Unit I

1 Fundamentals of Object Oriented Programming

1.1 : Introduction to Procedural, Modular, Generic and Object Oriented Programming Techniques

Q.1 Compare procedure oriented programming vs. object oriented programming. ☞ [SPPU : Dec.-19, May-19 Marks 4]

Ans. :

Sr. No.	Procedural Programming Language	Object Oriented Programming Language (OOP)
1.	The procedural programming **executes** series of **procedures** sequentially.	In object oriented programming approach there is a collection of **objects.**
2.	This is a **top down** programming approach.	This is a **bottom up** programming approach.
3.	The major **focus** is on procedures or **functions.**	The main **focus** is on **objects.**
4.	Data reusability is **not** possible.	**Data reusability** is one of the important feature of OOP.
5.	Data hiding is **not** possible.	**Data hiding** can be done by making it private.
6.	It is **simple** to implement.	It is **complex** to implement.
7.	For example : C, Fortran, COBOL	For example : C++, JAVA

1.2 : Need of Object Oriented Programming

Q.2 Explain the need of object oriented programming.

Ans. :

1. Emphasis is on data rather than procedures.
2. Programs can be divided into known objects.
3. Data needs to be hidden from the outside functions.
4. New data needs to be added frequently for maintaining the code.
5. Objects need to communicate with each other.
6. Some common properties are used by various functions.

1.3 : Fundamentals of OOP

Q.3 Explain the features of object oriented programming.

☞ [SPPU : May-17, Marks 3, May-18, Marks 4, Dec.-19, Marks 6]

Ans. : 1. Object :

- Object is an instance of a class.
- Objects are basic run-time entities in object oriented programming.
- In C++ the class variables are called objects. Using objects we can access the member variable and member function of a class.
- **Example**

  Fruit f1;

For the class **Fruit** the object **f1** can be created.

2. Classes : • A class can be defined as an entity in which data and functions are put together. The concept of class is similar to the concept of **structure** in C.

- **Example**

```
class rectangle
{
    private :
        int len, br;
```

```
public :
    void get_data ( ) ;
    void area( );
    void print_data ( );
};
```

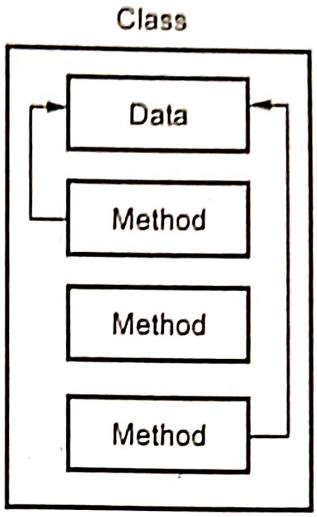


Fig. Q.3.1 Concept of encapsulation

3. Data Encapsulation :

- **Definition** : Encapsulation means binding of data and method together in a **single entity called class.**
- The data inside that class is accessible by the function in the same class. It is normally not accessible from the outside of the component.

4. Inheritance :

- **Definition :** Inheritance is a property by which the new classes are created using the old classes. In other words the new classes can be developed using some of the properties of old classes.
- **Example** :
- Here the **Shape** is a base class from which the **Circle, Line** and **Rectangle** are the derived classes. These classes inherit the functionality **draw()** and **resize()**. Similarly the **Rectangle** is a base class for the derived class **Square.**

5. Polymorphism : • **Definition :** Polymorphism is the ability to take more than one form and refers to an operation exhibiting different behavior in different instances (situations).

The behavior depends on the type of data used in the operation. It plays an important role in allowing objects with different internal structures to share the same external interface.

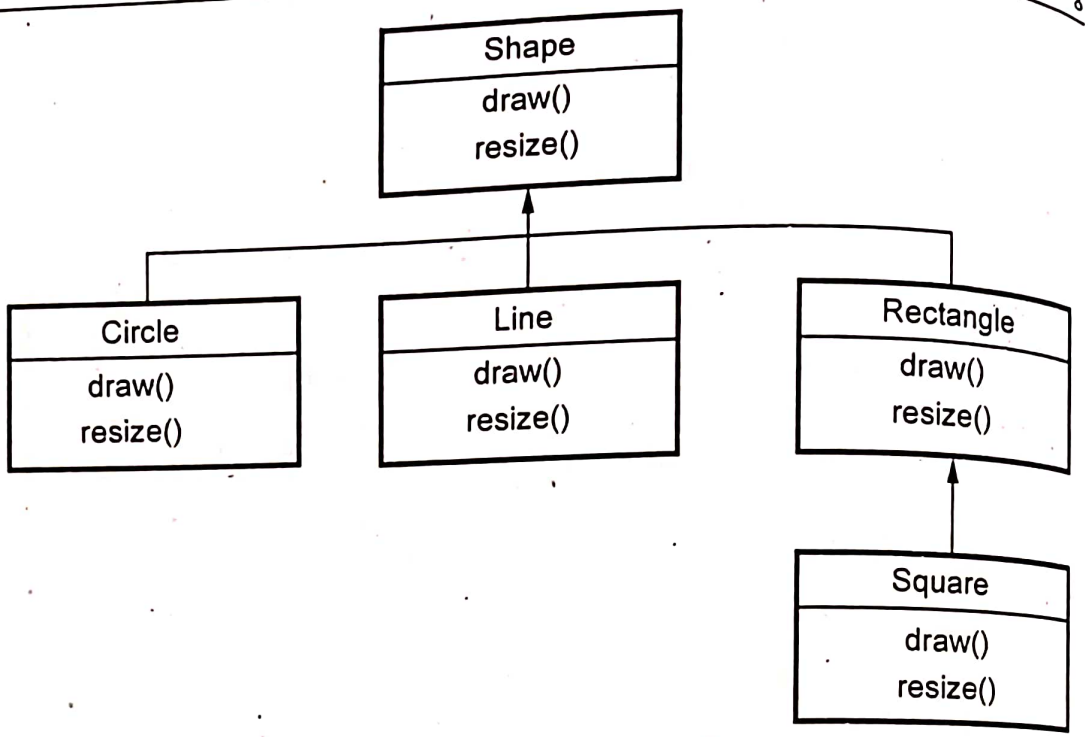


Fig. Q.3.2 Hierarchical structure of inheritance

Q.4 What is the difference between data encapsulation and data abstraction ?

