Instructions:

- Except your Roll No and Section, DO NOT WRITE anything on this paper.
- Return the question paper with your answer sheet.
- Read each question completely before answering it. There are **8 questions and 4 pages.**
- In case of any ambiguity, you may make assumptions. But your assumption should not contradict with any statement in the question paper.
- All the answers must be solved according to the sequence given in the question paper.
- Be specific, to the point while coding, logic should be properly commented, and illustrate with diagrams where necessary.

Time: 180 minutes. **Max Marks:** 100 points

Question # 01:Filing

[points: 10] [Estimated Time: 20 minutes]

Write a program that will read in a file of student academic credit data and create a list of students on academic warning. The list of students on warning will be written to a file. Each line of the input file will contain the student name (a single String with no spaces), the number of semester hours earned (an integer), the total quality points earned (a double).

The following shows part of a typical data file:

Alishba 27 83.7
Yumna 21 28.35
Areeba 96 182.4
Faisal 60 150

The program should compute the GPA (grade point or quality point average) for each student (the total quality points divided by the number of semester hours) then write the student information to the output file if that student should be put on academic warning. A student will be on warning if he/she has a GPA less than 1.5 for students with fewer than 30 semester hours credit, 1.75 for students with fewer than 60 semester hours credit, and 2.0 for all other students.

Question # 02: STL

[points: 10] [Estimated Time: 20 minutes]

A small bookshop is available in my area where different kinds of textbooks, reference books, story books and cooking recipes books are sold both new and used versions. It is a very important place for all educated persons. Most of the customers of the book shop are book lovers of all ages. Each of the book class, which has BookId, Title, Price, Author, status(new or old), availability(Yes or No).

The tasks you have to do are:

Design a Book class according to the above requirements.
Design an input() method, enter the 10 book details and store them in a vector.
Display all book details in the same sequence.

Question # 03:Abstraction

[points: 10] [Estimated Time: 10 minutes]

Declare a class File as an abstract class. The class contains data members like size, location, created date and modified date, and functions like open() and print().

Derive three classes (PDF File, ASCII File, and PS File) from File class, such that there is slight difference between the implementation of print() function in all derived classes.

Create 3 File class pointers in main, and store the reference objects of each subclass in them and call their respective print() functions polymorphic ally.

Question #04:Polymorphism *[points: 12] [Estimated Time: 20 minutes]*

Create a class RationalNumber (fractions) with the following capabilities:

1. Create a constructor that prevents a 0 denominator in a fraction, reduces or simplifies fractions that are not in reduced form and avoids negative denominators.
2. Overload the addition operator in this class.
3. Overload the division operators as a friend function for this class.
4. Overload the equality(==) operator for this class.
5. Overload the insertion operator(<<) to display the result.
6. Use appropriate exception handling where necessary.

Test Case:

```
RationalNumber obj1(3,5), obj2(5,4), result;
result=obj1+obj2;cout<<result;
result=obj1/obj2;cout<<result;
cout<<obj1==obj2;
```

Question # 05:Exception Handling *[points: 05+08] [Estimated Time: 30 minutes]*

1. Write a program that will convert the date written in the format **"hh/mm/ss"** into the number of seconds. Handle exceptions related to format of time.
2. Consider the following class:

```
class rollFor{
        int numberOfRolls;
        int N;
        //constructor & setter/getter & display
};
```

Write a method that simulates rolling a pair of dice until the total on the dice comes up to be a given number. The number that you are rolling for is a N to initilize with a parameterized constructor. You can assume that the parameter is one of the possible totals: 2, 3, ..,12. Display the number of rolls it takes to get snake eyes(. .).

Create a global function that throws and handles the exception that arises when the value of rollFor::N is out of the range(2,3,..., 12).

Question # 06:Inheritance *[points: 10] [Estimated Time: 20 minutes]*

There is a system to make vehicles. The system contains four classes.

