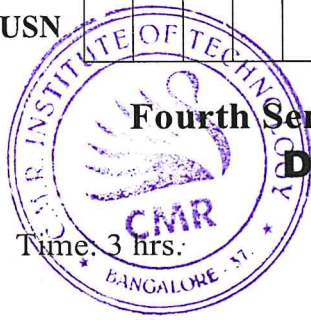


CBCS SCHEME

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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 $t_1(n) + t_2(n) \in O(\max(g_1(n), g_2(n)))$. (06 Marks)
- b. Consider the following algorithm,
Algorithm Enigma ($A[0 \dots n-1, 0 \dots n-1]$).
for $i \rightarrow 0$ to $n-2$ do
 for $j \rightarrow i+1$ to $n-1$ do
 if $A[i, j] \neq A[j, i]$
 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 $n = 2^k$).

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

- 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)

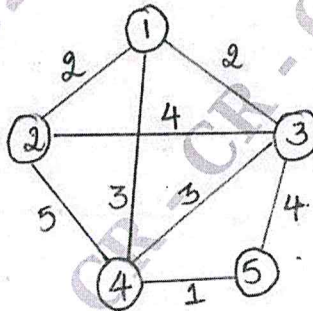


Fig. Q5 (b)

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

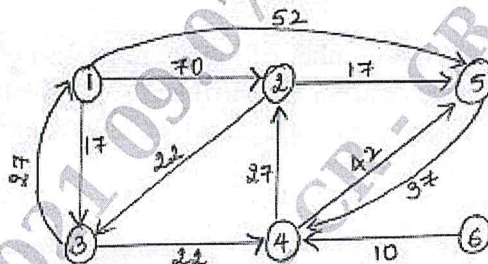


Fig. Q6 (a)

- 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)

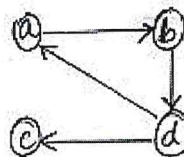


Fig. Q7 (a)

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- 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)

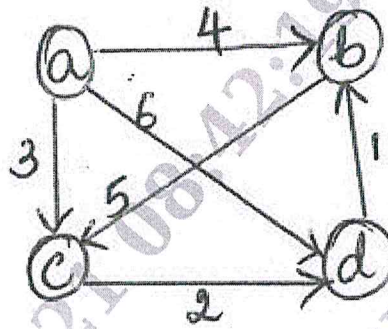


Fig. Q8 (a)

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- 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)

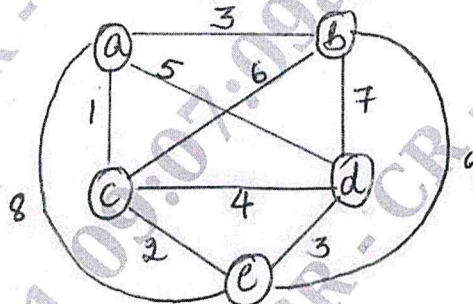


Fig. Q10 (a)

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