Ans. :

Sr. No.	Data encapsulation	Data abstraction
1.	It is a process of binding data members of a class to the member functions of that class.	It is the process of eliminating unimportant details of a class. In this process only important properties are highlighted.
2.	Data encapsulation depends upon object data type.	Data abstraction is independent upon object data type.
3.	It is used in software implementation phase.	It is used in software design phase.
4.	Data encapsulation can be achieved by inheritance.	Data abstraction is represented by using abstract classes.

1.4 : Benefits of OOP

Q.5 What are the benefits of OOP ?

Ans. : Following are some advantages of object oriented programming -

1. Using **inheritance** the redundant code can be eliminated and the existing classes can be used.
2. The standard working **modules** can be created using object oriented programming. These modules can then communicate to each other to accomplish certain task.
3. Due to **data hiding** property, important data can be kept away from unauthorized access.
4. It is possible to create **multiple objects** for a given class.
5. For **upgrading the system** from small scale to large scale is possible due to object oriented feature.
6. Due to **data centered nature** of object oriented programming most of the details of the application model can be captured.
7. **Message passing technique** in object oriented programming allows the objects to communicate to the external systems.
8. **Partitioning the code** for simplicity, understanding and debugging is possible due to object oriented and modular approach.

1.5 : C++ as Object Oriented Programming Language

Q.6 What is the difference between C and C++ ?

Ans. :

Sr. No.	C language	C++ language
1.	C is a procedure oriented language.	C++ is an object oriented programming language.
2.	C makes use of top down approach of problem solving.	C++ makes use of bottom up approach of problem solving.

3.	The input and output is done using **scanf** and **printf** statements.	The input and output is done using **cin** and **cout** statements.
4.	The I/O operations are supported by **stdio.h** header file.	The I/O operations are supported by **iostream.h** header file.
5.	C does not support inheritance, polymorphism, class and object concepts.	C++ supports inheritance, polymorphism, class and object concepts.
6.	The data type specifier or format specifier (%d, %f, %c) is required in printf and scanf functions.	The format specifier is not required in **cin** and **cout** functions.

1.6 : C++ Programming Basics

Q.7 Give the structure of C++.

Ans. : There are four sections in the structure of C++ program -

Include file section
Class declaration section
Function definition section
Main function definition

Fig. Q.7.1 Structure of C++ program

The sample C++ program is as follows-

C++ Program

FirstProg.cpp

```
//This is my first C++ program
//This program simply prints the message Hello World
#include<iostream>
using namespace std;
```

```
int main()
{
  cout<<"Hello World\n";
}
```

1.7 : Data Types

Q.8 What are primitive data types and user defined data types ?

[SPPU : Dec.-18, Marks 3]

Ans. :

Type	Size	Range
char	1 byte	– 127 to 127 or 0 to 255
unsigned char	1 byte	0 to 255
signed char	1 byte	– 127 to 127
int	4 bytes	– 2147483648 to 2147483647
unsigned int	4 bytes	0 to 4294967295
signed int	4 bytes	– 2147483648 to 2147483647
short int	2 bytes	– 32768 to 32767
unsigned short int	2 bytes	0 to 65,535
signed short int	2 bytes	– 32768 to 32767
long int	4 bytes	– 2,147,483,647 to 2,147,483,647
signed long int	4 bytes	same as long int
unsigned long int	4 bytes	0 to 4,294,967,295
float	4 bytes	+/- 3.4e +/- 38
double	8 bytes	+/- 1.7e +/- 308
long double	8 bytes	+/- 1.7e +/- 308

1.8 : Structures

Q.9 Explain the concept of structures with suitable example.

Ans. : Definition : A structure is a group of items in which each item is defined by some identifier. These items are called **members** of the structure. Thus structure is a collection of various data items which can be of **different data types.**

The **Syntax** of declaring structure in C++ is as follows -

```
struct name {
        member 1;
        member 2;
        ...
        ...
        ...
        member n;
    };
```

Example :

```
struct stud {
        int roll_no;
        char name[10];
        float marks;
            };
    struct stud stud1,stud2;
```

The stud 1 and stud 2 will look like this

roll_no	name [10]	marks

Q.10 Write a C program to represent a complex number using structure and add two complex numbers.

Ans. :

```
#include<iostream>
using namespace std;
typedef struct Complex
{
   float real;
   float img;
}C;
```

```
void main()
{
    C x, y, z;
    cout<<"\n Enter the real part of first complex number: ";
    cin>>x.real;
    cout<<"\n Enter the imaginary part of first complex number: ";
    cin>>x.img;
    cout<<"\n Enter the real part of second complex number: ";
    cin>>y.real;
    cout<<"\n Enter the imaginary part of second complex number: ";
    cin>>y.img;
    cout<<"\n\t The First complex number is
"<<x.real<<"+"<<x.img<<"i";
    cout<<"\n\t The second complex number is
"<<y.real<<"+"<<y.img << "i";
    z.real = x.real + y.real;
    z.img = x.img + y.img;
    cout<<"\n The Addition is: "<<z.real<<"+"<<z.img << "i";
}
```

Output

```
Enter the real part of first complex number: 3

Enter the imaginary part of first complex number: 6

Enter the real part of second complex number: 4

Enter the imaginary part of second complex number: 8

        The First complex number is 3+6i
        The second complex number is 4+8i
The Addition is: 7+14i
```

1.9 : Enumeration

Q.11 What is enumeration ? Explain it with example.

