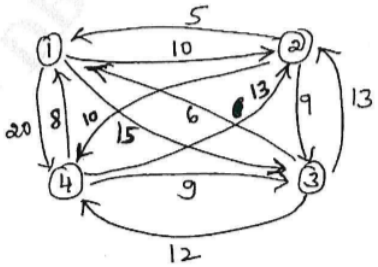

Fig.Q7(b)

OR

8 a. Write an algorithm to construct optimal binary search tree for the following data:

Key	A	B	C	D
Probability	0.1	0.2	0.4	0.3

(10 Marks)

b. Apply the bottom-up dynamic programming algorithm to the following instance of the knapsack problem. Knapsack capacity W = 10.

Item	Weight	Value
1	7	42
2	3	12
3	4	40
4	5	25

(10 Marks)

Module-5

9 a. Construct state-space tree for solving four queens problem using backtracking. **(06 Marks)**

b. Discuss graph coloring problem. Find different solutions for 4 nodes and all possible 3 coloring problem. **(06 Marks)**

c. Write a note on: (i) Non deterministic algorithms. (ii) LC branch and bound solution to solve O/I knapsack problem. **(08 Marks)**

OR

10 a. What are the two additional items required by Branch and Bound technique, compared with backtracking. Solve the following assignment problem using branch and bound technique, whose cost matrix for assigning four jobs to four persons are given

$$\begin{bmatrix} 9 & 2 & 7 & 8 \\ 6 & 4 & 3 & 7 \\ 5 & 8 & 1 & 8 \\ 7 & 6 & 9 & 4 \end{bmatrix}$$

(10 Marks)

b. Discuss the following :

(i) Subset sum problem

(ii) NP hard and NP complete classes. **(10 Marks)**

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17CS43

Fourth Semester B.E. Degree Examination, Aug./Sept.2020
Design and Analysis of Algorithms

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define an algorithm. Explain the characteristics of an algorithm. **(04 Marks)**

b. What are Asymptotic notations? List and describe the various asymptotic notations with an example of each. **(08 Marks)**

c. Explain the general plan of mathematical analysis of non-recursive algorithm with an example. **(08 Marks)**

OR

2 a. What is the worst case, best case and average case efficiencies of sequential search? **(04 Marks)**

b. Illustrate mathematical analysis of recursive algorithm for Towers of Hanoi problem. **(08 Marks)**

c. Discuss the important problem types and fundamental data structures. **(08 Marks)**

Module-2

3 a. Discuss how Quick sort algorithm works to sort an array and trace for the following data set. Draw the tree of recursive calls made.

25	91	46	35	11	82	14	55

Derive best case complexity of quick sort algorithm. **(10 Marks)**

b. Obtain the topological sorting for the digraph shown in Fig.Q3(b), using source removal method.

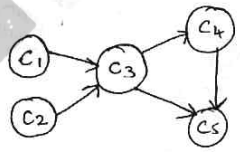

Fig.Q3(b) **(06 Marks)**

c. List out the advantages and disadvantages of divide and conquer technique. **(04 Marks)**

OR

4 a. Explain divide and conquer technique with its control abstraction. **(04 Marks)**

b. Develop an algorithm for sorting elements using Simple merge. Apply the same for sorting list of elements given below:

67	90	12	56	23	34	45

(08 Marks)

c. Apply Strassen's algorithm to compute

$$\begin{bmatrix} 1 & 0 & 2 & 1 \\ 4 & 1 & 1 & 0 \\ 0 & 1 & 3 & 0 \\ 5 & 0 & 2 & 1 \end{bmatrix} * \begin{bmatrix} 0 & 1 & 0 & 1 \\ 2 & 1 & 0 & 4 \\ 2 & 0 & 1 & 1 \\ 1 & 3 & 5 & 0 \end{bmatrix}$$

(08 Marks)

Module-3

5 a. State Job sequencing with deadline problem. Find the solution generated by job sequencing problem for 7 jobs given profits 3, 5, 20, 18, 1, 6, 30 and deadlines 1, 3, 4, 3, 2, 1, 2 respectively. **(04 Marks)**

b. Explain the concept of greedy technique for Prim's algorithm. Obtain a minimum cost spanning tree for the graph below in Fig.Q5(b).

