CBCS SCHEME

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18CS42

Fourth Semester B.E. Degree Examination, July/August 2022
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. Give the definition of an Algorithm and also discuss the characteristics of an Algorithm. **(05 Marks)**

b. Define Space Complexity and Time Complexity of an algorithm and compute the time complexity of Fibbonocci Numbers algorithm. **(05 Marks)**

c. What are the various basic Asymptotic efficiency classes? Explain Big – O , Big - Ω , Big - θ notations with examples. **(10 Marks)**

OR

2 a. Give the Mathematical Analysis of Non recursive Matrix Multiplication Algorithm. **(05 Marks)**

b. Give the general plan for analyzing Time efficiency of Recursive algorithms and also Analyze the Tower of Hanoi Recursive algorithm. **(10 Marks)**

c. Mention the important problem types considered for design and analysis. Explain any two problem types. **(05 Marks)**

Module-2

3 a. Give the Recursive algorithm to find maximum and minimum element from the list and apply the algorithm to find maximum and minimum to the list
[31 , 22 , 12 , -7 , 75 , -6 , 17 , 47 , 60]. **(10 Marks)**

b. Apply both mergesort and quicksort algorithm to sort the characters VTUBELAGAVI. **(10 Marks)**

OR

4 a. Apply Strassen's algorithm for matrix multiplication to multiply the following matrices and justify how the Strassen's algorithm is better.

$$\begin{bmatrix} 4 & 3 \\ 1 & 2 \end{bmatrix} \times \begin{bmatrix} 1 & 2 \\ 6 & 5 \end{bmatrix}.$$

(10 Marks)

b. Obtain the topological sort for the graph , Fig. Q4(b) using i) Source Removal method ii) DFS method. **(10 Marks)**

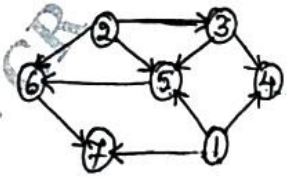


Fig. Q4(b)

Module-3

5 a. Solve the Greedy Knapsack problem, Fig, Q5(a) of capacity 5kgs. **(05 Marks)**

Items	1	2	3	4
Profit	5	9	4	8
Weight	1	3	2	2

Fig. Q5(a)

b. Find the Optimal solution for the Greedy Job sequencing problem given n = 4 , profits [10 , 30 , 60 , 40] , deadlines [2 , 3 , 1 , 3]. **(05 Marks)**

c. Apply Prims and Kruskal's algorithm to find the minimal cost spanning tree for the graph given in Fig. Q5(c). **(10 Marks)**

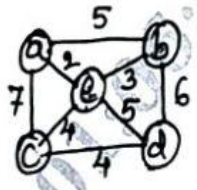


Fig. Q5(c)

OR

6 a. A document contains the letters "A" through "E" with frequencies is follows :
A : 22 , B : 13 , C : 18 , D : 16 , E : 31.
Construct a Huffman Tree and codes and
Encode : CAB , ADD , BAD , ACE
Decode : 110011 and 1000110001. **(10 Marks)**

b. Apply Heapsort for the list [9 , 7 , 1 , 8 , 3 , 6 , 2 , 4 , 10 , 5] using Bottom up approach. **(10 Marks)**

Module-4

7 a. Apply Floyd's algorithm to find the all pairs shortest path for the given adjacency matrix. Fig. Q7(a).

$$W = \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{array} \begin{array}{c} \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array} \\ \begin{bmatrix} 0 & 1 & \infty & 1 & 5 \\ 9 & 0 & 3 & 2 & \infty \\ \infty & \infty & 0 & 4 & \infty \\ \infty & \infty & 2 & 0 & 3 \\ 3 & \infty & \infty & \infty & 0 \end{bmatrix} \end{array}$$

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

b. Solve the instance of 0/1 Knapsack problem Fig. Q7(b), using Dynamic Programming approach. **(10 Marks)**

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

Capacity W = 5

Fig. Q7(b)

OR

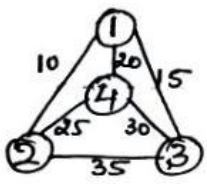
8 a. Construct an Optimal Binary search tree for the set of keys given in Fig. Q8(a). **(10 Marks)**