Ans. : To create user defined type names the keyword **enum** is used. The syntax of using enum is

enum *name*{list of names} *variables;*

For example :

```
enum day{Monday,Tuesday,Wednesday} d;
d=Tuesday;
```

By default the value of first name is 0, second name has value 1 and so on. But we can give some other specific value to the list element. For example

```
enum day{Monday=10,Tuesday=20,Wednesday=30};
```

Following is a simple C++ program that illustrates the use of enum

```
/*****************************************************************
Program for using enum
*****************************************************************/
#include<iostream>
using namespace std;
int main()
{
    enum mylist{small,middle=5,large} a,b;
    a=middle;
    b=large;
    cout<<"a= "<<a<" b= "<<b;
    return 0;
}
```

Output

```
a= 5 b= 6
```

1.10 : Control Structures

Q.12 Explain the conditional statements used in C++.

Ans. : There are two types of if statements - simple if statement and compound if statement. The **simple if** statement is a kind of if statement which is followed by single statement. The **compound if** statement is a kind of if statement for which a group of statements are followed. These group of statements are enclosed within the curly brackets.

If statement can also be accompanied by the **else** part.

Following table illustrates various forms of **if statement**

Type of Statement	Syntax	Example
simple if	if(condition) statement	if(a<b) cout<<"a is smaller than b";

compound if	if(condition)
	{
	statement 1;
	...
	...
	}
		if(a<b)
		{
		cout<<"a is smaller than b";
		cout<<"b is larger than a";
		}

if...else	if(condition)
	statement;
	else
	statement;
		if(a<b)
		cout<<"a is smaller than b";
		else
		cout<<"a is larger than b";

compound if...else	if(condition)
	{
	statement 1;
	...
	...
	}
	else
	{
	statement 1;
	...
	...
	}
		if(a<b)
		{
		cout<<"a is smaller than b";
		cout<<"b is larger than a";
		}
		else
		{
		cout<<"a is larger than b";
		cout<<"b is smaller than a";
		}

if...else if	if(condition)
	{
	statement 1;
	...
	...
		if(a<b)
		cout<<"a is smaller than b";
		else if(a<c)
		cout<<"a is smaller than b"
		else
		cout<<"a is larger than b and c";

```
}
else if(condition)
{
 statement 1;
   ...
   ...

}
else
{
 statement 1;
   ...
   ...
}
```

Q.13 What is the use of switch-case statement ? Explain it with suitable example.

Ans. :

From multiple cases if only one case is to be executed at a time then switch case statement is executed. Following table shows the use of switch case statements

Type of statement	Syntax	Example
switch ...case	switch(condition) { case caseno:statements break; .... default: statements	cout<<"\n Enter choice"; cin>>choice; switch(choice) { case 1: cout<<"You have selected 1"; break;

```
}
                    case 2: cout<<"You have selected 2";
                            break;
                    case 3: cout<<"You have selected 3";
                            break;
                    default: cout<<"good bye";
                    }
```

1.11 : Arrays

Q.14 What is arrays ? Explain the method of array initialization

Ans. : • Array is a collection of similar data type elements.

- Syntax of array is

  Datatype Name[size]

- Example

  int a[10];

This type of array is called **one dimensional array.**

Method 1 :

Syntax

```
Data type name[size]={value 0, value  1, value 2, ..., value n-1};
```

Example

```
int a[5]={10,20,30,40,50};
```

Method 2 :

```
cout<<"\n Enter the elements";
for(int i=0;i<n;i++)
        cin>>a[i];
```

- The arrays in which the elements are arranged in the form of rows and columns are called two dimensional arrays

- The initialization of two dimensional arrays is -

Method 1 :

```
int a[2][3]={
            {10,20,30},
            {40,50,60}
      };
```

Method 2 :

```
cout<<"\n Enter the elements";
for(int i=0;i<n;i++)
      {
       for(int j=0;;j<m;j++)
       {
                                  cin>>a[i][j];
       }
      }
```

Q.15 Write a C++ program to store and retrieve the elements of an array.

Ans. :

```
/*****************************************************************
Program to store the elements in an array and then retrieve them
*****************************************************************/
#include<iostream.h>
void main()
{
   int a[10],i,n;
   cout<<"\n How many elements are there in the array?";
   cin>>n;
   cout<<"\n Enter the elements\n";
   for(i=0;i<n;i++)
      cin>>a[i];
   cout<<"\n The elements of an array are ...\n";
   for(i=0;i<n;i++)
```

```
        cout<<" "<<a[i];

}
```

Output

```
How many elements are there in the array?5

Enter the elements
10 20 30 40 50

The elements of an array are ...
 10  20  30  40  50
```

1.12 : Strings

Q.16 What is strings ? Explain the method of initialization of strings.

Ans. : String is a collection of characters.

- **C/C++ representation :** In C / C++, the string is represented as array of characters. For example the string **str** can be represented as

```
char str[10];
```

- **Initialization of string :** Initializing of string can be done as follows -

```
char str[6]="INDIA"
```

Or

```
char str[]={'I','N','D','I','A'}
```

Q.17 Write and explain the concept of string class used in C++.

