CBCS SCHEME

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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}, $0.001\ln^4 + 3n^3 + 1$, $\ln^2 n$, $\sqrt[3]{n}$, 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)**

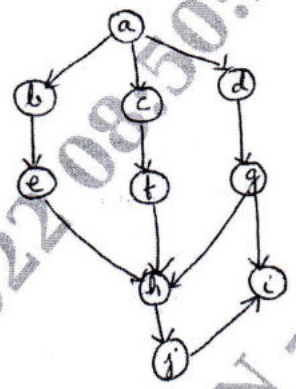

Fig. Q4 (a)

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

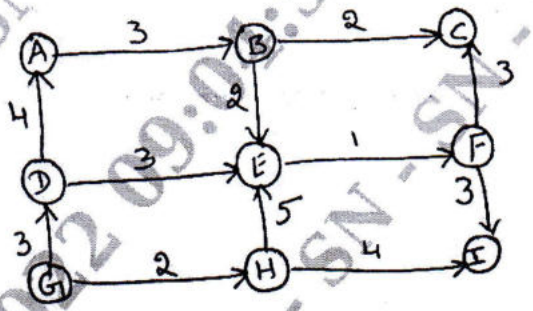

Fig. Q5 (b) **(10 Marks)**

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)**

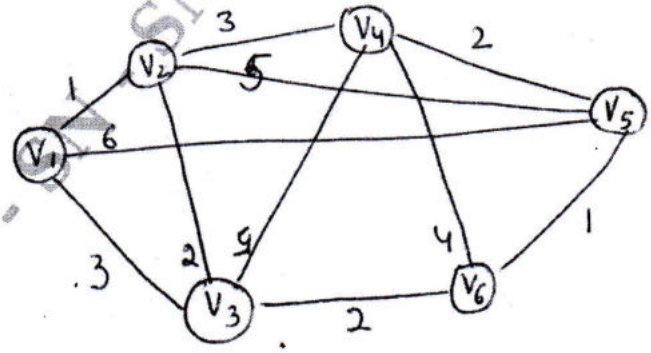

Fig. Q6 (a)

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)**

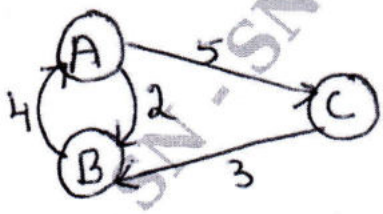

Fig. Q7 (a)

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)**

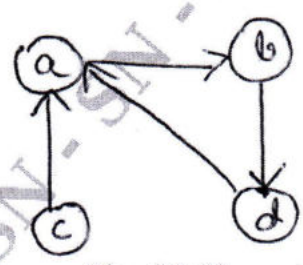

Fig. Q8 (a)

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)**

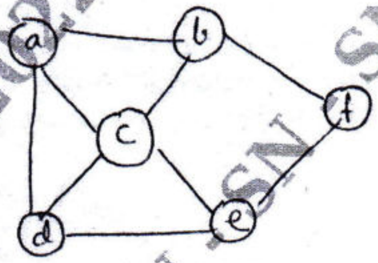

Fig. Q10 (a)

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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