Q.5	i.	Differentiate between dynamic programming and greedy algorithms.	**3**	1	1	1
	ii.	Design a three stage system with device types D1, D2 and D3. The costs are $30, $15 and $20 respectively. Reliability is 0.9, 0.8 and 0.5. The total cost of the system must not be more than c=$105.	**7**	3	1,2,3	4
OR	iii.	Define the Longest Common Subsequence (LCS) problem. For the strings X="ABCBDAB" and Y="BDCAB", use dynamic programming to find the length of the LCS. Write out the DP table and explain each step.	**7**	3	1,2,3	2
Q.6		Attempt any two:				
	i.	Describe the backtracking approach for solving the N-Queens problem.	**5**	2	1,2	4
	ii.	Explain branch and bound with respect to solving the Travelling Salesman Problem.	**5**	2	1,2,3	4
	iii.	Define P, NP, NP-hard and NP-complete classes with examples.	**5**	1	1	1

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Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No.....

Faculty of Engineering
End Sem Examination Dec 2024
IT3CO34 Design & Analysis of Algorithms

Programme: B.Tech. Branch/Specialisation: IT

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

			Marks	**BL**	**PO**	**CO**	**PSO**
Q.1	i.	Which of the following is true if f(n)= n, g(n)=log(n) and h(n)=n^2? (a) f(n)= O(g(n)) (b) g(n)= O(h(n)) (c) h(n) = O(g(n)) (d) h(n)= O(f(n))	**1**	3	1	5	
	ii.	What is the average case complexity of bubble sort? (a) O(nlogn) (b) O(logn) (c) O(n) (d) O(n^2)	**1**	1	1	5	
	iii.	What is the worst case time complexity of a quick sort algorithm if array is already sorted? (a) O(N) (b) O(N log N) (c) O(N^2) (d) O(log N)	**1**	2	1	5	
	iv.	If you need to repeatedly extract the maximum element from a dynamic dataset, which data structure would be the most efficient? (a) Array (b) Linked List (c) Min-Heap (d) Max-Heap	**1**	1	1,2	1	
	v.	Which of the following algorithms are used to find the shortest path from a source node to all other nodes in a weighted graph? (a) BFS (b) Djikstra's Algorithm (c) Prims Algorithm (d) Kruskal's Algorithm	**1**	2	1,2	2	

vi.	You have five jobs with deadlines 5 for each job. If the profits are all equal, what is the best strategy for job sequencing? (a) Prioritize by earliest deadline. (b) Any sequence will work since profits are equal. (c) Prioritize by job number. (d) Sort by longest job duration first.	**1**	2	1,2,3	4
vii.	Which of the following is NOT a type of dynamic programming problem? (a) Path finding problems (b) Combinatorial optimization problems (c) Sorting algorithms (d) String matching problems	**1**	1	1	4
viii.	Which of the following is/are property/properties of a dynamic programming problem? (a) Optimal substructure (b) Overlapping subproblems (c) Greedy approach (d) Both (a) and (b)	**1**	1	1,2	2
ix.	Which of the following problems can be solved using backtracking? (a) N-Queens problem (b) Traveling Salesman Problem (c) Binary Search (d) Dijkstra's Algorithm	**1**	1	1,2	4
x.	What distinguishes branch and bound from backtracking? (a) Branch and bound uses a tree structure, while backtracking does not (b) Branch and bound employs bounds to eliminate suboptimal solutions, while backtracking does not (c) Backtracking is always slower than branch and bound (d) Backtracking guarantees an optimal solution, while branch and bound does not	**1**	1	1	2

Q.2	i.	Define the term time complexity and space complexity.	**2**	1	1,2	3
	ii.	Sort the following sequence using selection sort. 30, 12, 3, 40, 11, 9. Also show the step by step procedure.	**3**	3	1,3	1
	iii.	What are the various asymptotic notations? Explain each notation with its function, graph and an example.	**5**	1	1	1
OR	iv.	Solve the following recurrence relation: (a) T(n)=2T(n/2)+n logn (b) T(n)=2T(n/3)+n	**5**	3	1,3	2
Q.3	i.	Write the recurrence relation for binary search and analyze its time complexity.	**3**	2	1,3	2
	ii.	Write algorithm for merge sort and perform a recursive analysis of the merge sort algorithm.	**7**	1	1,3	2
OR	iii.	In the context of computational complexity, explain how Strassen's algorithm represents an improvement in matrix multiplication for large data sets. What impact did it have on the development of faster matrix multiplication algorithms?	**7**	1	1,2	5
Q.4	i.	What do you mean by minimum spanning tree? Give an examples of the methods used for finding minimum spanning tree?	**3**	2	1,3	2
	ii.	For the Fractional Knapsack Problem, given a knapsack capacity of W=50 and items with the following weights and values, calculate the maximum profit: Item 1: Weight = 10, Value = 60 Item 2: Weight = 20, Value = 100 Item 3: Weight = 30, Value = 120	**7**	3	1,2,3	4
OR	iii.	Generate optimal merge tree for the given files. Calculate its weighted external path length. Also determine the Huffman codes for the following characters and their frequencies: A: 10, B: 15, C: 30, D: 20, E: 25 Show each step of building the tree and assign the codes to each character.	**7**	3	1,2,3	4

Marking Scheme
IT3CO34 (T) Design & Analysis of Algorithms (T)

Q.1	i)	b) g(n)= O(h(n))	**1**
	ii)	d) $O(n^2)$	**1**
	iii)	c) $O(N^2)$	**1**
	iv)	d) Max-Heap	**1**
	v)	b) Djikstra's Algorithm	**1**
	vi)	b) Any sequence will work since profits are equal.	**1**
	vii)	c) Sorting algorithms	**1**
	viii)	d) Both optimal substructure and overlapping subproblems	**1**
	ix)	a) N-Queens problem	**1**
	x)	b) Branch and bound employs bounds to eliminate suboptimal solutions, while backtracking does not	**1**
Q.2	i.	1 mark for each	**2**
	ii.	3 marks for sorting	**3**
	iii.	1 mark for notation, 1 mark for graph, 1 mark for function and 2 marks for example	**5**
OR	iv.	2.5 marks for each	**5**
Q.3	i.	1 marks for recurrence relation and 2 for analysis	**3**
	ii.	5 marks for algorithm and 2 marks for analysis	**7**
OR	iii.	7 marks for complete explanation and formula's	**7**
Q.4	i.	1 mark for definition and 2 marks for examples	**3**
	ii.	7 marks for solution	**7**
OR	iii.	4 marks for tree, 1 mark for path length, 2 mark for coding	**7**
Q.5	i.	1 mark for each difference	**3**
	ii.	7 mark for solution	
OR	iii.	7 mark for solution	**7**
Q.6			
	i.	5 marks for explanation	**5**
	ii.	5 marks for explanation	**5**
	iii.	5 marks for explanation	**5**

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