Ans. : The **string** class is used to define the strings. The syntax of using the **string** class is as follows -

```
string()
string(char *str);
string(string &str);
```

C++ Program

```
#include<iostream>
#include<string>
using namespace std;
void main()
{
    string s1, s2;
    s1 = "Hello";
    cout << "\n The string : ";
    cout << s1;
    s2 = s1;
    cout << "\n The copied string is: ";
    cout << s2;
    s2 = "Friends";
    cout << "\n The new string is: " << s2;
    string s3;
    s3 = s1 + s2;
    cout << "\n The concatenated string is: ";
    cout << s3;
}
```

Output

```
The string : Hello
The copied string is: Hello
The new string is: Friends
The concatenated string is:
HelloFriends
```

1.13 : Class and Object

Q.18 Define the term class. ☞ [SPPU : May-14, Marks 2]

Ans. : • Each class is a collection of data and functions that manipulate the data.

- Placing the **data and functions together** into a single entity is the **central idea** in object oriented programming.
- The **nouns** in the system specification help the C++ programmer to determine the set of **classes.** The objects for these classes are created. These objects work together to implement the system.
- Classes in C++ is the natural evolution of C notion of **struct.**

For example :

```
class rectangle
{
 private:
 int len,br;
 public:
 void get_data();
 void area();
 void print_data();
};
```

Q.19 Give the difference between structure and class.

Ans. :

Sr. No.	Structure	Class
1.	By default the members of structure are **public.**	By default the members of class are **private.**
2.	The structure **can not be inherited.**	The class can be **inherited.**
3.	The structures **do not require constructors.**	The classes **require constructors** for initializing the objects.
4.	A structure contains **only data** members.	A class contains the **data** as well as the **function** members.

Q.20 What is class and object ? Differentiate between class and object. ☞ [SPPU : Dec.-17, Marks 6]

Ans. : Class : Refer Q.18.

Object : The object is an instance of a class. Hence object can be created using the class name. The object interacts with the help of procedures or the methods defined within the class.

Difference between Class and Object

Sr. No.	Class	Object
1.	For a single class there can be any number of objects. For example - If we define the class as River then Ganga, Yamuna, Narmada can be the objects of the class River.	There are many objects that can be created from one class. These objects make use of the methods and attributes defined by the belonging class.
2.	The scope of the class is persistent throughout the program.	The objects can be created and destroyed as per the requirements.
3.	The class can not be initialized with some property values.	We can assign some property values to the objects.
4.	A class has unique name.	Various objects having different names can be created for the same class.

1.14 : Class and Data Abstraction

Q.21 How does class play an important role in data abstraction ? Explain

Ans. :

(1) Data abstraction is one of the characteristics of C++ by which simplified representation of the C++ program is presented to the user.

(2) The implementation details are hidden.

(3) Class is used to achieve data abstraction in C++.

(4) Example

```
class Student
{
   Private:
      int roll;
      char name[10];
   public:
      void input();
      void display();
```

```
};
```

In the main function, we can access the functionalities using the object. For instance -

```
Student obj;
obj input();
obj.display();
```

From above code the implementation details are hidden

1.15 : Class Scope and Accessing Class Members

Q.22 Explain the method of accessing class members used in C++ with the help of suitable example.

Ans. :

(1) The class has two types of members - i) Data members and ii) member functions.

(2) Typically the data members are declared as private and member functions are declared as public. Hence the data members of class are accessed used by member functions of a class.

(3) For accessing the class members outside the class, the object of that class is created and used.

(4) The member functions can be defined inside a class or outside a class. For defining the member functions outside the class the scope **resolution** operator is used.

(5) Example :

```
#include <iostream>
using namespace std;
class Test
{
   private:
      int a,b,c;
   public:
      int Addition(int a, int b)
        {
          c= a+b;
          return c;
```

Data members are declared as private.

Member functions are declared as public.
Note that: Only within the function the data members can be manipulated.

```
        }
    void Display( );
};
void Test::Display( ) //Using Scope resolution operator
{                     //display function is defined outside the class
 cout << "The sum is:" << c << "\n";
}

int main()
{
   Test obj;
   obj.Addition(10,20);
   obj.Display();
   return 0;
}
```

Only member functions are accessible outside the class because they are **public.**

1.16 : Access Specifiers

Q.23 Define the term - Member Access Control

☞ [SPPU : May 2014, 2 Marks]

Ans. : Member Access Control defines the manner by which the data can be accessible. The keywords public, private and protected are used to control access to member.

Q.24 Explain the terms private, public and protected.

Ans. : • By default the access specifier is of **private** type. When the data and functions are declared as private then only members of same class can access them. This achieves the **data hiding** property.

- The **public** access specifier allows the function declared outside the class to access the data and functions declared under it.
- The **protected** access specifier allows the functions and data declared under it be accessible by the belonging class and the immediate derived class. Outside the belonging class and derived class these members are not accessible.

1.17 : Separating Interface from Implementation

Q.25 What are interface and implementation files ? Explain the advantages of separating interface from implementation.

Ans. : The **interface file** is a file that contains the declaration of the class. The **implementation files** are the files that define the actual functionalities and invoke those functionalities.

Thus the C++ program can be split into

- **Header files** - contains class definitions and function prototypes
- **Source-code files** - contains member function definitions

The **advantage** of this arrangement is that the modification of the program becomes easy.

1.18 : Functions

Q.26 What is function prototype ?

Ans. : A **function prototype** is declaration of function without specifying the function body. That is the function prototype specifies name of function, argument type and return type.

