CBCS SCHEME

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17CS43

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

Time: 3 hrs. Max. Marks: 100

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

1 a. Define asymptotic notations with example. **(09 Marks)**

b. Solve the following recurrence relation. Using backward substitution :
$x(n) = 3x(n-1)$ for $n > 1$, $x(1) = 4$ **(03 Marks)**

c. List and explain the basic asymptotic efficiency classes. **(08 Marks)**

2 a. Define the following terms :
(i) Graph
(ii) Tree
(iii) Set and Dictionaries. **(04 Marks)**

b. Write an algorithm to find n^{th} Fibonacci number recursively. Set up a recurrence relation for Fibonacci number and solve it. **(08 Marks)**

c. Consider the following algorithm :

```
Algorithm Mystery (n)
//Input : A nonnegative integer is
S←0
for i ← 1 to n do
    s←s + i * i
return s
```

(i) What does this algorithm compute?
(ii) What is its basic operation?
(iii) How many time is the basic operation executed?
(iv) What is the efficiency class of this algorithm? **(08 Marks)**

3 a. Write an algorithm to finding the maximum and minimum of the given set of elements, {a(i), a(i+1),…….a(j)} **(08 Marks)**

b. Apply Quicksort algorithm to the following set of input values and draw a tree of recursive calls to quicksort with input values *l* and r of subarray bounds and split position P of a partition obtained.
5, 3, 1, 9, 8, 2, 4, 7 **(12 Marks)**

4 a. Explain the Strassen's matrix multiplication algorithm to compute the product of 2×2 matrices. **(08 Marks)**

b. Describe the advantages and disadvantages of divide and conquer technique. **(06 Marks)**

c. Consider the following graph, apply the DFS-based algorithm to solve the topological sorting problem for the given digraphs : (Refer Fig. Q4 (c)) **(06 Marks)**

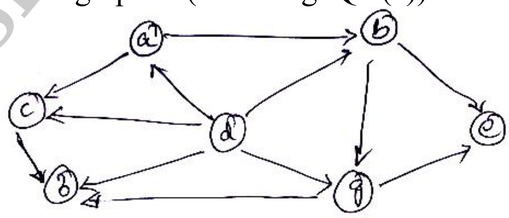

Fig. Q4 (c)

5 a. Write an algorithm of greedy method control abstraction for the subset paradigm. **(06 Marks)**

b. What is spanning tree? Explain the Prim's algorithm for constructing a minimum spanning tree for the weighted connected graph. **(08 Marks)**

c. Apply the dijkstra's algorithm for single source shortest paths for the given graph and assume vertex 'A' as source (Fig. Q5 (c)) **(06 Marks)**

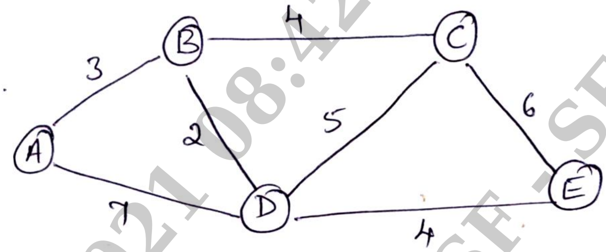

Fig. Q5 (c)

6 a. (i) Construct a Huffman code for the following data:

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

(ii) Encode the text ABACABAD using the code of Q(i).

(iii) Decode the text whose encoding is 100010111001010 in the code of Q(i). **(10 Marks)**

b. Construct a heap for the list 2, 9, 7, 6, 5, 8 by bottom up algorithm and how efficient is this algorithm in the worst case? **(10 Marks)**

7 a. Apply the dynamic programming algorithm for constructing an optimal binary search-tree for the following data set :

Key	A	B	C	D
Probability	0.1	0.2	0.4	0.3

(10 Marks)

b. Solve the all pairs shortest path problem for the diagram with the following weight matrix:

$$\begin{bmatrix} 0 & 2 & \infty & 1 & 8 \\ 6 & 0 & 3 & 2 & \infty \\ \infty & \infty & 0 & 4 & \infty \\ \infty & \infty & 2 & 0 & 3 \\ 3 & \infty & \infty & \infty & 0 \end{bmatrix}$$

(10 Marks)

8 a. Compute the optimal tour of the given directed graph using dynamic programming techniques of TSP. (Refer Fig. Q8 (a)). **(10 Marks)**

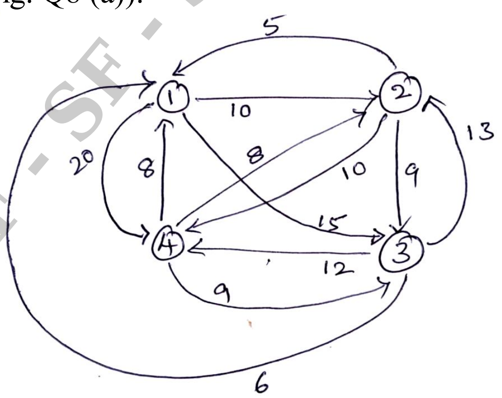

Fig. Q8 (a)

b. Apply the bottom-up dynamic programming algorithm to the following instance of the knapsack problem.

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

Capacity W = 5

(10 Marks)

9 a. Explain how the board's symmetry can be used to find the second solution to the 4-Queen problems. **(06 Marks)**

b. Apply backtracking to the problem of finding a Hamiltonian circuit in the following graph (Fig. Q9 (b)) **(08 Marks)**

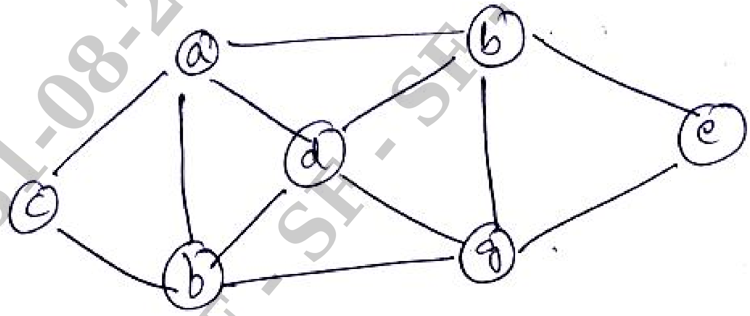

Fig. Q9 (b)

c. Write a pseudocode of the backtracking algorithm. **(06 Marks)**

10 a. Construct and draw the state space tree of the backtracking algorithm applied to the instance A={3, 5, 6, 7} and d = 15 of the subset problem. **(10 Marks)**

b. Solve the following instance of the knapsack problem by FIFOBB algorithm.

n = 4 $(P_1, P_2, P_3, P_4) = (10, 10, 12, 18)$

$W_1, W_2, W_3, W_4 = (2, 4, 6, 9)$ M = 15

(10 Marks)

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