Keys	A	B	C	D
Probability	0.1	0.2	0.4	0.3

Fig. Q8(a)

b. Apply Dynamic programming approach to solve the given Travelling Salesman problem. **(10 Marks)**

Fig. Q8(b)

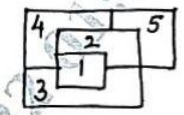


Module-5

9 a. With the help of State Space tree, solve the 4 – queens problem by using Backtracking approach. **(10 Marks)**

b. Color the regions in the Map given in Fig. Q9(b), by applying backtracking graph color algorithm. Color = (R G B & Y). **(10 Marks)**

Fig. Q9(b)



OR

10 a. Apply LC – Branch and Bound approach to the assignment problem Fig. Q10(a). **(10 Marks)**

Fig. Q10(a)

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

b. Apply Branch and Bound approach to solve the instance of 0/1 Knapsack problem.

KnapSack Capacity W = 10

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

Fig. Q10(b) **(10 Marks)**

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18CS42

Fourth Semester B.E. Degree Examination, Feb./Mar.2022
Design and Analysis of Algorithm

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. What is an algorithm? Explain the criteria to be satisfied by algorithm. **(06 Marks)**

b. 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
end algorithm
```

(i) What does this algorithm compute?
(ii) What is its input size?
(iii) What is its basic operation?
(iv) How many times is the basic operation executed?
(v) What is the efficiency class of this algorithm? **(10 Marks)**

c. Prove the following theorem:
If $t_1(n) \in O(g_1(n))$ and $t_2(n) \in O(g_2(n))$, then $t_1(n) + t_2(n) \in O(\max\{g_1(n), g_2(n)\})$. **(04 Marks)**

OR

2 a. Design an algorithm for performing sequential search and compute best case, worst case and average case efficiency. **(10 Marks)**

b. The factorial function n! has value 1 when n<=1 and value $n*(n-1)!$ when n>1. Write both a recursive and an iterative algorithm to compute n! **(06 Marks)**

c. List the following functions according to their order of growth from the lowest to the highest. State proper reasons,
$(n-2)!$, $5\log(n+100)^{10}$, 2^{2n}, $0.00\ln^4 + 3n^3 + 1$, $\ln^2 n$, $\sqrt[3]{n}$, 3^n. **(04 Marks)**

Module-2

3 a. Design an algorithm for performing merge sort. Analyze its time efficiency. Apply the same to sort the following set of numbers 4, 9, 0, −1, 6, 8, 9, 2, 3, 12 **(10 Marks)**

b. Apply Strassen's multiplication to multiply the following matrices. Show the details of the computation.

$$A = \begin{bmatrix} 4 & 5 \\ 1 & 3 \end{bmatrix}, \quad B = \begin{bmatrix} 0 & 2 \\ 1 & 3 \end{bmatrix}.$$ **(10 Marks)**

OR

4 a. Apply topological sort on the following graph using source removal and DFS based methods. **(10 Marks)**

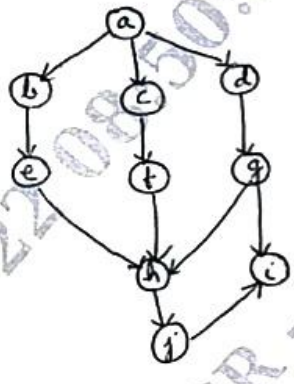

Fig. Q4 (a)

b. Desing an algoirhtm for performing quick sort, apply the same to sort the following set of numbers 5, 3, 1, 9, 8, 2, 4, 7 **(10 Marks)**

Module-3

5 a. Write an algorithm to solve the knapsack problem using greedy approach and apply the same to find an optimal solution to the knapsack instance, n = 5, m = 6,
$(p_1, p_2, p_3, p_4, p_5) = (25, 20, 15, 40, 50)$ and
$(w_1, w_2, w_3, w_4, w_5) = (3, 2, 1, 4, 5)$ using greedy approach. **(10 Marks)**