Q.27 Explain call by value and call by reference with suitable examples

Ans. : 1. **Call By Value :** In this method, actual values are passed as parameters to the function. For example

```
void sum(int x,int y)/*definition*/
{
        int c;
         c=x+y;
        cout<<"\n The Addition is: "<<c;
}
int main()
{
    int a,b;
    cout<<"\n Enter The two numbers: ";
```

```
    cin>>a;
    cin>>b;
    sum(a,b);/*call*/
    return 0;
}
```

2. **Call By Reference :** In this method, the parameters are passed by reference. Pointers are used for passing this type of parameters. For example

```
void sum(int *x,int *y)//function definition
{
   int c;
   c=*x+*y;
   cout<<"The addition of two numbers is: "<<c;
}
int main()
{
   int a,b;
   void sum(int *,int *);//function declaration
   cout<<"\n Enter The Two Numbers: ";
   cin>>a;
   cin>>b;
   sum(&a,&b);//call to the function
   return 0;
}
```

Q.28 Consider the following declaration :

```
class TRAIN
{
int trainno;
char dest[20];
float distance;
    public:
void get( ); //To read an object from the keyboard
void put( ); //To write an object into a file
void show( ); //To display the file contents on the monitor
};
```

Complete the member functions definitions ☞ [SPPU : May-17, Marks 8]

Ans. :

```
#include <iostream>
#include <fstream>
using namespace std;
class TRAIN
{
protected:
    int trainno;
    char dest[20];
    float distance;

public:
    void get()
    {
        cout << "\n Enter trainno: ";
        cin >> trainno;
        cout << "\n Enter destination: ";
        cin >> dest;
        cout << "\n Enter distance: ";
        cin >> distance;
    }
    void show()
    {
        ifstream in_obj;
        in_obj.open("test.dat", ios::binary);
        in_obj.read((char*)this, sizeof(TRAIN));

        cout << "\n Train No : " << trainno;
        cout << "\n Destination : " << dest;
        cout << "\n Distance :" << distance;

    }
    void put()        // Member function for write file
    {
```

```
        ofstream out_obj;
        out_obj.open("test.dat", ios::app | ios::binary);
        out_obj.write((char*)this, sizeof(TRAIN)); //writes current record
to file
    }
};
int main()
{
    TRAIN obj;
    cout << "\nEnter the Record:";
    obj.get();
    cout << "\tWriting the Record....";
    obj.put();
    cout << "\nThe Record is:";
    obj.show();
    return 0;
}
```

1.19 : Accessing Function and Utility Function

Q.29 Explain the concept of access and utility function.

Ans. :

- **Access Function**
  - It is a function that can read or display data.
  - Another use of access function is to check the truth or false conditions. Such functions are also called as predicate functions.
- **Utility Function**
  - It is a helper or supporting function that can be used by access function to perform some common activities.
  - It is a private function because it is not intended to use outside the class.

```
double division(double a, double b)//Utility Function
{
    c = a / b;
```

```
    return c;
}
Void Get_data (double x, doubley) // Access function
{
    a = x;
    b = y;
}
```

1.20 : Constructors

Q.30 What is constructors ?

Ans. : Constructors are the functions created for initializing the objects or data members of a class. The name of constructor is same as that of class name. The constructors must be declared in public mode.

Q.31 Enlist the characteristics of constructors.

Ans. : Following are some rules that must be followed while making use of constructors -

1. Name of the constructor must be **same as the name of the class** for which it is being used.
2. The constructor must be declared in the **public** mode.
3. The constructor gets invoked automatically when an object gets created.
4. The constructor should not have any return type. Even a **void** type should not be written for the constructor.
5. The constructor can not be used as a member of union or structure.
6. The constructors can have default arguments.

Q.32 Write a C++ program for parameterized constructor.

Ans. : C++ Program

```
#include<iostream>
using namespace std;
class image
{
  private:
```

```
        int height,width;
public:
        image(int x,int y)   //constructor
        {
         height=x;
         width=y;
        }
        int area()
        {
         return (height*width);
        }
    };
int main()
{
 image obj1(5,3);
 cout<<"The area is :"<<obj1.area()<<endl;
 return 0;
}
```

Output

The area is :15

Q.33 Write a class called "arithmetic" having two integer and one character data members. It performs the operation on its integer members indicated by character member(+,-,*,/) For example * indicates multiplication on data members as d1*d2. Write a class with all necessary constructors and methods to perform the operation and print the operation performed in format Ans= d1 op d2. Test your class using main()

Ans. :

```
#include<iostream>
using namespace std;
class Arithmetic
{
   int d1,d2;
   char op;
public:
```

```
    Arithmetic(int x,char c,int y)
    {
        d1=x;
        d2=y;
        op=c;
    }
    int operation()
    {
        int c;
        switch(op)
        {
        case '+':c=d1+d2;
                        break;
        case '-':c=d1-d2;
                        break;
        case '*':c=d1*d2;
                        break;
        case '/':c=d1/d2;
                        break;
        }
        return c;
    }
};
int main()
{
    Arithmetic obj1(10,'+',20);
    Arithmetic obj2(20,'-',10);
    Arithmetic obj3(10,'/',5);
    Arithmetic obj4(10,'*',20);
   cout<<"\n Addition of 10+20= "<<obj1.operation();
    cout<<"\n Subtraction of 20-10= "<<obj2.operation();
```

```
    cout<<"\n Division of 10/5= "<<obj3.operation();
    cout<<"\n Multiplication of 10*20= "<<obj4.operation();
    return 0;
}
```

Output

```
Addition of 10+20= 30
Subtraction of 20-10= 10
Division of 10/5= 2
 Multiplication of 10*20= 200
```

Q.34 Write short note on - Copy Constructor.

☞ [Dec 2014, Marks 3, Dec 2015, Marks 2]

Ans. : ***Definition :*** Copy constructor is a special type of constructor in which new object is created as a copy of existing object.

