MCA 5th Semester-2021
Analysis and Design of Algorithm, paper-5.4

Answer all questions

Q1 (a) Discuss on various asymptotic notations used to express the running time of an algorithm. (7)
(b) Solve the recurrence relations:$(i)T(n) = 3T(n/4)+O(n^2)$.$(ii)T(n) = \sqrt{n}T(\sqrt{n})+ n$. (7)

OR

(c) Prove that for $i \geq 0$, the $(i+2)^{th}$ Fibonacci number satisfies$F_{i+2} \geq \phi_i$. (7)
(d) Describe an $\Theta(nlogn)$-time algorithm that, given a set S of n integers and another integer x, determines whether or not there exist two elements in S whose sum is exactly x . (7)

2.(a) Sort the numbers 12, 4, 23, 7, 8, 21, 5, 22, 3,14 using heap sort. (7)
(b) Show that the running time of Build-Max-Heap () is $O(n)$. (7)

OR

(c) Sort the numbers 1, 14, 33, 7, 18, 20, 5, 12, 10 using quick sort (7)
(d) Discuss the algorithms for Extract-min and Decrease-Key operations of min-priority queue and find their time complexities. (7)

3.. (a) Insert the keys: 12, 23, 11, 35, 20, 34, 66, 54, 102, and 88 into an empty 2-3-4 tree. (7)
(b) Using the longest common sequence algorithm, describe the various steps to find the LCS of the following two sequences: $X = \{A, B, B, C, D, B, A\}$ $Y = \{B, D, C, A, B, A\}$. (7)

OR

(c)Using backtracking find the solution of the following sum of the subset problem: Given a set $S = \{15, 12, 50, 6, 4, 1\}$ and a number $t = 19$. Find the elements of S whose sum is t. (7)
(d) Discuss the difference between dynamic programming and greedy algorithm . Obtain the Optimal Huffman prefix code for the (alphabet : frequency) pairs: $a : 2, b : 5, c : 4, d : 8, e : 7, f : 20, g : 22$ of a text file. (7)

4.(a). For the sets $A = \{a, b, c, d, e\}$ and $B = \{1, 67, 12\}$ find their union by

linked list representation of sets and then union by rank and path compression heuristics. (7)
(b) For the following weighted graph, suppose the (edge :cost) pairs are : $(a,b) : 12, (a,i) : 13, (b,i) : 8, (b,c) : 17, (i,d) : 3, (i,g) : 16, (i,e) : 11, (d,e) : 2, (c,f) : 4, (c,g) : 7, (c,e) : 2, (e,f) : 3, (f,h) : 4, (e,h) : 1$ Then using Prims algorithm find the maximum spanning tree of the graph taking a as the root of tree. (7)

OR

(c) Modify BFS algorithm to find the height of the spanning tree (4)
(d) Given a directed graph G with directed edges :
$(y,z), (y,x), (z,x), (w,x), (w,z), (z,s), (v,z), (v,w), (v,s), (s,t), (u,t), (u,v), (u,v)$.
For G, find DFS spanning tree/forest, obtain the topological sort and classify the edges (10)

5.(a) Discuss NP-complete problem, polynomial reduce-ability, complexity class P, NP with examples. (7)
(b) Show that if $L_1 \leq_p L_2$ and $L_2 \leq_p L_3$, then $L_1 \leq_p L_3$ (7)

OR

(c)) Show that $CLIQUE$ problem is NP-complete. (14)