221-Assignment-01 (40 marks)

1. Time Complexity

1 a. **Find** the time-complexity of the following task in terms of number of students. **03**
CO2

You are given a student attendance sheet. Each student has a unique integer ID. You have to count the number of students having an even number as ID. The list is sorted but the IDs are not necessarily consecutive. So you check each ID one by one.

b. **Write** the asymptotic time complexity of the following code snippet. Show your works/reasoning. **02**
CO2

```
1. for i in range (1,n)
2.     j= 1
3.     while j < i*i
4.         j= j+1
```

c. **Express** the following running time $T(n)$ with an asymptotic bound. **05**
CO2

$$T(n) = 8T(\frac{n}{4}) + n\sqrt{n}$$

Any method is acceptable as long as you show calculations.

2. Sorting

2. Renowned Progressive Rock band 'Porcupine Tree' released an album called 'Closure/Continuation' after about 13 years. Now as a Progressive Rock Music fan you are going to listen to the tracks of the album but in the order of their Youtube views (highest one at first, lowest one at last) instead of the order of the album tracklist.

You have chosen an Algorithm to order them as per your preference. If multiple tracks have the same views, you are going to listen to any of them the Algorithm puts first in the list after ordering. This algorithm also solves your concern about the issues regarding space that your device is facing. Porcupine Tree made the fans wait for 13 years for a new album and so you think you have the patience to wait as much time as the Algorithm may take to order the tracks.

The following table contains the list of the tracks and their Youtube views (in thousand) :

Track	Harridan	Of The New Day	Rats Return	Dignity	Herd Culling	Walk the Plank	Chimera's Wreck	Population Three
Views	15	8	11	112	33	39	88	41

a. CO2 **Specify** the name of the algorithm you have chosen and **simulate** the Algorithm to order the tracks of the album as per your preference. Show your workings in detail. **7**

b. CO5 Suppose you want to run the algorithm again on the ordered list. **Determine** the run-time complexity of the algorithm in this scenario. **3**

3. Divide and conquer Algorithm

4

Suppose the company, "Sparkling Ideas," has been new in the market for the past few years and you work as a financial analyst hired for this company.

You have been provided a list of the company's monthly incomes over the last year. However, the incomes are mixed with positive and negative figures, which indicates the company has faced some difficulties during certain months. The company's CFO has a special skill to identify the trend in the company's income details, which helps her make informed decisions. She believes that there is a particular set of consecutive months where the company earns the most, and she wants you to find out which one(s) it is.

Your task is to find the maximum earnings from the given monthly incomes and determine in which part of the year the company earned the most.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7	-15	9	-4	12	-8	3	-11	16	-2	6	-10

The figures are in millions of USD.

CO4 **07**

CO4

a) Try to think of an efficient algorithm to solve this problem and provide the result in terms of the starting and ending months, along with the corresponding total income. **Show** a simulation of your algorithm. **03**

b) **Calculate** the time complexity of your algorithm. Show proper mathematical logic.

4. Graph

4 **CO1** The cities in Italy are connected in such a way that their adjacency list representation looks as follows-
Rome: Milan, Venice, Florence
Milan: Rome, Florence, Bologna, Venice
Florence: Milan, Naples, Rome, Bologna, Venice
Venice: Rome, Milan, Florence
Naples: Florence, Bologna, Genoa
Turin: Genoa
Bologna: Naples, Genoa, Milan, Florence
Genoa: Turin, Bologna, Naples
Palermo:Catania, Syracuse
Catania: Palermo, Syracuse
Syracuse: Catania, Palermo

Suppose Rome suddenly gets affected with covid-19. The rest of the cities are non-affected. You are asked to find out the time steps the covid virus will take to affect all the non-affected cities if it takes one time step to travel from one city to another. So, one affected city will affect all of its neighbors in one time step.

a) **Draw** the graph and create the adjacency matrix for the graph. **04**
b) **Mention** the name of the graph traversal algorithm you think is suitable for solving the problem. **01**
c) **Simulate** the suitable algorithm to find the time steps needed for each non affected city to be affected. Choose the smallest (in alphabetical order) vertex when there is a choice. **05**