- In other words in copy constructor one object is initialized by the other object. The general form of copy constructor is -

```
classname (classname &object)
{
//body of the constructor
}
```

While invoking the copy constructor we will use following syntax

```
classname new_object_name(old_object_name);
```

Thus the copy constructor takes a reference to an object of same class as an argument.

C++ Program

```
class test
{
   int x;
public:
   test(); //default constructor
   test(int val)  //parameterized constructor
   {
      x = val;
```

```
    }
    test(test &obj)  //copy constructor
    {
       x = obj.x;//entered the value in obj.x
    }
    void show()
    {  cout << x;   }
};
int main()
{
    test Old(100);
    //call for copy constructor
    test New(Old); //<---- object 'Old' is passed as argument to object
                          'New'
    cout << "\n The original value is: ";
    Old.show();
    cout << "\n The New copied value is: ";
    New.show();
    cout << endl;
    return 0;
}
```

The output of above program will be 100 for both original and copied value.

1.21 : Destructor

Q.35 What is destructor ? Explain it with suitable example.

Ans. : The destructor is called when the object is destroyed. The object can be destroyed automatically when the scope of the objects end (i.e. when the function ends) or explicitly by using operator delete.

The destructor must have the same name as the class but preceded with a tilde sign (~) and it must also return no value.

C++ Program

```
#include<iostream>
using namespace std;
class image
{
   private:
            int *height,*width;
   public:
            image(int,int);//constructor
            ~image();//destructor
            int area();//regular function
};
image::image(int x,int y)
{
    height=new int;//assigns memory dynamically using 'new'
    width=new int;
    *height=x;
    *width=y;
}
image::~image()
{
 delete height;//destroys the memory using 'delete'
 delete width;
}
int image::area()
{
 return (*height* *width);
}
int main()
{
    image obj1(10,20);
    cout<<"The area is :"<<obj1.area()<<endl;
    return 0;
}
```

Output

The area is : 200

1.22 : Object and Memory Requirements

Q.36 Explain how memory is allocated for the objects in C++?

Ans. : • The memory space objects is allocated when they are **declared.**

- The members functions are created and placed in the memory only when they are defined as a part of a class specification.
- As the objects are using the same **member functions** of the belonging class, **no separate** memory space is created for these function when objects are created.
- Only for the **member variables** the **separate memory space** is created for **each object.**

Fig. Q.36.1 illustrates this concept

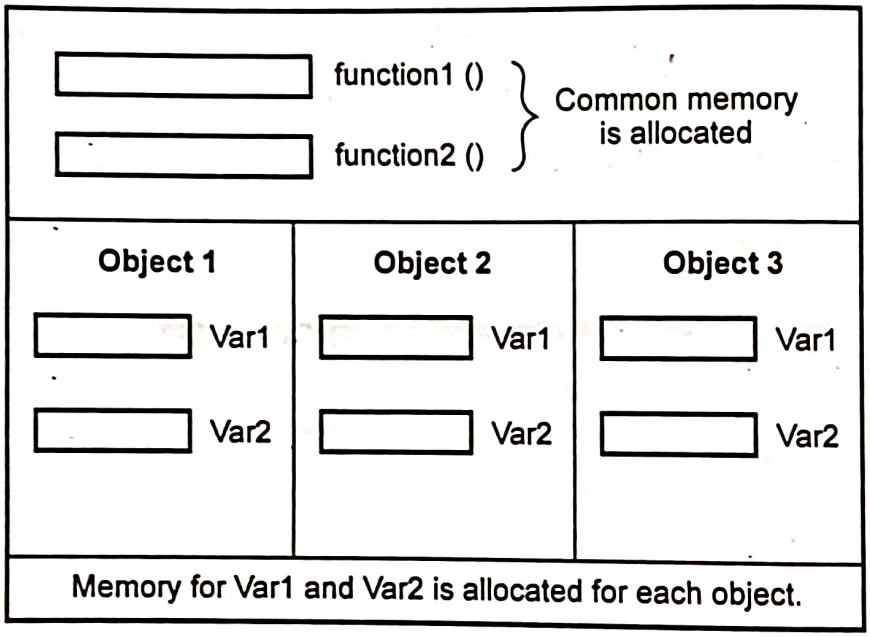


Fig. Q.36.1 Memory allocation for objects

1.23 : Static Members

Q.37 Define the term-static data member

☞ **[May 2014, Dec 2015, Marks 2]**

Ans. : The static data members are basically the data members that are declared with keyword static. The static members have the same

properties as that of global variables. For example we can declare the static integer variable as follows

static int count;

Q.38 Give a C++ code to illustrate the use of static data member.

Ans. : Static data member is created to make the variable act like a global variable. For example

C++ program using static keyword

```
#include<iostream>
using namespace std;
void fun()
{
    static int cnt=0;
    cout << "\ncount = " <<cnt;
    cnt++;
}
int main()
{
    for (int i = 0; i < 5; i++)
        fun();
    return 0;
}
```

Output

```
count = 0
count = 1
count = 2
count = 3
count = 4
```

C++ Program without using static

```
#include<iostream>
using namespace std;
void fun()
{
    int cnt=0;
    cout << "\ncount = " <<cnt;
    cnt++;
}
int main()
{
    for (int i = 0; i < 5; i++)
        fun();
    return 0;
}
```

Output

```
count = 0
count = 0
count = 0
count = 0
count = 0
```

Q.39 What is static member function ? Give an example for the same. ☞ [SPPU : May-14, Marks 4, Dec.-19, Marks 3]

Ans. : (1) The static member functions are the member functions declared with the keyword **static**. This function is independent of any particular object of the class.