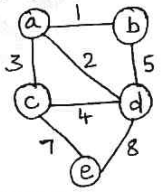

Fig.Q5(b) **(08 Marks)**

c. Sort the given list of number using Heap sort:

2	7	1	6	5	4	3

(08 Marks)

OR

6 a. Explain Greedy criterion. Apply greedy method for the following instance of knapsack problem. Capacity of the knapsack (M) = 5.

Item	Weight	Value
1	2	$12
2	1	$10
3	3	$20
4	2	$15

(08 Marks)

b. Construct a Huffman code for the following data and encode the test BADEC.

Character	A	B	C	D	E
Probability	0.4	0.1	0.2	0.15	0.15

(06 Marks)

c. Solve the below instance (Fig.Q6(c)) of single source shortest path problem with vertex a as the source.

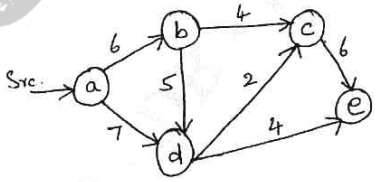

Fig.Q6(c) **(06 Marks)**

Module-4

7 a. What is Dynamic programming? Using Warshall's algorithm, obtain the transitive closure of the graph defined by the following adjacency matrix.

$$R = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 \end{bmatrix}$$

(04 Marks)

b. Define multistage graph problem. Determine the minimum cost path from source (S) to sink (T) for the graph in Fig.Q7(b) using forward approach.

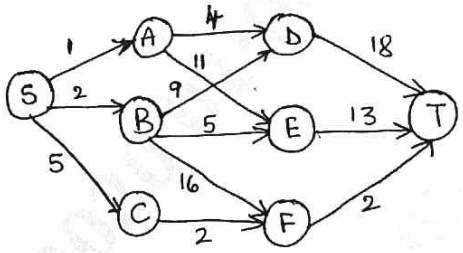

Fig.Q7(b) **(06 Marks)**

c. Solve the below instance of Bellman-Ford algorithm [Fig.Q7(c)].

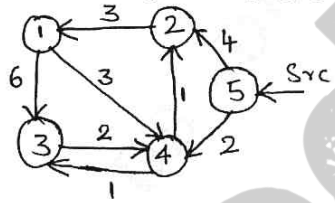

Fig.Q7(c) **(10 Marks)**

OR

8 a. Explain Travelling Salesperson Problem (TSP). Solve the below instance of TSP using dynamic programming.

	1	2	3	4
1	0	10	15	20
2	5	0	9	10
3	6	13	0	12
4	8	8	9	0

(08 Marks)

b. Obtain optimal Binary search Tree for the following identifiers.

	1	2	3	4
a[i]	do	if	int	while
p[i]	0.1	0.2	0.4	0.3

(12 Marks)

Module-5

9 a. Draw the state-space tree top generate solutions to 4-Queen's problem. **(04 Marks)**

b. Apply backtracking technique to the below instance of the subset sum problem.

$s = \{ 1, 3, 4, 6 \}$ $d = 7$ **(08 Marks)**

c. Apply Branch_and_Bound technique to the following insurance of assignment problem.

$$C = \begin{array}{c} \begin{matrix} \text{job1} & \text{job2} & \text{job3} & \text{job4} \end{matrix} \\ \begin{bmatrix} 9 & 2 & 7 & 8 \\ 6 & 4 & 3 & 7 \\ 5 & 8 & 1 & 8 \\ 7 & 6 & 9 & 4 \end{bmatrix} \end{array} \begin{matrix} \\ \text{Person a} \\ \text{Person b} \\ \text{Person c} \\ \text{Person d} \end{matrix}$$

(08 Marks)

OR

10 a. How the Branch_and_Bound technique is different from backhacking? Solve the following insurance of knapsack problem using Branch_and_Bound technique. Give knapsack capacity = 10.

