Hall Ticket Number:

Code No. : 14667 N/O

VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD

Accredited by NAAC with A++ Grade

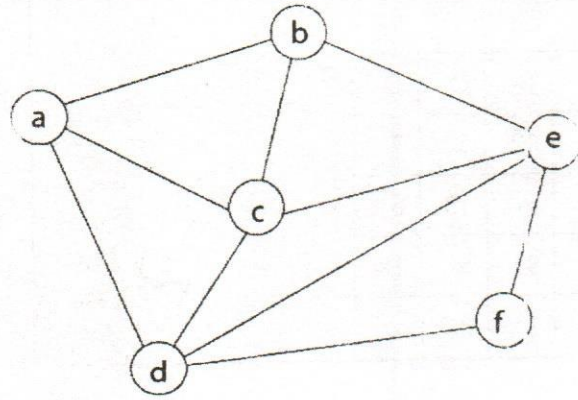
B.E. (I.T.) IV-Semester Main & Backlog Examinations, July-2023

Design and Analysis of Algorithms

Time: **3 hours** Max. Marks: **60**

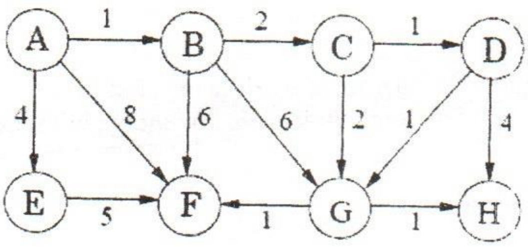
Note: Answer all questions from ***Part-A*** *and any* ***FIVE*** *from* ***Part-B***

Part-A (10 × 2 = 20 Marks)

Q. No.	Stem of the question	M	L	CO	PO
1.	Rank the following functions by decreasing order of growth: $100n^2$, $(n+1)!$, $n*2^n$, $2^{\log 2n}+20$	2	1	1	1
2.	Given a binary array arr[] of size N, which is sorted in non-increasing order, count the number of 1's in it. Examples: Input: arr[] = {1, 1, 0, 0, 0, 0, 0} Output: 2 Input: arr[] = {1, 1, 1, 1, 1, 1, 1} Output: 7 Write a algorithm which takes better time complexity than O(n).	2	4	1	2
3.	Consider the sorting algorithms Merge sort, Quick sort, Selection sort. Which of these are stable algorithms? Explain with the help of an example.	2	2	2	2
4.	Given an array F with size n. Assume the array content F[i] indicates the length of the i^{th} file and we want to merge all these files into one single file. Check whether the following algorithm gives the best solution for this problem or not? Justify your answer. **Algorithm:** Merge the files contiguously. That means select the first two files and merge them, then select the output of the previous merge and merge with the third file and keep going...	2	3	2	2
5.	Write the relax algorithm of Bellman ford.	2	1	3	1
6.	Explain what would happen if a dynamic programming algorithm is designed to solve a problem that does not have overlapping sub-problems.	2	3	3	1
7.	Does the following graph have a Hamiltonian cycle? Justify your answer.  	2	1	4	1

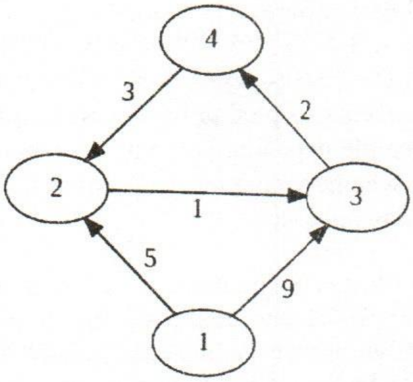
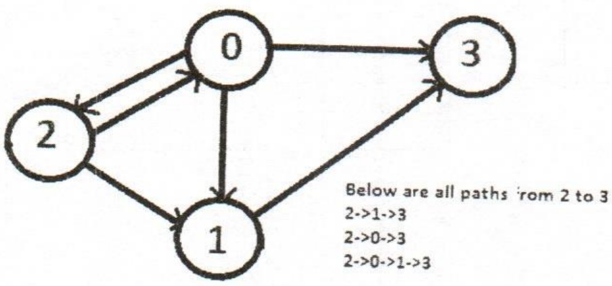
Contd... 2

