C   Reg. No. :

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Question Paper Code: 55805

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2023

Fifth Semester

Information Technology

15UIT504- ANALYSIS AND DESIGN OF ALGORITHMS

(Regulation 2015)

Duration: Three hours   Maximum: 100 Marks

Answer ALL Questions

PART A - (5 x 1 = 5 Marks)

1. What is the time efficiency class of the following code.   CO1- App

    ```
    for (int i=0;i<=n-2;i++){
    for(int j=i+1;<=n-1;j++){
    for (int k=i;k<=n;k++){
        A[j,k]=A[j,k]-A[i,k]*A[j,i]/A[i,j]

    }}}
    ```
    (a) n^2 (b) n^3 (c) n^4 (d) n!

2. How many comparisons are required to place smallest element in   CO2- R
    correct position in selection sort?

    (a) 2n   (b) n^2 (c) n   (d) n-1

3. If all c(i, j)'s and r(i, j)'s are calculated, then OBST algorithm in worst   CO3- R

    case takes _____time.

    (a) $O(n^2)$ (b) $O(n^3)$ (c)O(log n)   (d)O(n log n)

4. The problem of finding a subset of positive integers whose sum is equal
    to a given positive integer is called as?   CO4- R

    (a) n- queen problem   (b) subset sum problem

    (c) knapsack problem   (d) hamiltonian circuit problem

5. A problem L is NP-complete if and only if L is NP-hard and   CO5- R

    (a) L = NP   (b) L ε NP   (c) L α NP   (d) L ≈ NP

6. Analyze the time complexity of the following segment:
   ```
   for(i=0;i<N;i++)
   for(j=N/2;j>0;j--)
   sum++;
   ```
   CO1-App

7. Assess how the Articulation point of the graph is found using depth first search.   CO2 R

8. Analyze the time complexity of Huffman Tree.   CO3 R

9. Define Hamiltonian Circuit problem in an undirected Graph.   CO4 R

10. A NP-hard problem can be solved in deterministic polynomial time. Justify.   CO5 R

PART – C (5 x 16= 80Marks)

11. (a) (i) Write a recursive algorithm for the factorial function and solve   CO1- App   (9)
       its recurrence relation.

   (ii) Solve the recurrence relation, x (n) =x(n/2)+n, for n>1, x(1)=1.   CO1- App   (7)

Or

   (b) (i) Consider the following recursive algorithm: CO1- App   (9)
       ```
       Min(A[0..n-1])
       Input: An array A[0..n-1])
       if n=1 return A[0]
       else temp= Min(A[0..n-2])
         if temp <= A[n-1] return temp
       else return A[n-1]
       ```

   1.What does this algorithm compute?
   2.Set up a recurrence relation for the algorithm's basic operation
   count and solve it.

   (ii) Solve the recurrence relation, x (n)= x(n/2)+n, for n>1, x(1)=1.   CO1- App   (7)

12. (a) (i) Write an algorithm for selection sort using the brute force   CO2- App   (8)
       technique. Apply it to sort and trace the instances such as
       s,e,t,h,u,i,n,s,t,i,t,u,t,e in alphabetical order. What is the total
       running time of the algorithm?

   (ii) Show the result of running BFS and DFS on the directed graph   CO2- App   (8)
   given below using vertex '0' as source. Show the status of the data
   structure used at each stage.

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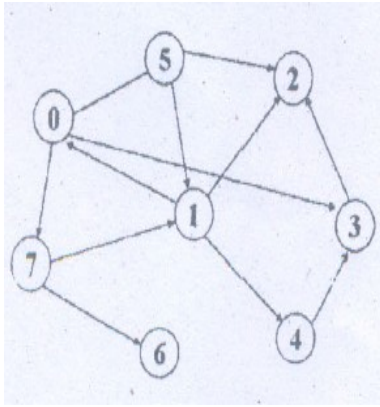
Or

(b) (i) Write an algorithm to sort a given list using Quick sort method.   CO2- App   (8)
Execute your algorithm for two passes using the following list as
input: 66, 33, 40, 20, 50, 88, 60, 11, 77, 30, 45, and 65.

(ii) Harsha and Deepesh are two friends playing with the number   CO2- App   (8)
game for identifying their favorite number. Harsha arranged the
card numbers with an increasing order and hide their cards.
Deepesh wants to find her favorite number with the minimum
search time. Write a suitable algorithm for the above and also find
the time efficiency.

13. (a) (i) Formulate the minimum spanning tree for the following graph   CO3- Ana   (8)
using Kruskal algorithm.
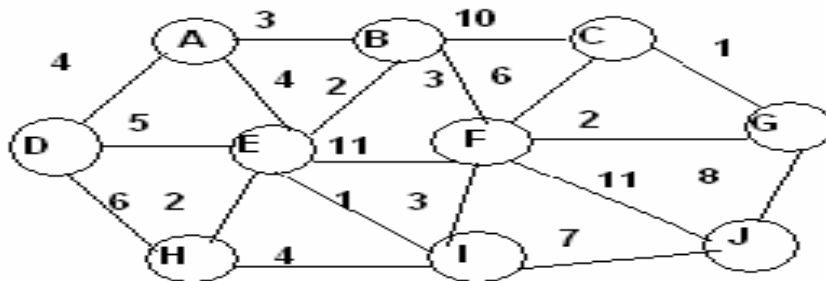
(ii) Write the Huffman's Algorithm. Construct the Huffman's tree   CO3- Ana   (8)
for the following data and obtain its Huffman's Code.

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

Or

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(b) (i) Construct an optimal binary search tree for the following items CO3- Ana (10)
with probabilities given in the table below.

Items	1	2	3	4	5
Probability	0.24	0.22	0.23	0.3	0.01

(ii) Write an algorithm for 8-Queens problem and analyze its time CO3- Ana (6)
complexity.

14. (a) (i) Given a set of 6 elements, $S = \{1, 2, 5, 6, 8\}$. Generate all the CO4- App (8)
possible combinations of the subsets whose sum is equal to the
value, $M = 9$. Construct the state space tree for the above problem.

(ii) Solve the following instances of the Knapsack problem by CO4- App (8)
using LC branch-and-bound technique. Items (W1,W2,W3,W4),
Weight(4,7,5,3), Profit(40,42,25,12) and Knapsack capacity
$W = 10$.

Or

(b) Assume you are in a position to assign different jobs are to CO4- App (16)
different persons. The cost of the jobs and the persons are given
below in the table. Find the optimal solution for the persons to
complete the job with minimum cost using branch and bound
technique. Write a suitable algorithm for the above said problem
and find the complexity of the algorithm.

Job / Person	Job 1	Job 2	Job 3	Job 4
Person 1	4	3	8	6
Person 2	5	7	2	4
Person 3	16	9	3	1
Person 4	2	5	3	7

15. (a) Explain how pointer doubling problem used for list ranking and CO5- U (16)
analyze the straight forward serial algorithm is best for list
ranking.

Or

(b) (i) Analyze how you can reduce the polynomial time for an CO5- U (8)
Hamiltonian circuit problem.

(ii) Discuss the classes P, NP, NP complete, and NP hard with CO5- U (8)
examples. How can we show that a problem is NP complete?

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