Item	1	2	3	4
Weight	4	7	5	3
Valve	40	42	25	12

(08 Marks)

b. Define Hamiltonian cycle. Check whether the Hamiltonian cycle exists for the graph given below in Fig.Q10(b).

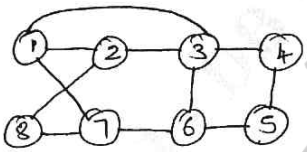

Fig.Q10(b) **(04 Marks)**

c. Define the following :
(i) Class P (ii) Class NP (iii) NP Complete Problem (iv) NP Hard Problem.

(08 Marks)

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15CS43

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
Design and Analysis of Algorithms

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain the worst case, best case and average case efficiencies of an algorithm, with an example each case. **(08 Marks)**

b. Explain the method of comparing the order of growth of two functions using limits, compute the order of growth of: (i) $\log_2 n$ and $\sqrt{n}$ (ii) 2^n and $n!$ **(08 Marks)**

OR

2 a. Define Big Oh notation. Prove that if $t_1(n) \in O(g_1(n))$ and $t_2(n) \in O(g_2(n))$ then $t_1(n) + t_2(n) \in O(\max\{g_1(n), g_2(n)\})$ **(08 Marks)**

b. Explain the general plan for analyzing the efficiency of a recursive algorithm by considering Tower of Honoi problem as an example. **(08 Marks)**

Module-2

3 a. Explain the concept of divide and conquer. Design and algorithm for merge sort. **(08 Marks)**

b. Apply Stressen's matrix multiplication algorithm to compute product of following two matrices: $\begin{bmatrix} 4 & 5 \\ 5 & 1 \end{bmatrix} * \begin{bmatrix} 1 & 3 \\ 4 & 5 \end{bmatrix}$ **(08 Marks)**

OR

4 a. Discuss how Quick sort works to sort an array. Trace Quick sort algorithm for the following data set: 2, –4, 1, 0, 3, 5, –7. Also derive the worst case time complexity of Quick sort. **(08 Marks)**

b. Design and analyse an algorithm for findings the maximum and minimum of an elements using Divide and Conquer Approach. **(08 Marks)**

Module-3

5 a. Write the algorithm to find optimal solution for job sequencing problem with deadline. Apply the same algorithm for the following dataset and find an optimal solution.
$n = 4$, Profit $(p_1, p_2, p_3, p_4) = (100, 10, 15, 27)$,
Deadlines: $(d_1, d_2, d_3, d_4) = (2, 1, 2, 1)$ **(08 Marks)**

b. Write a Kruskal's algorithm to find minimum cost spanning tree and obtain minimum spanning tree for the graph shown in Fig.Q5(b).

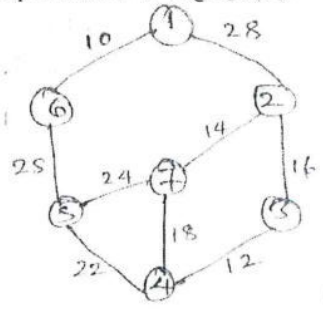

Fig.Q5(b) **(08 Marks)**

OR

6 a. What is an Heap? Write an algorithm to sort the elements using Heap Sort. **(08 Marks)**

b. Obtain the shortest distance cost and paths from node 5 to other nodes from the graph shown in Fig.Q6(b).

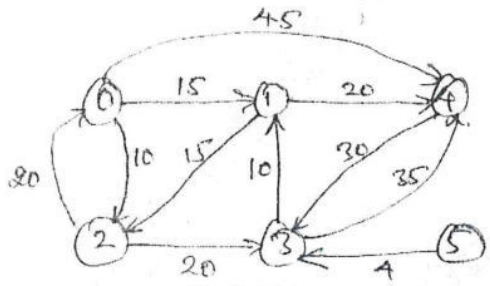

Fig.Q6(b) **(08 Marks)**

Module-4

7 a. Write Warshall's algorithm and find the transitive closure of the matrix given below:

$$R = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 \end{bmatrix}$$ **(08 Marks)**

b. Explain multistage graphs with example. Write multistage graph algorithm using forward approach. **(08 Marks)**