1. The first class will decide the model of the vehicle (i.e the year in which the car will be made).
2. The second class extending the functionality of the first class will be used to decide the type of vehicle. (Whether it's a car, bus, or van).
3. The third class extending the functionality of the first class will also decide the engine_type of vehicle. (i.e automatic, manual, or hybrid).
4. The fourth class extending the functionality of the second and the third class will make the final class. The fourth class will have the functionality of displaying all the details of the class made.

All the save variables can be accessed using assessors. All the assessors must be constant. All data members must be private. You have to write the above system in a way that by declaring an object, it will assign model, vehicle type, and engine type.

Question # 07:Template *[points: 15+08] [Estimated Time: 40 minutes]*

1. Imagine there are lots of people within a room and some of them are having corona. Let's say we have 10 people overcrowded in this room with 4 people having corona. Now our task is to separate

...rona patients from non-corona patients so that the ones having corona can be shifted to another room and doctors can then deal with these patients accordingly.

Our task is to send these corona patients in some sorted manner with having non corona patients residing in the same room also having the same sorted order.

Your task is to implement what we should follow in order to achieve the task described above.

Restrictions: We CANNOT send these corona patients to another room one by one thereby, we need to first sort these corona patients up then only we can shift all these patients to some other room together.

Following questions should be answered. You can have some extra variables(like name & age) associated with each patient.

a. What sorting criteria do you intend to use and why? This means what value of the patient will be taken into consideration for sorting them.
b. How do you intend to separate corona patients from non corona patients?
c. Show the implementation using template class.

2. Write a template class to find the largest and second largest element in an array. Show the results for the following arrays:

12, 0, -9, 4, 11 (Largest:12, Second Largest: 11)
'G', 'X', 'A', 'M', 'B' (Largest:X, Second Largest: M)

Question # 08:Virtual Table *[points: 12] [Estimated Time: 20 minutes]*

```
class Base{
        public:
                void f1(){cout<<"Base f1"<<endl;}
                virtual void f2(){cout<<"Base vf2"<<endl;}
                virtual void f3(){cout<<"Base vf3"<<endl;}
                virtual void f4(){cout<<"Base vf4"<<endl;}
                virtual void f4(int x){cout<<"Base f4 x"<<x<<endl;}
};
class Derived1: public Base{
        public:
                void f1(){cout<<"Derived1 f1"<<endl;}
                void f3(){cout<<"Derived1 f3"<<endl;}
                void f4(){cout<<"Derived1 f4"<<endl;}
                virtual void f4(int x, int y=99){cout<<"Derived1 f4 x"<<x<<" y "<<y<<endl;}
                void f5(){cout<<"Derived1 f5"<<endl;}
};
class Derived2: public Derived1{
        public:
                void f1(){cout<<"Derived2 f1"<<endl;}
                void f3(){cout<<"Derived2 f3"<<endl;}
                void f4(){cout<<"Derived2 f4"<<endl;}
                void f4(int x, int y=7890){cout<<"B f4 x"<<x<<" y "<<y<<endl;}
                void f5(){cout<<"Derived2 f5"<<endl;}
};
int main(){
        Base *ptr1,b1,*ptr2;
        Derived1 obj1,*d1;
        Derived2 obj2;
        ptr1=&b1;ptr2=&obj2;d1=&obj2;
        ptr2->f1();
```

```
    ptr2->f2();
    ptr2->f3();
    ptr2->f4();
    d1->f4();
    d1->f4(11);
    d1->f5();
    ptr2->f4(101);
    ptr1->f5(84);
    d1->f1();
    d1->f2();
    d1->f5(34);
    d1->f3();
    d1->f4(30,52);
    ptr2->f5(62);
}
```

1. What is VTable and *vptr? Make all possible virtual tables of the above program and fill all possible entries.
2. If a class(has one virtual function) has 5 Objects then how many Vtables it will have?
3. Is this statement true? The v-table is for per class and not for per object. Justify your answer.
4. Show the output of the above program and also write where early binding and late binding have done. If you find any error, highlight that statement.