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RV COLLEGE OF NGINEERING®

(An Autonomous Institution Affiliated to VTU)

IV Semester B. E. Examinations Oct-2023

Common to CS / IS / AIML

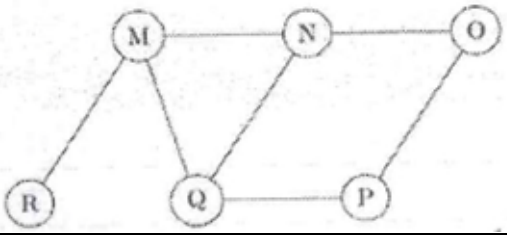
DESIGN AND ANALYSIS OF ALGORITHMS

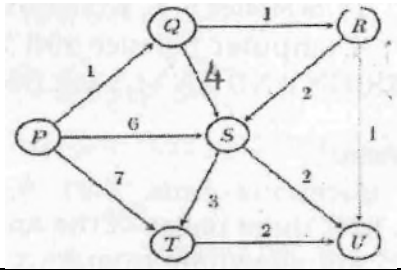
Time: 03 Hours ***Maximum Marks: 100***

Instructions to candidates:

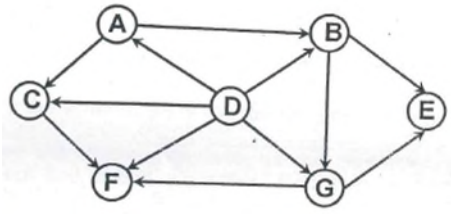
1. Answer all questions from Part A. Part A questions should be answered in first three pages of the answer book only.
2. Answer FIVE full questions from Part B. In Part B question number 2 is compulsory. Answer any one full question from 3 and 4, 5 and 6, 7 and 8, 9 and 10.

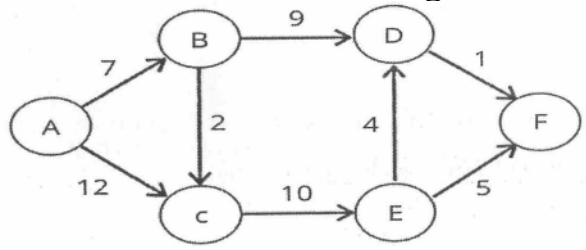
PART-A

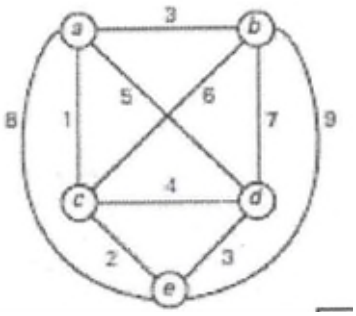
1	1.1	What is the recursion relation of the worst case in quicksort?	01
	1.2	Name the algorithm design technique where an algorithm that relies on pre-sorting its element list.	01
	1.3	$Algorithm\ F(n)$ $//Computes\ the\ nth\ Fibonacci\ number$ $If\ n <= 1\ return\ n$ $else\ return\ F(n-1) + F(n-2)$ For the above algorithm, write a recurrence relation for the number of additions performed.	01
	1.4	State the basic operation of Sieve of Eratosthenes algorithm.	01
	1.5	What is the lower bound for comparison based sorting algorithm?	01
	1.6	Name the class of decision problems that can be solved by non deterministic polynomial algorithms.	01
	1.7	What is the sorting algorithm termed as, if relative order of occurrence of non-district elements is maintained?	01
	1.8	What is the time complexity of the algorithm in which we don't sort the edges based on the weights to find the minimum spanning tree? (Assuming that the priority queue is implemented as a min-heap)	01
	1.9	Solve the following recurrence using Master theorem: $T(n) = 27T(n/3) + 4000n^2$	01
	1.10	What is the minimum number of comparisons required in an array to find the maximum and minimum of 202 integers?	01
	1.11	Order the following functions by growth rate: $n, n^{1.5}, n^2, nlogn, nloglogn, nlog^2n, nlog(n^2), 2/n, 2^{n/2}, 37, n^2logn, n^3$. Indicate which functions grow at the same rate.	02
	1.12	Write the order of elements after performing 3 iterations of selection sort on the given set of elements : 10 40 −5 20 −10 20 25 30	02
	1.13	Perform BFS traversal on the graph given below, Start the traversal from vertex Q. (follow Lexicographically order)  	02