b. What is Dijkstra's algorithm used for? Apply Dijkstra's algorithm on the following graph. Initial node is G

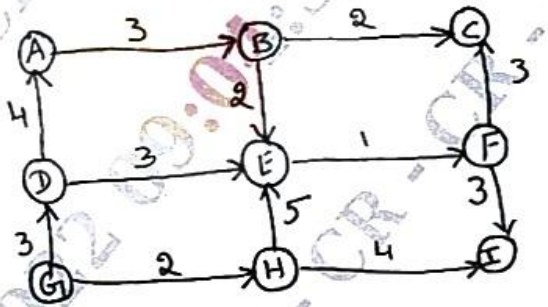

Fig. Q5 (b) **(10 Marks)**

OR

6 a. Define minimum spanning tree. Write Prim's algorithm to find minimum spanning tree. Apply the same on the following graph: **(10 Marks)**

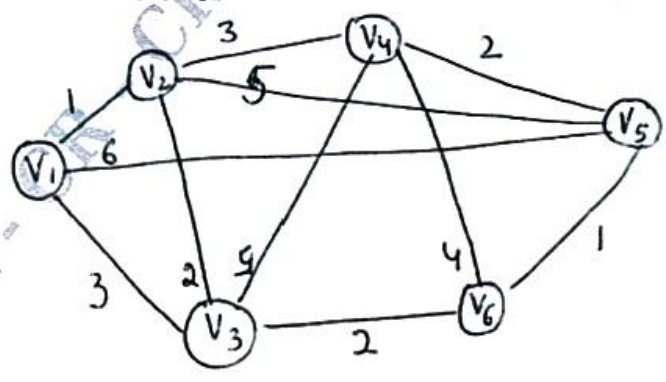

Fig. Q6 (a)

b. A message consisting of the characters given in the table below has to be transmitted over a network in a secured manner.

Character	A	M	R	_
Probability	0.4	0.2	0.3	0.1

(i) Construct Huffman tree for the given characters (Branch label : left (0), right(1))
(ii) Device Huffman codes for the given character.
(iii) Encode the text RAMA_RAMAR using Huffman codes.
(iv) Decode the text whose encoding is 1000101
(v) Compute the effectiveness of Huffman codes. **(10 Marks)**

Module-4

7 a. Design an algorithm to find all pairs of shortest paths given a weighted connected path using dynamic programming technique. Apply the same algorithm to compute all pairs of shortest path for the following weighted connected graph. (Refer Fig. Q7 (a)) **(10 Marks)**

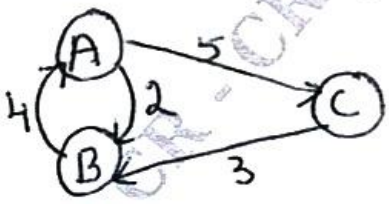

Fig. Q7 (a)

b. Design an algorithm to solve knapsack problem using dynamic programming. Apply the same to solve the following knapsack problem where W = 50.

Item	Weight	Value
1	10	60
2	20	100
3	30	120

(10 Marks)

OR

8 a. Define transitive closure of a directed graph. Write Warshall's algorithm to find transitive closure. Apply the same to find the transitive closure of the digraph given below in Fig. Q8 (a). **(10 Marks)**

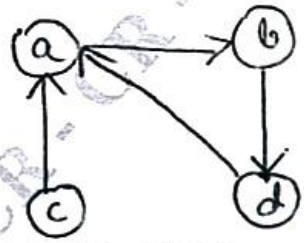

Fig. Q8 (a)

b. Define a multistage graph. Give an example. Explain the technique of finding the minimum cost path in a multistage graph. **(10 Marks)**

Module-5

9 a. What is backtracking? List out two advantages of backtracking strategy. Considering 4-Queens problem, provide two possible solutions to this problem using backtracking technique. **(10 Marks)**

b. Solve the following assignment problem using branch and bound technique.

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

(10 Marks)

OR

10 a. Find a Hamiltonian circuit for the following graph shown in Fig. Q10 (a) using backtracking technique. **(10 Marks)**

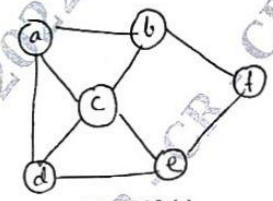

Fig. Q10 (a)

b. Explain the following concepts:
(i) Tractable and intractable problems
(ii) P problems
(iii) Non deterministic algorithm.
(iv) NP problem.
(v) NP complete problems. **(10 Marks)**

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17CS43

Fourth Semester B.E. Degree Examination, July/August 2022
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 an array using sequential search. Discuss the worst case, best case and average case efficiency of this algorithm. **(08 Marks)**

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

c. Define an algorithm. Explain the characteristics of an algorithm. **(06 Marks)**

OR

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

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

