19/12/24 (FN)

Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. /B.Tech / B. Arch (Full Time) - ARREAR EXAMINATIONS, NOV / DEC 2024

INFORMATION TECHNOLOGY
Semester IV
IT5402 & Design and Analysis of Algorithms
(Regulation 2019)

Time: 3 hrs | Max.Marks: 100

CO1	Articulate the process of problem solving and writing algorithms.
CO2	Understand different algorithmic design strategies.
CO3	Design and implement any problem using design techniques.
CO4	Critically analyse the complexity of the given algorithm.
CO5	Solve a problem in polynomial time or prove that to be an NP-Complete problem.

BL – Bloom's Taxonomy Levels
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A(10x2=20Marks)
(Answer all Questions)

Q.No.	Questions	Marks	CO	BL
1	Define the basic asymptotic notations.	2	CO1	L2
2	Compare the order of growth of $\log_2 n$ and $\log_e n$.	2	CO1	L3
3	Differentiate Divide and Conquer Strategy with Dynamic Programming.	2	CO2	L4
4	Define the optimal substructure property of an LCS.	2	CO2	L2
5	Define the elements of greedy strategy.	2	CO3	L2
6	Consider a system Ax = b where A can be factored as A = LU, where L is lower triangular and U is upper triangular. Write the two steps/stages to solve the system Ax = b.	2	CO3	L3
7	What is Linear Programming?	2	CO4	L2
8	Construct the dual to the primal problem Maximize $Z = 3X_1 + 5X_2$ Subject to $6X_1 + 6X_2 \leq 55$ $8X_1 + 2X_2 \leq 30$ $5X_1 - 3X_2 \leq 18$ $X_2 \leq 28$ Where $X_1 \geq 0, X_2 \geq 0.$	2	CO4	L3
9	What is meant by polynomial time algorithms? List two examples that are not solved in polynomial time.	2	CO5	L2
10	Define NP completeness.	2	CO5	L1

PART- B(5x 13=65Marks)
(Restrict to a maximum of 2 subdivisions)

Q.No.	Questions	Marks	CO	BL
11 (a)(i)	Write an algorithm to determine the number of times each element has occurred in an array. Analyze the algorithm and estimate the running time associated with cost.	8	CO1	L4
(ii)	Solve the following recurrence relation using Master's Theorem: $T(n) = 7T(n/3) + n^2$	5	CO1	L3
	OR			

11 (b)(i)	Write the recurrence relation of Factorial function and determine its complexity.	8	CO1	L4
(ii)	Find the order of growth for the following recurrence: $T(n) = 4T(n/2) + n^2$, $T(1) = 1$.	5	CO1	L3
12 (a)(i)	Find an optimal parenthesization of a matrix-chain product whose sequence of dimensions is (5, 3, 2, 4, 6). A1 = 5 * 3 A2 = 3 * 2 A3 = 2 * 4 A4 = 4 * 6	8	CO2	L3
(ii)	Simulate the divide and conquer strategy of mergesort for n = 32 elements using recursion tree. (Draw the tree and justify)	5	CO2	L3
	OR			
12 (b)(i)	Write the algorithm of quicksort using Partitioning method and describe the best case, worst case and average case analysis.	8	CO2	L3
(ii)	Determine an LCS of x= <A,B,C,B,D,A,B> AND y = <B,D,C,A,B,A>.	5	CO2	L3
13 (a) (i)	Determine the Huffman Encoding Tree for { A: 10 B: 10 C: 25 D: 15 E: 30 F: 21}	8	CO3	L3
(ii)	Simulate the activity selection problem for the following set of activities. A 1 2 3 4 5 6 7 8 9 S 1 3 0 5 3 4 5 3 6 F 4 5 6 7 9 9 11 13 14	5	CO3	L3
	OR			
13 (b)	i. Find the L, U and P values for the following and solve it further to determine the values of the variables x_1, x_2 and x_3. $x_1 + x_2 + x_3 = 1$ $3x_1 + x_2 - 3x_3 = 5$ $x_1 - 2x_2 - 5x_3 = 10$ ii. Write down the algorithm involved in it.	8 + 5	CO3	L3
14 (a) (i)	What is the standard form of linear programming problem? Convert the given linear program to standard form. **minimize** $Z = 2x_2 + 5x_3$ subject to $x_1 + x_2 \geq 2$ $2x_1 + x_2 + 6x_3 \leq 6$ $x_1 - x_2 + 3x_3 = 4$ $x_1, x_2, x_3 \geq 0$	8	CO4	L3

(ii)	Find an initial basic feasible solution for the linear program in standard form obtained in 14 a (i).	5	CO4	L3
	OR			
14 (b)	Solve the linear program using SIMPLEX. maximize x_1+x_2 subject to: $4x_1 - x_2 \leq 8$ $2x_1 + x_2 \leq 10$ $5x_1 - 2x_2 \geq -2$ $x_1, x_2 \geq 0$	13	CO4	L3
15 (a)	Prove that Circuit satisfiability is an NP complete problem.	13	CO5	L4
	OR			
15 (b)	Prove that the vertex-cover problem is NP-complete and give a polynomial-time approximation algorithm for the same.	13	CO5	L4

PART- C(1x 15=15Marks)
(Q.No.16 is compulsory)

Q.No.	Questions	Marks	CO	BL
16.(i)	Given two strings **s1 = PARK** and **s2 = SPAKE** of lengths **m** and **n** respectively. a. Find the minimum number of edits (operations) to convert '**s1**' into '**s2**'. b. Write the algorithm to solve the problem.	6+4	CO4	L5
(ii)	Consider a farmer who cultivates only two kinds of fruit trees – A and B. Both the trees require Water and Fertilizer only. To grow each tree of A and B, the following quantities are required: • Each unit of A requires 1 unit of Water and 3 units of Fertilizer • Each unit of B requires 1 unit of Water and 2 units of Fertilizer The farmer has a total of 5 units of Water and 12 units of Fertilizer. On each yield, the farmer makes a profit of • Rs 6 per unit A grown • Rs 5 per unit B grown. Now, the farmer wishes to maximize his profit. How many units of A and B should he cultivate respectively? Formulate the above requirements as a linear programming problem.	5	CO3	L5