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VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS), HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (C.S.E./AIML) IV-Semester Main & Backlog Examinations, July-2022

Design and Analysis of Algorithms

Time: 3 hours

Max. Marks: 60

Note: Answer all questions from Part-A and any FIVE from Part-B

Part-A (10 × 2 = 20 Marks)

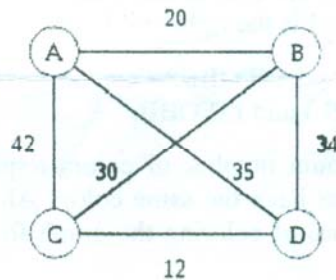
Q. No.	Stem of the question	M	L	CO	PO
1.	Given $f(n) = 3n^2 + 5n - 4$. Is $f(n) = \Omega(n^2)$? Justify your answer with relevant reasons.	2	2	1	1,2
2.	Why is amortized analysis needed? Give an example.	2	2	1	1
3.	Write the Control abstraction for divide and conquer strategy.	2	1	2	1
4.	Find an optimal placement for 10 programs on a tape T0 where the programs are of lengths 15,4,18,6,5,20,16,12,8,9. Compute the minimum mean retrieval time.	2	3	2	1,2
5.	Consider the strings "NOPQRNOPQ" and "NPCRNDPOPNQ". What is the length of the longest common subsequence?	2	3	3	1,2
6.	Give an Optimal binary search tree (OBST) with the identifiers k_1, k_2 and k_3 such that $k_1 < k_2 < k_3$. Probabilities $p(1)=0.5, p(2)=0.1, p(3)=0.05, q(0)=0.15, q(1)=0.1, q(2)=0.05$ and $q(3)=0.05$. What is the cost of the OBST if k_2 is the root node and k_1 is the left child of k_2 and k_3 is the right child of k_2 ?	2	2	3	1,2
7.	What is the difference between FIFOBB and LIFOBB? Give an example to show how nodes are generated using FIFOBB and LIFOBB.	2	2	4	1,2
8.	For the given graph, What are the minimum number of colors required to color the nodes such that no adjacent nodes have the same color? Also draw the state space tree showing the possibilities of coloring the graph following the given constraint.	2	3	4	1,2,3
9.	Differentiate between a tractable problem and intractable problem. Give example for each.	2	1	5	1,2
10.	When do we write a non-deterministic algorithm? Write a non-deterministic algorithm for sorting the elements in $O(n)$ time.	2	3	5	1,2,3
	Part-B (5 × 8 = 40 Marks)				
11. a)	Solve the following recursive relation using Masters theorem. $T(n) = 2 T(n/2) + Cn \quad n > 1$ $T(n) = 2 \quad n = 1$ Identify which case of Master's theorem is applied to solve it.	4	3	1	1,2

- b) Design the algorithm which finds the vowels from the given array of characters given as input parameter to the algorithm. It then replaces the vowels with character 'v'. Also determine the time complexity of the designed algorithm. 4 3 1 1,2,3
12. a) Design a divide and conquer algorithm for Quick sort. Analyze its time complexity in the best and worst case. 4 1 2 1,2,3
- b) What is job sequencing with deadline problem? Solve the following job scheduling with deadlines problem using the greedy method. 4 2 2 1,2,3
- Consider a set of given jobs as shown in the following table. We have to find a sequence of jobs, which will be completed within their deadlines and will give maximum profit. Each job is associated with a deadline and profit.

Job	1	2	3	4
Deadline	2	1	2	1
Profit	100	10	15	27

Find the maximum profit, valid schedule and list of unfinished jobs.

13. a) Explain matrix chain multiplication problem using dynamic programming approach. 4 2 3 1,2,3
- b) Given a set of cities A, B, C and D and the distance between every pair of cities as shown in the below graph. The problem is to find the shortest possible route that visits every city exactly once and returns to the starting point. Assume the starting point be city A. Solve the problem using Dynamic Programming approach. 4 2 3 1,2,3



14. a) What is N Queens problem? Design an algorithm to solve N Queens problem using backtracking? 4 2 4 1,2,3
- b) i) What design strategy is used in solving Hamiltonian Cycle problem? Determine if a Hamiltonian Cycle exists for the following graphs. If yes, draw the Hamiltonian path. If no, support your answer with relevant reasons. 4 3 4 1,2,3

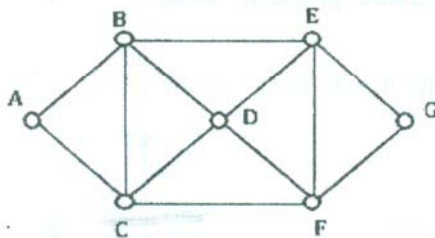


Fig. a

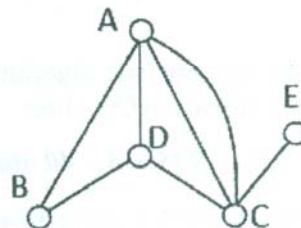


Fig. b

- ii) Design the backtracking algorithm to check if a Hamiltonian cycle exists or not.

15. a)	Write a non-deterministic algorithm for 0/1 Knapsack problem.	4	3	5	1,2,3												
b)	Prove the Clique Decision Problem is NP-Complete or not.	4	2	5	1,2,3												
16. a)	What is Little-Oh (o) Notation? If $f(n) = n^2$ and $g(n) = n^3$, Is $f(n) = o(g(n))$? Give reasons to support your answer.	4	1	1	1,2												
b)	A networking company uses a compression technique (Huffman coding) to encode the message before transmitting over the network. Suppose the message contains the following characters with their frequency, obtain an optimal solution to encode the message and compute the average length of the code. Character frequency given as shown in the below table.	4	3	2	1,2,3												
<table border="1" style="margin-left: 40px;"> <tr> <td>M1</td> <td>M2</td> <td>M3</td> <td>M4</td> <td>M5</td> <td>M6</td> </tr> <tr> <td>12</td> <td>5</td> <td>8</td> <td>14</td> <td>44</td> <td>18</td> </tr> </table>						M1	M2	M3	M4	M5	M6	12	5	8	14	44	18
M1	M2	M3	M4	M5	M6												
12	5	8	14	44	18												
17.	Answer any <i>two</i> of the following:																
a)	What is Longest common subsequence problem? Design an algorithm to find longest common subsequence problem using dynamic programming approach.	4	2	3	1,2,3												
b)	Given a 0/1 Knapsack problem with $n=5$, $(p_1,p_2,p_3,p_4,p_5)=(10,15,6,8,4)$, $(w_1,w_2,w_3,w_4,w_5)=(4,6,2,4,3)$ and $m=12$. Solve the given instance of 0/1 Knapsack problem using Least Cost Branch and Bound (LCBB) and determine the maximum profit and the items which are included in the knapsack. Also the draw the variable tuple size state space tree LCBB solution depicting the solution with Upper bounds, Cost functions at each node in the state space tree.	4	3	4	1,2,3												
c)	What is Vertex Cover problem? Prove Vertex Cover problem is NP Complete with a suitable example.	4	2	5	1,2,3												

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

i)	Blooms Taxonomy Level – 1	20%
ii)	Blooms Taxonomy Level – 2	35%
iii)	Blooms Taxonomy Level – 3 & 4	45%