(2) A static member function can only access static data member, other static member functions and any other functions from outside the class.

(3) **Example Program**

```
class Test
{
private:
    static int number;
public:
    static int Increment_count();      //static member function
};
int Test::Increment_count()
{
    return number++;
}
int Test::number = 0;                  // definition of static data
int main()
{
    Test a,b,c;
    //will increment the count 3 times
    cout << "  a = " << a.Increment_count() << endl; //output:0

    cout << "  b = " << b.Increment_count() << endl; //output:1
    cout << "  c = " << c.Increment_count() << endl; //output:2
    return 0;
}
```

1.24 : Inline Function

Q.40 Define the term - Inline function.

☞ [SPPU : May-14, Marks 2, Dec.-19, Marks 4]

Ans. : Definition : The inline function is a function whose code is copied in place of each function call. The inline specifies that the compiler should insert the complete body of function in every context where the function is used.

Programming example :

```
#include<iostream.h>
inline largest(int x,int y,int z)
{
   if(x>y&&x>z)
   {
      cout<<" First number is greatest and it is: "<<x;
   }
   else if(y>x&&y>z)
   {
      cout<<" Second number is greatest and it is: "<<y;
   }
   else
   {
      cout<<" Third number is greatest and it is: "<<z;
   }
}
```

Q.41 Define class number which has inline function mult ( ) and cube ( ) for calculating the multiplication of 2 double numbers given and cube of the integer number given.

☞ [SPPU : Dec.-16, Marks 4]

Ans. :

```
#include <iostream>
using namespace std;
        inline double Mult(double x, double y)
```

```
        {
                return (x*y);
        }
        inline int cube(int n)
        {
                return n*n*n;
        }
};
int main()
{
        number obj;
        cout << "Mult (20,10): " << obj.Mult(20, 10) << endl;
        cout << "Cube (10): " << obj.cube(10) << endl;
        return 0;
}
```

Output

```
Mult (20,10): 200
Cube (10): 1000
```

1.25 : Friend Function

Q.42 What is friend function ? Explain with suitable example.

☞ [SPPU : Dec.-16, Marks 2, May-19, Marks 4]

Ans. : The friend function is a function that **is not a member function** of the class but it **can access the private and protected members** of the class.

The friend function is given by a keyword ***friend***.

These are special functions which are declared anywhere in the class but have given **special permission to access the private members** of the class.

C++ Program

```
#include<iostream>
using namespace std;
class test
   {
    int data;
    friend int fun(int x);//declaration of friend function
```

```
public:
test()//constructor
{
    data = 5;
}
};
int fun(int x)
{
  test obj;
 //accessing private data by friend function
  return obj.data + x;
}
int main()
{
  cout << "Result is = "<< fun(4)<<endl;
  return 0;
}
```

Output

```
Result is = 9
```

Q.43 Explain merits and demerits of friend function.

☞ [SPPU : May-14, Marks 2]

Ans. : Merits

1. We can able to access the other class members in our class if, we use friend keyword.
2. We can access the members without inheriting the class.

Demerits

1. It can not be invoked by using object of particular class.
2. It can not be used to achieve runtime polymorphism.

END...

Unit II

2 Inheritance and Pointers

2.1 : Basic Concept of Inheritance

Q.1 Define the term inheritance.

Ans. : Inheritance is a property in which data members and member functions of some class are used by some other class.

2.2 : Base Class and Derived Class

Q.2 Explain the term base class and derived class.

Ans. : • The class from which the data members and member functions are used by another class is called the **base class.**

The class which uses the properties of base class and at the same time can add its own properties is called **derived class.**

2.3 : Public and Private Inheritance

Q.3 Write a C++ program to inherit a base class in public mode.

Ans. :

```
#include <iostream>
using namespace std;
class Base
{
 int x;
 public:
 void set_x(int n)
 {
    x = n;
 }
```

```
void show_x( )
{
   cout <<"\n x= "<<x;
}
};
// Inherit as public
class derived : public Base
{
 int y;
 public:
 void set_y(int n)
 {
   y = n;
 }
 void show_y()
 {
   cout <<"\n y= "<<y;
 }
};

int main()
{
 derived obj;//object of derived class
 int x, y;
 cout<<"\n Enter the value of x";
 cin>>x;
 cout<<"\n Enter the value of y";
 cin>>y;
//using obj of derived class base class member is accessed
 obj.set_x(x);
 obj.set_y(y); // access member of derived class
 obj.show_x(); // access member of base class
 obj.show_y(); // access member of derived class
 return 0;
```

```
}
```

Output

```
Enter the value of x30

Enter the value of y70

        x= 30
        y= 70
```

In above program the *obj* is an object of derived class. Using *obj* we are accessing the member function of base class. The derived class inherits base class using an access specifier public.

Q.4 Write a C++ program to inherit base class in private mode.

Ans. :

```
#include <iostream>
using namespace std;
class Base
{
 int x;
 public:
 void set_x(int n)
 {
    x = n;
 }
 void show_x( )
 {
    cout <<"\n x= "<<x;
 }
};
// Inherit as private
class derived : private Base
{
 int y;
 public:
 void set_y(int n)
```

```
{
   y = n;
}
void show_y()
{
   cout <<"\n y= "<<y;
}
};


int main()
{
derived obj;//object of derived class
int x, y;
cout<<"\n Enter the value of x";
cin>>x;
cout<<"\n Enter the value of y";
cin>>y;
obj.set_x(x); // error: not accessible
obj.set_y(y);
obj.show_x(); // access member of base class
obj.show_y(); // error:not accessible
return 0;
}
```

As indicated by the comments the above program will generate error messages "*not accessible*". This is because the derived class inherits the base class privately. Hence the public members of base class become private to derived class.