8.	Compare backtracking approach with branch and bound approach for solving a problem.	2	2	4	2
9.	Write the non-deterministic algorithm for knapsack problem.	2	3	5	2
10.	Explain strategy to prove that a problem is NP-hard with the help of an example.	2	1	5	1
	Part-B (5 × 8 = 40 Marks)				
11. a)	Suppose you are choosing between the following three algorithms: a) Algorithm A solves problems by dividing them into five subproblems of half the size, recursively solving each subproblem, and then combining the solutions in linear time. b) Algorithm B solves problems of size n by recursively solving two subproblems of size n - 1 and then combining the solutions in constant time. c) Algorithm C solves problems of size n by dividing them into nine subproblems of size n/3, recursively solving each subproblem, and then combining the solutions in O(n^2) time. What are the running times of each of these algorithms (in big-O notation), and which would you choose?	4	3	1	2
b)	Define time and space complexity? Describe asymptotic notations used for describing the complexity?	4	1	1	1
12. a)	Let S = {a, b, c, d, e, f, g} be a collection of objects with benefit-weight values as follows: a: (12,4), b: (10,6), c: (8,5), d: (11,7), e: (14,3), f: (7,1) and g: (9,6). What are various strategies chosen to incorporate greediness? What is the optimal solution to the fractional knapsack problem for S assuming that knapsack can hold objects with total weight 18? What is the complexity?	4	2	2	2
b)	Apply Dijkstra's algorithm for the following digraph and find the path between nodes A and H.	4	2	2	3



13. a)	Find the shortest tour of travelling salesperson for the following instance using dynamic programming.	4	2	3	2

	A	B	C	D
A	∞	12	5	7
B	11	∞	13	6
C	4	9	∞	18
D	10	3	2	∞

b)	Write an algorithm and find the shortest path between all pairs of nodes in the following graph. 	4	2	3	2
14. a)	Given a directed graph, a source vertex 's' and a destination vertex 'd', write an algorithm to print all paths from given 's' to 'd'. For example: Consider the following directed graph. Let the s be 2 and d be 3. There are 3 different paths from 2 to 3. 	4	4	4	3
b)	Explain Branch and Bound. Give LCBB solution for the following Knapsack - instance n = 4, (PI' P2, Ps' P4) = (10, 10, 12, 18), (WI' W2, Ws' W4) = (2, 4, 6, 9) and m = 15.	4	2	4	2
15. a)	Explain in detail about classes P, NP, NP-Hard and NP-Complete with the help of an venn diagram.	4	1	5	1
b)	Prove that clique decision problem is NP-Complete with the help of 3SAT.	4	3	5	2
16. a)	Solve the following two recurrence relations: i) $T(n)= 8T(n/2)+n^3$ using substitution method ii) $T(n)=2T(n-1)+1$ using recursive tree method. Check the same with Master's Theorem.	4	2	1	2
b)	Given a sorted array arr[] with possibly duplicate elements, write a program to find indexes of the first and last occurrences of an element x in the given array with O(n) and O(logn) complexities. Example: Input : arr[] = {1, 3, 5, 5, 5, 5, 67, 123, 125}, x = 5 Output : First Occurrence = 2 Last Occurrence = 5	4	4	2	2

17. Answer any *two* of the following:

a) If we have to compute the product P=ABCD where A, B, C and D are some given matrices with appropriate dimensions: A(3 X 5), B(5 X 8) C(8 X 3), D(3 X 4), then A(B(CD)) = A((BC)D) = (A(BC))D = (AB)(CD) = ((AB)C)D. It is a fact of life that the total number of scalar products executed in the course of a chained matrix multiplication can vary significantly depending on how we parenthesize the sequence. Find the parenthesized scheme which takes optimum number of calculations using dynamic programming approach.

4	3	3	2

b) Given a 3×3 board with 8 tiles (every tile has one number from 1 to 8) and one empty space. Write an algorithm using branch and bound strategy to place the numbers on tiles to match the final configuration using the empty space. You can slide four adjacent (left, right, above, and below) tiles into the empty space.

4	4	4	2

For Example:

Initial Configuration

1		**3**
4	**2**	**5**
7	**8**	**6**

Final Configuration

1	**2**	**3**
4	**5**	**6**
7	**8**	

c) Differentiate between

i) Deterministic and Non-deterministic
ii) Optimization problem and decision problem

With the help of an example.

4	2	5	1

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

i)	Blooms Taxonomy Level – 1	20%
ii)	Blooms Taxonomy Level – 2	40%
iii)	Blooms Taxonomy Level – 3 & 4	40%

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