National University of Computer and Emerging Sciences

(Islamabad Campus)

Department of Computer Science

Signature of Invigilator: _____ **Serial No:_____**

CS103Computer Programming

Instructor(s):

Total Marks: 100 **Time Allowed: 3 hour**

Instructions:

(1) Understanding the question paper is also part of the exam, so do not ask any clarification.
(2) Solve questions in the space provided.
(3) You are allowed to use calculator.
(4) Write your name and roll number on each page.
(5) If you need more space write on the back side of the paper and clearly mark question and part number etc.
(6) The question paper is printed on both sides of the pages and has 16 pages.
(7) Use permanent ink pens only. Any part done using soft pencil will not be marked and cannot be claimed for rechecking.

Roll No: _____ **Name: _____** **Section: _____**

Parts	A	B	C						Total
Questions			C-1	C-2	C-3	C-4	C-5	C-6	
Points									
Score									

Vetted By: _____ Vetter Signature: _____

Part A [Total Marks: 20]

Write your answers here:

Question	Answer Option	Question	Answer Option	Question	Answer Option	Question	Answer Option
A-1		A-6		A-11		A-16	
A-2		A-7		A-12		A-17	
A-3		A-8		A-13		A-18	
A-4		A-9		A-14		A-19	
A-5		A-10		A-15		A-20	

Q. No. A-1

Assuming that spread[] is a one-dimensional array of type int, which of the following refers to the value of the third element in the array.

A.	*(spread + 2)	B.	*(spread+3)
C.	*spread + 2	D.	*spread + 3

Q. No. A-2

The delete operator does not delete the pointer; it takes the memory being pointed to and returns it to the heap. True/False?

A.	True	B.	False

Q. No. A-3

An object can access its own address using _____.

A.	&	B.	addressof()
C.	this pointer	D.	Its not possible

Q. No. A-4

Static member functions can access non-static data or functions. True/False?

A.	True	B.	False

Q. No. A-5

To declare a friend function, you need to type friend before the function prototype in the class that is giving friendship. True/False?

A.	True	B.	False

Q. No. A-6

If no exception is thrown:

A.	All catch blocks are executed.	B.	Catch block with ellipses is executed.
C.	All catch blocks are ignored.	D.	None of the above.

Q. No. A-7

Which of the following concepts means waiting until runtime to determine which function to call?

A.	Data hiding	B.	Data biding
C.	Dynamic biding	D.	Static biding

Q. No. A-8

An anonymous object can be thrown in an exception.

A.	True	B.	False

Q. No. A-9

A copy constructor is invoked when:

A.	A function returns by value	B.	An argument is passed by value
C.	An argument is passed by reference	D.	Both A and B

Q. No. A-10

If a class is inherited from more than one class it is called:

A.	Single inheritance	B.	Multi-level inheritance
C.	Multiple inheritance	D.	Hierarchical inheritance

Q. No. A-11

If a class has pure virtual function(s), then its immediate derived classes may or may not override that function.

A.	True	B.	False

Q. No. A-12

To convert from user defined data type to a built-in data type we have to use:

A.	A built-in conversion operator	B.	A one argument constructor
C.	A conversion function that is member of class	D.	None of all

Q. No. A-13

A template class can be derived from a non-template class

A.	True	B.	False

Q. No. A-14

Statements that generate exception are placed in catch block.

A.	True	B.	False

Q. No. A-15

Which of the following cannot be used with the keyword virtual?

A.	Class	B.	Member Function
C.	Constructor	D.	Destructor

Q. No. A-16

Which of the following is the correct declaration of a constant function?

A.	constintMyfun(void) { /* statements */ }	B.	int const Myfun(void) { /* statements */ }
C.	intMyfun(void) const { /* statements */ }	D.	Both B and C

Q. No. A-17

Which of the following concepts is used to implement late binding?

A.	Member Function	B.	Constant Function
C.	Virtual Function	D.	Static Function

Q. No. A-18

Which of the following is correct about the statements given below?