OR

8 a. Using dynamic programming, solve the following knapsack instance:
$n = 4$, $[w_1, w_2, w_3, w_4] = [2, 1, 3, 2]$,
$[p_1, p_2, p_3, p_4] = [12, 10, 20, 15]$ and $M = 5$ **(08 Marks)**

b. Solve the following traveling sales person problem using dynamic programming.

$$\begin{bmatrix} 0 & 10 & 15 & 20 \\ 5 & 0 & 9 & 10 \\ 6 & 13 & 0 & 12 \\ 8 & 8 & 9 & 0 \end{bmatrix}$$ starting city 1. **(08 Marks)**

Module-5

9 a. Discuss the general backtracking algorithm. Draw the state space tree for 4 – Queen's problem. **(08 Marks)**

b. Solve the following instance of Knapsack problem using Branch and Bound Approach, $n = 4$. $[w_1, w_2, w_3, w_4] = [4, 7, 5, 3]$, $[v_1, v_2, v_3, v_4] = [40, 42, 25, 12]$
The knapsack's capacity w is 10. **(08 Marks)**

OR

10 a. Define P, NP, NP – complete and NP – Hard classes. **(08 Marks)**

b. Solve the following instances of assignment problem using Branch and Bound.

	Job 1	Job 2	Job 3	Job 4	
C =	9	2	7	8	person a
	6	4	3	7	person b
	5	8	1	8	person c
	7	6	9	4	person d

(08 Marks)

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CBCS SCHEME

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15CS43

Fourth Semester B.E. Degree Examination, July/August 2021
Design and Analysis of Algorithms

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions.***

1 a. If $t_1(n) \in O(g_1(n))$ and $t_2(n) \in O(g_2(n))$, prove that $t_1(n) + t_2(n) \in O\left(\max(g_1(n), g_2(n))\right)$. **(06 Marks)**

b. Consider the following algorithm,
Algorithm Enigma $(A[0.....n-1, 0.....n-1])$.

```
for i → 0 to n − 2 do
    for j → i + 1 to n − 1 do
        if A[i, j] ≠ A[j, i]
            return False
        end For
    end For
return True
```

(i) What does the algorithm compute?
(ii) What is the basic operation?
(iii) How many times the basic operation is executed?
(iv) What is the efficiency class of the algorithm? **(05 Marks)**

c. By using limits compare the order of growth of the following:
(i) $\log_2 n$ and $\sqrt{n}$. (ii) $n!$ and 2^n **(05 Marks)**

2 a. If M(n) denotes the number of moves in towers of honoi puzzle, when n disks are involved. Give a recurrence relation for M(n) and solve the recurrence relation. **(06 Marks)**

b. Define basic three asymptotic notations with example. **(06 Marks)**

c. Define with example,
(i) Stack
(ii) Graphs
(iii) Trees
(iv) Sets and Dictionaries. **(04 Marks)**

3 a. Write Merge Sort algorithm and discuss its efficiency. Sort the list E, X, A, M, P, L, E in alphabetical order. **(08 Marks)**

b. Write recursive algorithm to find minimum and maximum element in a set of n elements by using divide and conquer and find the minimum and maximum element in the set 29, 4, 88, 15, 9, 87, 14, 1. **(08 Marks)**

4 a. Write Quick Sort Algorithm. Sort 5, 3, 1, 9, 8, 2, 4, 7 in ascending order and write the tree of recursive calls to quicksort algorithm. **(08 Marks)**

b. Solve the recurrence relation by using backward substitution method. (Solve for $n = 2^K$).

$$T(n) = \begin{cases} 2T\left(\frac{n}{2}\right) + 2 & \text{if } n > 2 \\ 1 & \text{if } n = 2 \\ 0 & \text{if } n = 1 \end{cases}$$ **(08 Marks)**

