National University of Computer & Emerging Sciences, Karachi
Spring-2020 (CS-Department)
Final Exam, 09:00 am - 12:30 pm

Course Code: CS-217	**Course Name:** Object-Oriented Programming	
Instructors: Dr. Abdul Aziz , M.Danish, Basit Jasani & S. Zain		
Student ID:	**Section:**	
Date: June 22, 2020	**Time Allowed:** 3.5 hours	**Total Points:** 100

Instructions:

- Start of Exam: 9:00 am; End of Exam: 12:00 pm.
- Paper submission till 12:30 pm.
- Read each question completely before answering it. There is 5 question and 5 page.
- In case of any ambiguity, you may make assumptions. But your assumption should not contradict any statement in the question paper.
- You will attempt this paper offline, in your hand writing.
- You may use cam-scanner, MS lens or any equivalent application to scan and convert your hand-written answer sheets in a single PDF file.
- The paper should be submitted using Google Classroom. You are given 30 minutes for this purpose, which is already mentioned above. Additionally, after submitting, you should email it to your instructor which should be exactly same pdf as uploaded earlier, within the specified time.
- No submission will be accepted after the specified time. (After 12:30 pm).
- WRITE YOUR ID ON TOP OF EVERY PAGE by your hand. Write also page # on every page. You should also sign on every page.

Question 1: **[Marks 4x4 =16]**
[Expected time to attempt 30 mins]

Consider the code snippets given below:

1.

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

template<typename T>
void print_max(const T& a, const T& b)
{
cout << ((a>b) ? a:b) << endl;
}

int main()
{
print_max(4, 5.5);
print_max(3.2, 1);
return 0;
}
```

a) Identify & briefly explain the error present in above code. [2]
b) Modify **print_max ()** to remove the error. [2]

2)

```
class A
{
        int x;
        public:
            display()
            {
                cout<<x<<endl;
            }
};

void set()
{
    A a;
    a.x = 10; //ERROR
    a.display();
}
```

a) Modify the above code in such a way that function **set()** can access the private data x of class A from outside. [4]

3)

```
class A
{
    int x;
    display()
    {
        cout<<x;
    }
};

class B
{
    A a;
    display()
    {
        cout<<a.x;
    }
};
```

a) Identify & briefly explain the error present in above code. [2]
b) Modify the above code to make it an error free program. [2]

4)

```
class shape
{
    int x;
};
class circle : virtual public shape
{
    int y;
};
class square : virtual public shape
{
    int z;
};
class circle_on_square : public circle, public square
{
    int a;
};
int main()
{
    circle_on_square cc(1,2,3,4); //x=1 , y=2, z=3, a=4
}
```

a) Provide proper implementation and its call of all constructors for each class. [4]

Question 2. Short Answer Questions **[6X4= 24 Points]**

[Expected time to attempt 30 mins]

a) What is the major critisim on the use of friend keyword.

b) Pure Virtual functions are used to make a class/function as abstract. Why is there a need for partial virtual functions (virtual function with a defination), as they are not also treated as abstract methods?

c) Using a function defination like