c. Explain asymptotic notation with example. **(06 Marks)**

Module-2

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

b. Apply DFS method and source removal method to find the Topological sequence for the graph shown in Fig.Q3(b).

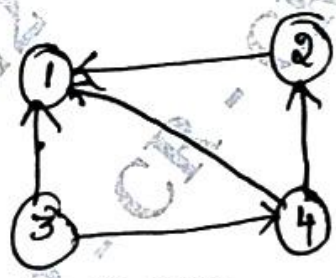

Fig.Q3(b)

c. List out the advantages and disadvantages of Divide and Conquer technique. **(06 Marks)**

OR

4 a. Apply Strassen's matrix multiplication to multiply following matrices. Discuss how this method is better than direct matrix multiplication method. **(06 Marks)**

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

b. Explain Divide and Conquer technique with its control abstraction. **(05 Marks)**

c. Write an algorithm to sort 'n' numbers using Mergesort. Mention its time complexity. **(07 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.
$(p_1 \ldots\ldots p_7) = (10, 5, 15, 7, 6, 18, 3)$
$(w_1 \ldots\ldots w_7) = (2, 3, 5, 7, 1, 4, 1)$ **(09 Marks)**

b. Apply Prim's algorithm to find the minimum cost spanning tree to the graph shown in Fig.Q5(b).

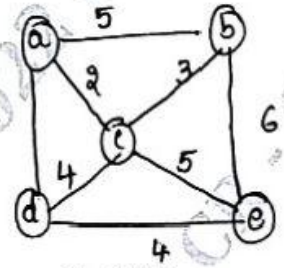

Fig.Q5(b) **(05 Marks)**

c. Solve the graph given below in Fig.Q5(c) using single source shortest path algorithm with vertex 'a' as the source.

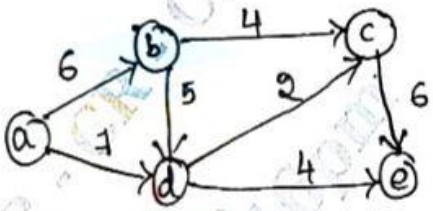

Fig.Q5(c) **(06 Marks)**

OR

6 a. Define heap. Write bottom up heap construction algorithm. Construct heap for the list 2, 6, 9, 8, 3, 7, 4 using bottom up algorithm. **(08 Marks)**

b. State job sequencing with deadline problem. Find the solution generated by job sequencing algorithm for 7 jobs, given profits 3, 5, 20, 18, 1, 6, 30 and deadline 1, 3, 4, 3, 2, 1, 2 respectively. **(06 Marks)**

c. Construct the Huffman tree for the following data:

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

(06 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 below.

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

(10 Marks)

b. 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)

OR

8 a. Apply dynamic programming method to solve the following instance of the knapsack problem. Knapsack capacity W = 10.

Item	Weight	Value
1	6	42
2	4	15
3	2	20
4	5	30

(10 Marks)

b. Apply Floyd's algorithm to the graph given below in Fig.Q8(b). Show all necessary steps. Derive its time efficiency.

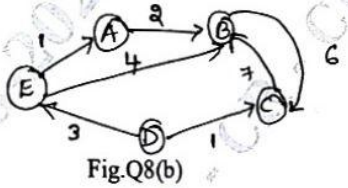

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. Construct state space tree for solving 4 Queen's problem using backtracking. **(06 Marks)**

b. Apply Backtracking technique to solve the below instance of the sum of subset problem. S = {1, 3, 4, 6}, d = 7. **(08 Marks)**

c. Apply Branch and bound technique to the following instance of assignment problem.

	job1	job2	job3	job4	
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

(06 Marks)

OR

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

b. Solve the following instance of the knapsack problem using Branch and Bound technique. Given knapsack capacity = 10.

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

(08 Marks)

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

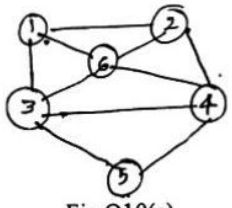

Fig.Q10(c) **(06 Marks)**