LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **MATHEMATICS**

FIRST SEMESTER – **APRIL 2023**

PMT1MC04 – DATA STRUCTURES AND ALGORITHMS USING PYTHON

Date: 04-05-2023 Dept. No. Max. : 100 Marks

Time: 09:00 AM - 12:00 NOON

SECTION A			
Answer ALL the Questions			
1.	**Answer the following** **(5 x 1 = 5)**		
a)	What are Python modules?	K1	CO1
b)	Specify an advantage of linked list over arrays?	K1	CO1
c)	How will you identify an efficient algorithm?	K1	CO1
d)	Write the principle of optimality.	K1	CO1
e)	List any two decision problems which are NP-complete.	K1	CO1
2.	**Choose the correct answer** **(5 x 1 = 5)**		
a)	How many numbers will be printed by the following program segment? i = 10 **while** True: $i = i - 1$ **if** i < = 6: **break** **else:** **print** (i) (i) 1 (ii) 2 (iii) 3 (iv) 4	K2	CO1
b)	Consider a circular queue q implementation whose size is 8 and the front and rear pointers are initialized to point at $q[2]$. In which position will the sixth element be added? (i) $q[0]$ (ii) $q[1]$ (iii) $q[6]$ (iv) $q[7]$.	K2	CO1
c)	The average time complexity of Algorithm Select1 is (i) $O(n)$ (ii) $O(logn)$ (iii) $O(nlogn)$ (iv) $O(n^2)$	K2	CO1
d)	The minimum mean retrieval time of 3 programs with lengths 2, 3 and 5 for an optimal storage on tapes problem is (i) 5 (ii) 10 (iii) 15 (iv) 18	K2	CO1
		K2	CO1

e)	The following is the list of nodes of a tree T given in sequential order: A | B | C | D | -- | E Which of the following is the preorder traversal of the tree? (i) ABCDE (ii) DBACE (iii) ABDCE (iv) DBAEC		

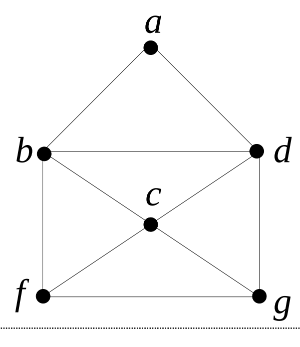
SECTION B

Answer any THREE questions: **(3 x 10 = 30)**

3.	Develop a Python code to illustrate loop structures.	K3	CO2
4.	Explain how insertion and deletion operations can be performed on a stack and write their implementations in Python.	K3	CO2
5.	What are asymptotic notations? Determine the asymptotic bounds for the recurrence relation given by $T(n) = 2T\left(\frac{n}{2}\right) + n^3$.	K3	CO2
6.	Write Prim's algorithm. How do you apply the algorithm to construct a minimum spanning tree of a graph?	K3	CO2
7.	What is nondeterministic algorithm? Develop the nondeterministic algorithm for a problem.	K3	CO2

SECTION C

Answer any TWO questions: **(2 x 12.5 = 25)**

8.	Formulate a Python code to implement a queue. What would be the length of the queue after performing the following operations: enqueue(10), enqueue(20), dequeue( ), enqueue(30), enqueue(40), dequeue( ), enqueue(50).	K4	CO3
9.	Develop a search algorithm which uses divide and conquer strategy. Validate the algorithm on the array $A(1 : 8)$ = (5, 15, 25, 30, 45, 50, 60, 68) to search the elements 22 and 60.	K4	CO3
10.	Design an algorithm to solve the longest common subsequence problem using dynamic programming. Use it to find the longest subsequence in the strings 'ABCBEADADA' and 'BCEADCDAD'.	K4	CO3
11.	Present breadth-first search algorithm and use it to construct the spanning tree of the following graph starting with the vertex b.  	K4	CO3

SECTION D

Answer any ONE question: **(1 x 15 = 15)**

12.	Design a Python code to create and search an element of a binary search tree. Construct a binary search tree with the inputs 60, 95, 72, 55, 40 and 130 using	K5	CO4

	the Python code.		
13.	State an algorithm which generates a two-way merge tree for n files with weight values (q_1, q_2 … q_n), $n \geq 1$ and prove that it generates an optimal two-way merge tree. Simulate the algorithm on 7 files whose lengths are 72, 52, 12, 2, 42 and 62.	K5	CO4
SECTION E			
Answer any ONE question:			**(1 x 20 = 20)**
14.	Design an algorithm to sort a set of numbers using the heap data structure and simulate it on A[1 : 7] = (18, 8, 78, 28, 38, 48, 58). Describe how heap data structure is used to implement priority queues.	K6	CO5
15.	Explain how backtracking strategy is used to solve the sum of subsets problem and create an algorithm to solve it. Run your algorithm when w = {3, 5, 7, 10, 15} and m = 25. Also, draw the portion of state space tree generated by SumOfSub.	K6	CO5

############