I. All operators can be overloaded in C++.

II. We can change the basic meaning of an operator in C++.

A.	Only I is true	B.	Both I and II are true
C.	Only I is false	D.	Both I and II are false

Q. No. A-19

What is correct about the static data member of a class?

A.	A static member function can access only static data members of a class.	B.	A static data member is shared among all the object of the class.
C.	A static data member can be accessed directly from main()	D.	Both A and B

Q. No. A-20

To convert from built-in data type to a user defined data type we have to use:

A.	A built-in conversion operator	B.	A one argument constructor
C.	A conversion function that is member of class	D.	None of all

Part B [Total Marks: 25]

Q. No. B-1 (Marks: 1)

What is the output of the following program segment? Identify errors (if any).

```
class Book{
public:
     int bookid;
     book* next;
};

int main(){
     book *head=NULL;
     for( int i=1; i<=5; i++ ){
          book *temp = new book;
          bookid = i;
          temp->next = head;
          head = temp;
          cout<<i<< " ";
     }
     return 0;
}
```

OUTPUT:

Q. No. B-2 (Marks: 1)

Modify the code given on the left side such that the following statement can be executed without error:

```
o.setX(10).sety(20);
```

where o is an object of class Horizon.

Write the correct version on the right side

```
class Horizon{
     int x;
     int y;
public:
     void setX( int _x ){
          x = _x;
     }
     void setY( int _y ){
          y = _y;
     }
};
```

Modified code:

Q. No. B-3 (Marks: 1)

What is the output of the following program segment? Identify errors(if any).

```
class Maze{
     int i;
public:
     Maze(int i){
     this->i = i;
     cout<< "C" <<i<< "  ";
     }
     ~Maze(){
     cout<< "D" <<i<< "  ";
     }
};

Maze a(1);
int build(){
     Maze d(4);
     static Maze e(5);
}

int main(){
     Maze b(2);
     static Maze c(3);
     build();
     Maze f(6);
     return 0;
}
```

OUTPUT:

Q. No. B-4 (Marks: 1)

What is the output of the following program segment? Identify errors (if any).

```
int x, y;
x = 24;y = 60;
while (((y - x) % 5) != 0){
     cout<< y << " " ;
     y = y - 7;
}
```

OUTPUT:

Q. No. B-5 (Marks: 4)

What is the output of the following program? Identify errors (if any).

```
#include<iostream>
using namespace std;
template<typename T>
class Vector {
public:
     Vector(int s = 10) :
               size(s), ptr(new T[size]) {}
     void operator=(T *vec) {
          for (inti = 0; i< size; ++i)
               ptr[i] = vec[i];
     }
T & operator[](const int & i)
{
Return ptr[i];
}
     ~Vector() {
          cout<< *this;
          delete[] ptr;
     }
int GetSize(){return size;}
private:
     T *ptr;
     int size;
};
ostream& operator <<(ostream& cout, Vector<T>& v){
          for (inti = 0; i<v.Getsize(); ++i)
               cout<<ptr[i] << "  ";
          return cout;
     }

int main() {
     int a[] = { 10, 20, 3, 4, 5, 10, 40, 40 };
     Vector<int>v(8);
     v = a;
     double b[] = { 10, 20.7, 3, 4, 5, 10, 40, 40 };
     Vector<double>d(8);
     d = b;
}
```

OUTPUT:

Q. No. B-6 (Marks: 4)

What is the output of the following program? Identify errors (if any).

```
class Book {
public:
     void info() {
          cout<<endl<< ("This is a simple book ");
     }
     void info(Book &d) {
          this->info();
          d.info();
     }
};

class FunBook: public Book {
public:
     void info() {
          cout<<endl<< ("This is a FunBook ");
     }
};
class StoryBook {
public:
     void info() {
          cout<<endl<< ("This is a StoryBook");
     }
};

class NovelBook: public StoryBook {
public:
     void info() {
          StoryBook::info();
          cout<<endl<< ("This is a NovelBook");
     }
};
int main() {
     Book *b = new Book;
```

```
     FunBook *fb = new FunBook;
     b->info(*fb);
     StoryBook *sb = new NovelBook;
     sb->info();
}
```

