Air University

(Final-Term Examination: Fall 2022)

Subject:	**Data Structures and Algorithms Lab**	Total Marks:	**100**
Course Code:	**CS-214**	Date:	**28-12-2022**
Class:	**BS-CYS**	Time:	**11:30 PM – 02:30 PM**
Semester:	**III**	Duration:	**3 Hours**
Section:	**A**	FM Name:	**Abdul Wahid**

HoD Signatures:_____ FM Signatures:_____

Note:

- **All questions must be attempted.**
- **This examination carries 20% weight towards the final grade.**
- **Submit all codes on GCR in zipped folder with proper question number as file name.**
- **Plagiarized & copied code lead to 0 marks in whole exam.**

Q. No. 1 (CLO 1)	**25 Marks**

In practical life, the employees get salaries and pay taxes honestly. Sometimes, the process of drawing salaries and payment of taxes may lead to some interesting situation. Suppose, a person draws salary of Rs. 10,000 per month. A certain percentage of tax is charged on that amount, which is deducted every month. But if the salary of the person is more than Rs. 10,000 per month, then the tax rate is different. Similarly if a person is getting Rs. 20,000 per month, he/she would be charged more under a different tax rate slab. The interesting situation develops if there is an anomaly in the tax rates i.e. a person who is getting higher salary takes home lesser money as compared to the other person with less gross salary.

To further elaborate it, we suppose that there is company 'C' where 100 or less than 100 persons are employed. The salaries of the employees and their tax rates are known to us. We are required to list those unlucky persons, who are getting lesser take-home salary (net salary) than their colleagues with less gross salaries but lower tax rates.

Given tax brackets and given employees gross salaries, determine those employees who actually get less take-home salary than others with lower initial income.

Suppose the tax deduction law states that

- No tax will be deducted for persons with salaries ranging from Rs. 0 to Rs. 5,000 per month or in other words tax deduction rate is 0%.
- 5% tax deduction will be made from the persons with salaries ranging from Rs. 5,001 to Rs. 10,000 per month.
- For persons with salaries ranging from Rs. 10,001 to Rs. 20,000, a 10% tax deduction rate would be employed.
- For persons with salaries ranging from Rs. 20,001 and higher, 15% tax deduction would be made

Write a C++ code of above mentioned scenario using double dimensional arrays

Expected Output:

```
Please enter the total number of employees in your company: 5

 Please enter the gross salary for employee number: 0 : 10000

 Please enter the gross salary for employee number: 1 : 5001

 Please enter the gross salary for employee number: 2 : 10001

 Please enter the gross salary for employee number: 3 : 20000

 Please enter the gross salary for employee number: 4 : 30000

 Calculate the net salaries...

Locating the unlucky employees...

Printing the unlucky employees...

Employee No: 2


Displaying original salaries after deductions
        10000   9500
        5001    4750.95
        10001   9000.9
        20000   18000
        30000   25500
```

Q. No. 2 (CLO 2)	**25 Marks**

Consider the following problem:

- Consider there are 10 persons. They would like to choose a leader.
- The way they decide is that all 10 sit in a circle.
- They start a count with person 1 and go in clockwise direction and skip 3. Person 4 reached is eliminated.
- The count starts with the fifth and the next person to go is the fourth in count.
- Eventually, a single person remains.

Implement above mentioned problem using circular linked list.

Note: Implement only those functions which are necessary to solve this problem.

Q. No. 3 (CLO 3)	25 Marks

Write a C++ program to implement binary search tree (BST). Your program should accept a list of numbers from the user (minimum 5) and then build a binary search tree from those numbers. Implement following functions:

- Serach function: Number is found or not
- leavesCount: Returns number of leaves in binary tree
- inorder: Print the contents of tree using inorder traversal
- **Note: Define three files: bst.h, bst.cpp, main.cpp to solve this problem**

Q. No. 4 (CLO 3)	25 Marks

In this problem, you need to implement Merge sort algorithm. You need to perform following tasks:

- Generate 1000 random numbers using srand (defined in cstdlib) in between 0-1000
- You can set any seed for random number generation
- Apply Merge sort algorithm on this these numbers.
- After sorting you need to write sorted numbers in simple .txt file.
- Note: **Upload code & this sorted txt file on GCR**

Help:

Random number generation in C++

```cpp
#include<iostream>
#include<cstdlib>
using namespace std;

int main() {

  // set seed to 10
  srand(10);


  // generate random number
  int random = rand();

  cout << random;

  return 0;
}
```

File Reading & writing in C++

```cpp
#include<iostream>
```

```
#include<fstream>

using namespace std;
main()
{
      int rno,fee;
      char name[50];

      cout<<"Enter the Roll Number:";
      cin>>rno;

      cout<<"\nEnter the Name:";
      cin>>name;

      cout<<"\nEnter the Fee:";
      cin>>fee;

      ofstream fout("d:/student.doc");

      fout<<rno<<"\t"<<name<<"\t"<<fee;   //write data to the file student

      fout.close();

      ifstream fin("d:/student.doc");

      fin>>rno>>name>>fee;   //read data from the file student

      fin.close();

      cout<<endl<<rno<<"\t"<<name<<"\t"<<fee;

    return 0;
}
```

********** End of Question Paper **********