5 a. Write and explain Greedy Knapsack algorithm. **(04 Marks)**

b. What is minimum cost spanning tree? Explain with an example. Find minimum cost spanning tree for weighted graph given in Fig. Q5 (b) using Prim's algorithm, with source vertex 1. **(07 Marks)**

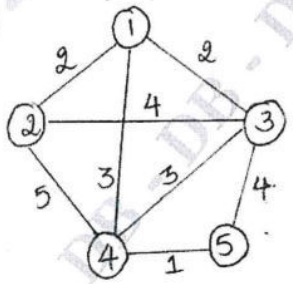

Fig. Q5 (b)

c. For n = 4, profits $(P_1, P_2, P_3, P_4) = (100, 10, 15, 27)$ and deadlines $(d_1, d_2, d_3, d_4) = (2, 1, 2, 1)$ Find all the feasible solutions and optimal solution for Job sequencing with deadlines problem. **(05 Marks)**

6 a. Write Dijikstra's algorithm. Apply Dijikstra's algorithm on the graph given in Fig. Q6 (a), to obtain the shortest paths from source vertex 1. **(08 Marks)**

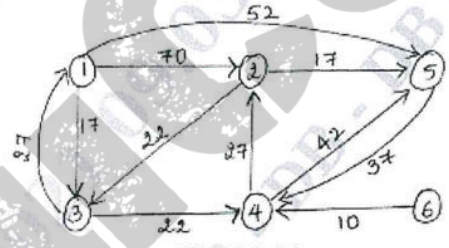

Fig. Q6 (a)

b. Sort the array 3, 2, 4, 1, 6, 5 by using heapsort with array representation of heaps in increasing order. **(04 Marks)**

c. Write Kruskal's algorithm. **(04 Marks)**

7 a. Using Warshalls algorithm, obtain transitive closure of matrix for the graph given in Fig. Q7 (a). **(08 Marks)**

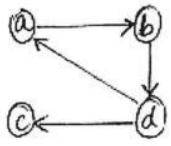

Fig. Q7 (a)

b. Using dynamic programming solve the following knapsack instance. For n = 4, M = 5, $(w_1, w_2, w_3, w_4) = (2, 1, 3, 2)$ and $(P_1, P_2, P_3, P_4) = (12, 10, 20, 15)$ **(08 Marks)**

8 a. Write Floyd's algorithm. Find all pair shortest path for the graph given in Fig. Q8 (a). **(08 Marks)**

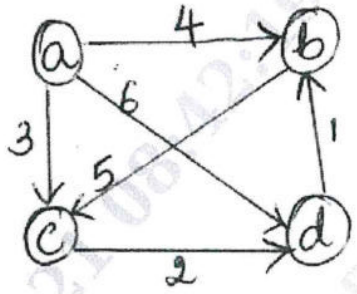

Fig. Q8 (a)

b. Write short note on:
   (i) Reliability design.
   (ii) Optimal binary search tree algorithm and its efficiency. **(08 Marks)**

9 a. Write the pseudocode for backtracking algorithm. Apply backtracking to solve the instance of the sum of subset problem. S = {3, 5, 6, 7} and d = 15. **(08 Marks)**

b. Write short note on:
   (i) N Queen's problem.
   (ii) Hamiltonian cycles. **(08 Marks)**

10 a. With the help of a state space tree, solve the following salesperson problem for graph given in Fig. Q10 (a), using branch and bound algorithm. **(08 Marks)**

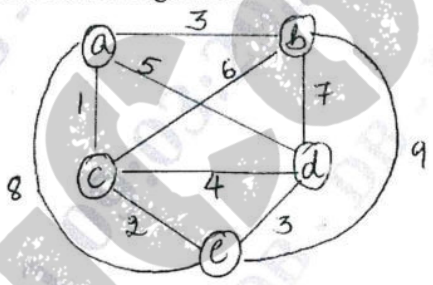

Fig. Q10 (a)

b. Write short note on:
   (i) Non deterministic algorithm
   (ii) Graph Colouring
   (iii) P, NP problems
   (iv) NP hard class. **(08 Marks)**

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