OUTPUT:

Q. No. B-7 (Marks: 4)

What is the output of the following program? Identify errors (if any).

```
class Book {
public:
     virtual void info() {
          cout<<endl<< ("This is a simple book ");
     }
     virtualvoid info(Book &d) {
          this->info();
          d.info();
     }
};

class FunBook: public Book {
public:
     virtual void info() {
          cout<<endl<< ("This is a FunBook ");
     }
};
class StoryBook {
public:
     virtual void info() {
          cout<<endl<< ("This is a StoryBook");
     }
};
class NovelBook: public StoryBook {
public:
     virtual void info() {
          StoryBook::info();
          cout<<endl<< ("This is a NovelBook");
     }
};
int main() {
     Book *b = new Book;
```

```
     FunBook *fb = new FunBook;
     b->info(*fb);
     StoryBook *sb = new NovelBook;
     sb->info();
}
```

OUTPUT:

Q. No. B-9 (Marks: 1)

What is the output of the following program segment? Identify errors (if any).

```
class Diamond{
private:
     inti;
     const int j;

public:
     Diamond(int x=10, int y=20){
          i = x;
          j = y;
     }
     void print_values(){
     cout<<i<< " " << j <<endl;
     }
};
int main(){
```

OUTPUT:

```
    Diamond q1;
    Diamond q2(1,2);

    q1.print_values();
    q2.print_values();
}
```

Part C [Total Marks:60]

Q. No. C-1 (Marks: 5)

`Let λ= 3 + 5 + 9 – 10 + 27 + 15 + 81 – 20 …`

Write a **recursive** function `approx_lambda` that receives a positive integer 'i' as an argument and approximates the value of λ up to 'i' terms, where 'i' will be always **even** starting from 2.

For example, `approxs_lambda(6)` returns the result of 3 + 5 + 9 – 10 + 27+15, `approxs_lambda(8)` returns the result of 3 + 5 + 9 – 10 + 27 + 15 + 81-20, etc.

Q. No. C-2 (Marks: 15)

Write a class named SignedHugeInteger that can store an integer up to 50 digits. As the name suggests, you are also required to store the sign with the object. [**You can use STL to simplify your task**]

Provide the following member functions:

(a) Default constructor [2 marks]
Initialize the object to zero.

(b) One argument constructor [3 marks]
Initializes the object to the numeric value corresponding to the number represented by the argument (a constant character pointer).

(c) Addition operator +[3 marks]
Adds two SignedHugeIntegers.

(d) Subtraction operator – [3 marks]
Subtract one SignedHugeInteger from another.

(e) Multiplication operator * [2 marks]
Multiplies two SignedHugeIntegers.

(f) Division operator /[2 marks]
Divides one SignedHugeInteger by another. Perform integer division.

(g) Modulus operator % [2 marks]
Returns the remainder when you divide one SignedHugeInteger by another.

(h) Equality operator == [2 marks]
Checks if two SignedHugeIntegers are equal.

(i) Inequality operator > [3 marks]
Checks if one SignedHugeIntegers is greater than the other.

(j) Stream insertion operator << [3 marks]

(k) Stream extraction operator >> [3 marks]
For this part only, you may assume that the number has up to 50 digits.

(l) The destructor. [2 marks]

Perform necessary cleanup.