	1.14	Calculate the number of character comparisons made by the Hospool's algorithm for the pattern $AAAAB$ to be searched in the text $1000\ A's$.	02
	1.15	Suppose we run Dijkstra's single shortest path algorithm on the following edge-weighted directed graph with vertex P as the source. What is the order of relaxation of vertices? 	02

PART-B

2	a	i) Design a recursive algorithm for computing 2^n for any nonnegative integer n that is based on the formula: $2^n = 2^{n-1} + 2^{n-1}$ ii) set up a recurrence relation for the number of additions made by the algorithm and solve it. iii) Draw a tree of recursive calls for this algorithm and count the number of calls made by the algorithm.	06
	b	Discuss the general plan to find the efficiency of a recursive algorithm. Apply the same to find the efficiency of solving tower of Hanoi problem.	06
	c	Prove that if $t1(n) \in \Omega(g1(n))$ and $t2(n) \in \Omega(g2(n))$, then $t1(n) + t2(n) \in \Omega(\max\{g1(n), g2(n)\})$.	04
3	a	Design an algorithm used to perform partition used in Quiksort. Discuss with recurrence the efficiency of Quiksort worst case.	06
	b	Write an algorithm to perform DFS traversal. Apply DFS to find the topological order for the graph given below. Consider A as the initial vertex. 	06
	c	Design an algorithm to compute the value of the smallest element in a given array using decrease and conquer. Comment on its time complexity.	04
		OR	
4	a	Write the insertion sort algorithm. Trace insertion sort on the following input and count the number of comparisons done: $10\ 5\ 15\ -10\ -20\ 25\ -5\ 20$.	06
	b	Write the Johnson Trotter algorithm for generating the permutation. Apply the same for an input size of 4.	06
	c	Design an algorithm to find the position of maximum element in an array using Divide and conquer. Comment on its time complexity.	04

5	a	Discuss the procedure used in Boyers Moor algorithm and apply the same to search the given pattern in the text. Text:$BESS\_KNEW\_ABOUT\_BAOBAB$ Pattern:$BAOBAB$	06
	b	Write a sorting algorithm using Distribution counting. Apply the same to sort for the following elements : 5 7 5 6 6 7 5 6	06
	c	Discuss Presort Element Uniqueness algorithm with its time complexity.	04
		OR	
6	a	Design an algorithm to construct a max heap using bottom up approach. Trace by applying the same to sort the following elements / characters : $A\ L\ G\ O\ R\ I\ T\ H\ M\ S$	06
	b	With Pseudocode, discuss Horspool's String matching algorithm and analyse its time complexity.	06
	c	Design a presorting based algorithm for finding the median and determine its efficiency class.	04
7	a	Solve the given instance of the 0/1 knapsack problem using dynamic programming. $W = 6$ wi 3 2 1 4 5 vi 25 20 15 40 50	06
	b	Define Spanning tree. Discuss with efficiency the Prim's algorithm to construct minimum spanning tree.	06
	c	Construct a Huffman tree for the following data: $Character$ | A | B | C | D | $-$ $Probability$ | 0.4 | 0.1 | 0.2 | 0.15 | 0.15 i) encode the text $ABACABAD$ ii) Find the compression ratio.	04
		OR	
8	a	Explain Dijkstra's shortest path algorithm. Using the same find the shortest path from vertex A to the remaining vertices.  	06
	b	Write the algorithm for computing Binomial coefficient $C(n,k)$ using dynamic programming approach. Draw the Binomial coefficient table for $C(8,3)$	06
	c	Write an algorithm to solve 0/1 knapsack problem using memory functions.	04
9	a	Write an algorithm to solve the subset-sum problem using backtracking. Apply the same to solve the following instance: $S = \{1,3,2,4,5\}$ and $d = 11$.	06
	b	Solve the following instance of the travelling salesman problem by the branch and bound algorithm. Find the number of promising and non promising nodes. Use Vertex 'c' as starting node. (Note: a comes before e).	



06

c Draw the decision tree for insertion sort for three elements. 04

OR

10 a With the help of state space tree, solve the 4 queens problems using Backtracking approach. 06

b Solve the following instance of the assignment problem by the branch and bound algorithm:

	$J1$	$J2$	$J3$	$J4$	$J5$
$P1$	9	11	14	11	7
$P2$	6	15	13	13	10
$P3$	12	13	6	8	8
$P4$	11	9	10	12	9
$P5$	7	12	14	10	17

06

c Define P, NP, NP complete and NP hard problem and establish their relationship with a proper diagram. 04