7^{th} semester IMCA Examination- 2019

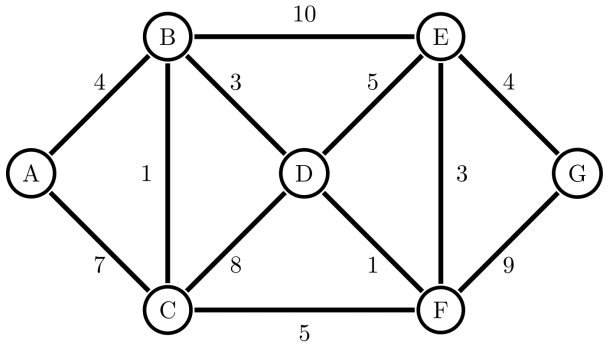
7.2 Analysis and Design of Algorithm

Full Marks – 70

Time – 3 Hours

Answer All Questions

1	a)	Write the binary search algorithm and its worst case performance analysis.	[4]
	b)	Sort the following elements using merge sort. 23, 78, 12, 43, 21, 80, 62, 48, 66.	[3]
	c)	Solve the following recurrences i) $T(n) = T\left(\frac{n}{2}\right) + 1$ using iteration method ii) $T(n) = T\left(\frac{9n}{10}\right) + n + 8$ using master method	[7]
	d)	iii) Write the recurrence for the time complexity of binary search. OR What is a recurrence relation? Solve the following recurrences using recursion tree method.	[7]
	e)	i) $T(n) = 3T\left(\frac{n}{4}\right) + n$	[3]

	f)	ii) $T(n) = 2T\left(\frac{n}{2}\right) + n$ Arrange the following functions by the asymptotic order of growth with justifications. $n!, 2^n, \log(n!), n^{\log n}, n^3$ Prove the followings i) $\sum_{i=1}^{n} i = O(n^2)$ ii) $3n^3 + 5 = w(n)$	[4]
2		Explain the Quick Sort algorithm using divide & conquer approach and find its worst case and best case time complexity. Determine the partitioning position of the given array of elements using Quick sort. 23, 78, 12, 43, 21, 80, 62, 48, 66. OR Explain the heap sort algorithm along with the building of heap to sort an array of elements with its time complexity. Sort the given list of elements using heap sort. 18, 23, 78, 12, 43, 21, 80, 62, 48, 66.	[14] [14]
3	a)	What is hashing technique? Explain the different hash functions with the collision resolution techniques. Insert the following elements into a hash table of size 10 with hash function as *H(X) = X mod table size* using linear and quadratic probing. 18, 23, 78, 12, 43, 22, 80, 62, 48, 62.	[7]
	b)	What is 2-3-4 tree? Write the procedure to insert an element into a 2-3-4 tree. Construct a 2-3-4 tree with the given list of elements: 18, 23, 78, 12, 43, 21, 80, 62, 48, 66.	[7]
	c)	OR	
	d)	Describe the concept of Amortized Analysis in brief. What is Red Black tree? Construct a red black tree with the following elements. 18, 23, 78, 12, 43, 22, 80, 62, 48, 62.	[7] [7]
4	a)	Determine the shortest path from the given source vertex A to all other vertices in the graph given using Dijkstra's algorithm.  	[7]
	b)	Let A(3 X 4), B(4 X 2), C(2 X 6) and D(6 X 3) be the chain of matrices to be multiplied.	[7]

	c)	Determine the minimum number of scalar multiplications and the optimal way of parenthesizing the chain of matrices. OR	[7]
	d)	What is MST problem? Write the Prim's algorithm to determine the Minimum Spanning tree and use it in the graph given in Q. 4- (a) to find out the MST. What is greedy choice property? Write the greedy algorithm to solve the fractional knapsack problem. Find an optimal solution to the knapsack instance n = 7, m = 15, (p1, p2, p3, p4, p5, p6, p7) = (10, 5, 15, 7, 6, 18, 3), and (w1, w2, w3, w4, w5, w6, w7) = (2, 3, 5, 7, 1, 4, 1) using greedy technique.	[7]
5	a)	What is an approximation algorithm? Explain the approximation algorithm to solve vertex cover problem with an example.	[7]
	b)	Describe the followings. i) Class P, NP and NP-Complete problems ii) Polynomial reduction OR	[7]
	c)	Write the implicit and explicit constraints of N-queen problem. Explain the algorithm to solve 4-Queen problem using backtracking approach.	[7]
	d)	What is Longest Common Subsequence problem? Let X="ABDBADBD" and Y="BABDAB" be the two sequences. Determine the Longest Common Subsequence of X and Y using Dynamic programming approach.	[7]