Q. No. C-3 (Marks: 15)

You are required to implement a vehicle management system for a rent a vehicle company. Company has two different types of vehicles at its disposal `Cars and Tractors` to lend to its customers. Company stores the basic information of each vehicle along with total distance travelled since last maintenance. Company takes the rent for tractors on daily basis while cars are rented out on hourly bases. Moreover, cars and tractors have different maintenance intervals, i.e. maintenance is needed for cars after every 5,000 kilometers while for tractors after 10,000 km

Your task is to implement an abstract base class `Vehicle` that provides the basic platform for implementing and storing objects of vehicle class. Vehicle class must store the basic of vehicle such as its `color, top_speed, fuel_capacity, load_capacity, kilometrage, maintenance_kilometerage`. Your vehicle class must provide (along with setters and getters) two abstract functions `compute_rent(` this function computes the rent for the rented vehicle) and `car_tuning` (performs the tuning of vehicle if it has crossed the maintenance limit).

Your Vehicle Management System should be able to perform the following tasks:

1. Add a vehicle's information to the system
2. Remove a vehicle's information from the system
3. Compute the rent of a vehicle for a particular duration.
4. Perform the maintenance of a particular vehicle.

Q. No. C-4 (Marks: 15)

Computer game packages use moveable objects to display and move the objects on the screen. Complex moveable objects are created using primitive moveable objects package. Your task is to write such a package consisting of these moveable primitive shapes.

Your package will contain following primitive movable objects: points, circles and rectangles. Note that all these objects are moveable and can move in a given direction i.e. left, right, up, down. Furthermore, movable objects such as circles and rectangles are made up of other moveable objects such as points. For instance, moveable circle uses moveable point to specify its center location, similarly rectangle uses a pair of movable points to indicate the top-left and bottom-right corner of the rectangle.

[Hint: Consider writing an abstract class Moveable]

Once you have written all the classes for moveable objects, write a main function to test these moveable objects.

Q. No. C-5 (Marks: 5)

A stack is a LIFO (last in, first out) data structure. When a new object is entered in a stack, it is placed on top of all the previously entered objects. Similarly, when an object is removed from a stack, the one on top gets removed first.

You are required to implement a generic template class `Stack` that includes the following functions:

(1) Default constructor

(2) Copy constructor

(3) IsEmpty

This function takes no argument and returns true if the stack is empty, false otherwise.

(4) Push

This function takes an object of the template type as argument and puts this on the top of the stack.

(5) Pop

If the stack is not already empty, this function returns the object on the top of the stack after removing it from the stack. Pop does not take any argument.

Q. No. C-6 (Marks: 15)

Design a class `Numbers` that can be used to translate whole Rupees amounts in the range 0 through 9999 into an English description of the number. For example, the number 713 would be translated into the string `seven hundred thirteen Rupees`, and 8203 would be translated into `eight thousand two hundred three Rupees`. The class should have a single integer member variable:

```
int number;
```

and a static array of string objects that specify how to translate key Rupees amounts into the desired format. For example, you might use static strings such as

```
string lessThan20[20] = {"zero", "one", ..., "eighteen",
"nineteen"};
string hundred = "hundred";
string thousand = "thousand";
```

The class should have a constructor that accepts a nonnegative integer and uses it to initialize the Numbers object. It should have a member function `print()` that prints the English description of the Numbers object. Demonstrate the class by writing a main function that asks the user to enter the number in a proper range and then prints out its description.

Q. No. C-7 (Marks: 5)

Design a class that will determine the monthly payment on a home loan. The monthly payment with interest compounded monthly can be calculated as follows:

$$\text{Payment} = \frac{\text{Loan} \times \frac{\text{Rate}}{12} \times \text{Term}}{\text{Term} - 1}$$

Where

$$\text{Term} = \left(1 + \frac{\text{Rate}}{12}\right)^{12 \times \text{Years}}$$

```
Payment = the monthly payment
Loan = the rupees amount of the loan
Rate = the annual interest rate
Years = the number of years of the loan
```

The class should have member functions for setting the loan amount, interest rate, and number of years of the loan. It should also have member functions for returning the monthly payment amount and the total amount paid to the bank at the end of the loan period. Implement the class in a complete program.

Input Validation: Do not accept negative numbers for any of the loan values.