CSE 2631: ALGORITHM DESIGN 1

Assignment 1:

Submission due date: 12/11/2024

- Assignment scores/markings depend on neatness and clarity.
- Write your answers with enough detail about your approach and concepts used, so that the grader will be able to understand it easily. You should ALWAYS prove the correctness of your algorithms either directly or by referring to a proof in the book.
- The marking would be out of 100
- You are allowed to use only those concepts which are covered in the lecture class till date.
- Plagiarized assignments will be given a zero mark.

CO 1: to apply **knowledge of computing and mathematics.**

CO2: to understand various types and aspects of basic data structures (array, linked list, stack, queue, binary tree) and **advanced data structures like priority queue (implementation using heap)**.

CO3: to explain the major **graph algorithms** and their analyses. Employ graphs to model engineering problems, when appropriate.

Sl. No.	Questions	PO	level
1.	Solve all the Exercises Q1, Q2, Q3, Q4, Q5 of the chapter-2 (Basics of Algorithm Analysis) text book [**Algorithm Design by Jon Kleinberg and Eva Tardos, Pearson Publication**]. Page No: [67-68]	PO2, PO3	L1, L4
2.	Let f and g be two functions that take non-negative values and suppose that $f = O(g)$. Show that $g = \Omega(f)$.	PO1, PO2	L1, L4
3.	Solve all the Exercises Q1, Q2, Q3, Q5, Q6 of the chapter-3 (Graphs) text book [**Algorithm Design by Jon Kleinberg and Eva Tardos, Pearson Publication**]. Page No: [107-108]	PO2, PO3	L5
4.	What are the minimum and maximum numbers of elements in a heap of height h? Is the array with values <23, 12, 14, 6, 13, 10, 1, 5, 7, 9> a max-heap? If not, build the max-heap.	PO2, PO3	L3,L4
5.	Illustrate the operation of MAX-HEAPIFY (A, 3) on the array A = [27, 17, 3, 16, 13, 10, 1, 5, 7, 12, 4, 8, 9, 0].	PO2, PO3	L1,L4
6.	Write pseudo-code for the procedures HEAP-MINIMUM, HEAP-EXTRACT-MIN, HEAP-DECREASE-KEY, and MIN-HEAP-INSERT that implement a min-priority Queue with a min-heap.	PO2, PO3	L5
7.	Illustrate the operation of MIN-HEAP-INSERT(A, 10) on the heap A =[15, 13, 9, 5, 12, 8, 7, 4, 0, 6, 2, 1].	PO2, PO3	L3,L4
8.	Prove that $lg\ n = O(\sqrt{n})$, however $\sqrt{n} \neq O(lg\ n)$.	PO1, PO2	L1,L4

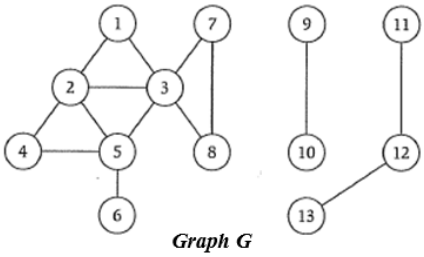
9.	**function(int *n*)**
	{ if(*n* = =1)
	return 1;
	else
	function(*n*/3); function(*n*/3); function(*n*/3);
	for(*i* = 1; *i* <= *n*; *i*++)
	x = *x* + 1;
		PO1, PO2	L5

	} Find the time and space complexity of the given algorithm.		

10.	**void function(int *n*){**
	Temp = 1;
	Repeat
	for *i* =1 to n
	temp = *temp* + 1
	n=*n*/2;
	Until *n* <= 1
	}
	Find the time and space complexity of the given algorithm.
		PO1, PO2	L1,L4

11.	**Solve the following recurrence using any of the suitable methods. If no solution is possible, justify using proper reasoning.** a. $T(n) = \begin{cases} 1 & if\ n = 2 \\ 1 & if\ n = 4 \\ T\left(\frac{n}{2}\right) + 2T\left(\frac{n}{4}\right) + \theta(n^2) & if\ n > 4 \end{cases}$ Where *n* is assumed to be a power of 2 b. $T(n) = T\left(\frac{n}{5}\right) + T\left(\frac{4n}{5}\right) + \theta(n)$ c. $T(n) = 3T\left(n/2\right) + cn^2$ d. $T(n) = 4T\left(n/2\right) + cn^2$ e. $T(n) = 3T\left(n/4\right) + nlogn$ f. $T(n) = 3T\left(n/3\right) + \sqrt{n}$ g. $T(n) = \sqrt{n}T\left(\sqrt{n}\right) + \log n$	PO1, PO2	L5
12.	The following pseudocode performs linear search on an array of size *n* to find the presence of an element *el*. Linear_Search(A, n, el) 1. for *i* = 1 to *n* do 2. If *A*[*i*] = *el* then 3. return *i* 4. return *NIL* Write the recursive version of the Linear_Search algorithm, formulate the recurrence relation for its time complexity function and compare the time and space complexities with the iterative version.	PO1, PO2	L5

13.	**int function(int *n*){**
	if(*n* <= 2)
	return 1;
	else
	return(function(floor(sqrt(*n*))) + 1);
	}
	Find the time and space complexity of the given algorithm.
		PO1, PO2	L5

14.	Draw the BFS-tree and DFS-tree of the following given graph G. In the both cases consider node 3 as a root node.  ***Graph G***	PO2, PO3	L5