```
class Temp{
public:
   Temp(){}
   virtual abc();
};
```

This virtual function will not make a class abstract. The code should compile and the object should also be created, why it is not happing in this case?

d) The child class always have access to the public members of its parent, why and how it is possible?

e) Why we cannot overload a function on return type?

f) When we are creating a file using code, it is important to define the extention of file like .txt, .dat , .jpg etc. But in c++ if we ommit the extention of the file it still work fine. Why is it so? Also explain how the system will decide the correct extention of file as every thing is in form of 0 and 1 in the memory?

Question 3. **[10 X 2 = 20 Points]**

[Expected time to attempt 45-50 mins]

Nothing.org is a job bank that allows job-seeking individuals to find employers, based on their qualifications, and also allows certain type of employers to find potential employees. Many organizations use Nothing.org to find suitable individuals for various posts, and also several candidates consider Nothing.org as a reliable source for finding rewarding jobs.

Read the following information very carefully. You can use these assumptions/information to understand the scenario and then perform the Ten (10) tasks that follow:

- **a)** Employers are the companies seeking candidates for various positions
- **b)** Candidates are job seekers who are looking to apply for positions based on their qualifications.
- **c)** The employers can be of type: educational institute, bank, pharmaceutical company or Construction Company. Regardless of its type, each individual employer should have a unique employer_ID.
- **d)** There are a few specialized attributes for employers as well. Educational institutes must specify the number of campuses, pharmaceutical companies should have the annual budget, bank should have the number of branches, and Construction Company should have number of active projects as attribute.
- **e)** All educational institutes should display/ask for "teaching years and ability to cope with pressure" while posting for a vacancy. Pharmaceutical companies should ask for "good analytical skills" while posting for a vacancy. Banks should ask for "Good communication skills and if a candidate can work in a large team". Construction companies should ask for "ability to work in remote areas".
- **f)** Each candidate must have a full name, NIC#, educational qualification/degree, DOB, experience (in months), permanent address, expected salary, and a unique candid_ID as well. While applying for a job, a candidate must make sure he passes all of his details to the employer whom he is sending his application to.
- **g)** A candidate can apply for any job, whereas an employer can receive application from any candidate.
- **h)** A moderator is another entity that is involved in all of this. A moderator should be able to keep track of the total job applications that have been submitted by candidates to date.
- **i)** There can be several moderators working for Nothing.org, but each with a unique mod_ID.
- **j)** You can assume that any candidate with 5 or more years of experience is immediately selected by an employer. And one of the moderators is informed by passing the message "vacancy closed".

Tasks to be performed:

1. Identify the valid objects, and using them, create classes containing proper attributes. You may create new attributes if needed but you must provide a reason for that in a comment.
2. Create an abstract function post_vacancy in employer. Then override this function in all of the child classes such that it fulfills the requirement in point (e) of the information provided.
3. Create appropriate constructors for each class to initialize its variables. Make sure your constructors have a mechanism in place to initialize variables that should have unique values for each instance (e.g. candid_ID, mod_ID).
4. Using the constructors you made, create one instance of each concrete (non-abstract) class that you have identified in this scenario.
5. Create a function receive_application in employer. This function is allowed to be used by candidates for providing their information. Make sure the requirements in point (f) are fulfilled. This function should ultimately call another member function select_candidate of employer class and pass on the candidate information.
6. Create the function select_candidate, this function must work based on the condition given in point (j).
7. Create a global overload for "<" operator, which allows comparison between two candidates based on their experience.
8. Write code in moderator class to find the number of total job applications as explained in point (h). You can create any new variables to achieve this (if needed).
9. Create a function write_data in moderator class that writes the number of total job application to a text file named "info.txt".
10. Overload this write_data function such that it receives a message as input and writes that message to a text file named "messages.txt".

Question 4: **[5 X 4 = 20 Points]**

[Expected time to attempt 45-50 mins]

BlueTech Technologies is an appliances company that makes Tracking devices, LED TVs, Mobile phones and Tablets. Apart from these, the company also makes Smart Ring that is a device capable of communication like Mobile phones as well as being able to serve as a Tracking device. The LED TVs have a screen size, model#, year of manufacture and number of supported apps as attributes, each Mobile phone has a model#, year of manufacture and camera resolution, Tablets have model#, year of manufacture and screen size as attributes, while Tracking devices have year of manufacture and accuracy (in continuous range 0-1) as attributes. There are no specialized attributes in Smart Ring.

1. Read the scenario and create all the classes with their attributes
2. Identify if Diamond Problem can occur in the classes you created. If yes, what will be the reason and can it be resolved?
3. Create a single global function *item_sort* that sorts items based on year of manufacture. The function must receive three instances of the same type as parameters. All the parameters need to be of same type, but it can be instances of any of the classes.
4. There is another company RedTech. This company keeps check and balance on the Tracking devices made by BlueTech, since they have a collaboration on inventing this product. For the purpose, RedTech requires direct access to all the features of tracking devices made by BlueTech.
5. Create a function checker in RedTech. The function should receive a tracking device as input and throw a user-defined exception if year of manufacture is earlier than 2010.

Question 5. OOP (Inheritance, Polymorphism and Exception Handling) [**4x5 = 20 Points**]

[Expected time to attempt 25-30 mins]

ABC is a bank which offers variety of Services: Cash Withdrawal, Point of Sales (PoS) Transaction, Loans, and Rewards to its Customers. The provided services are offered as per their membership category i.e. Diamond, Gold, and Silver Category. A Diamond member is required to have a monthly income of at least Rs. 200,000 and he/she has a withdrawal/transaction limit of Rs.250, 000 per day, it is also necessary to maintain at least Rs. 50,000 in their balance. A gold member is required to have a monthly income of at least Rs. 1 Lac and he/she has a withdrawal/transaction limit of Rs.150, 000 per day, it is also necessary to maintain at least Rs.10, 000 in their balance. A silver member is required to have a monthly income of at least Rs. 20,000 Lac and he/she has a withdrawal/transaction limit of Rs.100, 000 per day, it is also necessary to maintain at least Rs.10, 000 in their balance. A PoS transaction of more than Rs. 100,000 Tops up customer's mobile balance with 1% of transaction amount and awards 1000 bonus points to the customer, a PoS transaction from Rs. 10,000 to Rs.100, 000 awards 100 Bonus points to its customer, there are no rewards for PoS transactions below Rs. 10,000. A diamond member can apply for a loan of Rs. 10 million after showing a property of same amount, a gold member can apply for a loan of Rs. 5 million after showing a property of same amount, and silver member can apply for a loan of Rs. 1 million after showing a property of same amount.

1. Identify all the classes (only classes without any data and functions).
2. Identify the inheritance and levels of inheritance in the given case study and draw its diagram.
3. Identify all the data which need to be validated and implement Exceptional Handling for the identified rules.
4. Identify and write down code for any one possible friend function in the given case study.