2.4 : Protected Members

Q.5 Explain why and when do we use protected instead of private ?

☞ **[SPPU : Dec.-15, Marks 4]**

Ans. : The *protected* access specifier is equivalent to the *private* specifier with the sole exception that protected members of a base class are accessible to members of any class derived from that base. Outside the base or derived classes, protected members are not accessible.

Thus normally protected access specifier is used in the situations when the immediate derived class members want to access the base class members but the derived-derived class members are prohibited to access the base class members.

2.5 : Relationship between Base Class and Derived Class

Q.6 What are the advantages of inheritance ?

Ans. : One of the key benefits of inheritance is to minimize the amount of duplicate code in an application by sharing common code amongst several subclasses.

1. **Reusability :** The base class code can be used by derived class without any need to rewrite the code.
2. **Extensibility :** The base class logic can be extended in the derived classes.
3. **Data hiding :** Base class can decide to keep some data private so that it cannot be altered by the derived class.
4. **Overriding :** With inheritance, we will be able to override the methods of the base class so that meaningful implementation of the base class method can be designed in the derived class.

2.6 : Constructor and Destructor in Derived Class

Q.7 Explain the execution process of constructors and destructors in derived class.

Ans. : • When we create an object for derived class then first of all the Base class constructor is called and after that the Derived class constructor is called.

- When the main function finishes running, the derived class's destructor will get called first and after that the Base class destructor will be called.
- This is also called as **chain of constructor** calls.

```
class Base {
public:
 Base()
 {   cout << "Base constructor" << endl;  }
  ~Base()
 {   cout << "Base destructor" << endl;  }
};
class Derived:public Base {
public:
 Derived()
 {   cout << "Derived constructor" << endl;  }
 ~Derived ( )
 {   cout << "Derived destructor" << endl;  }
};
void main()
{
 Derived obj;
}
```

The output of above code will be invoking of base class constructor, then derived class constructor, then derived class destructor and finally base destructor.

2.7 : Overriding Member Functions

Q.8 Explain the function overriding concept with suitable example

Ans. : Definition : Redefining a function in a derived class is called function overriding.

For example - Consider following C++ program that uses the same function name i.e. **print_msg** in base class and derived class. The

function print_msg in derived class overrides the base class function print_msg

```
class A
{
    private:
        int a,b;
    public:
        void get_msg()
        {
            a=10;
            b=20;
        }
        void print_msg()
        {
            int c;
            c=a+b;//performing addition
            cout<<"\n C(10+20)= "<<c;
            cout<<"\n I'm print_msg() in class A";
        }
};
class B : public A
{
    private:
        int a,b;
    public:
        void set_msg()
        {
            a=100;
            b=10;
        }
        void print_msg()
        {
            int c;
```

```
            c=a-b;//performing subtraction in this function
             cout<<"\n\n C(100-10) = "<<c;
             cout<<"\n I'm print_msg() in class B ";
        }
};
void main()
 {
     A obj_base;
     B obj_derived;
     obj_base.get_msg();
     obj_base.print_msg();//same function name
     obj_derived.set_msg();
     obj_derived.print_msg();//but different tasks
 }
```

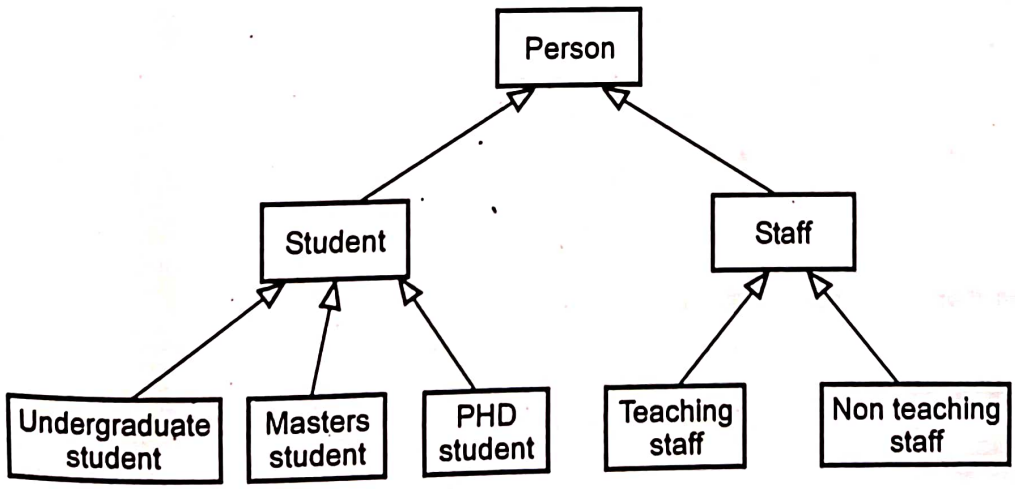
The above program will display 30 due to execution of **print_msg** function of base class and 90 due to execution of **print_msg** function of derived class.

2.8 : Class Hierarchies

Q.9 Write short note on class hierarchies.

Ans. : Inheritance is a mechanism in which using base class, various classes can be derived. Following diagram represents the class hierarchy. The class hierarchy is normally represented by **class diagram**

Example :



The implementation of class hierarchy is possible using **hierarchical inheritance.**

2.9 : Types of Inheritance

Q.10 With suitable examples, explain different types of inheritance.
☞ [SPPU : Dec.-15, Marks 4]

Or Write a note on type - single, multiple and hierarchical.
☞ [SPPU : May-16, Dec.-19, Marks 6]

Ans. : Various types of inheritance are - 1. Single inheritance 2. Multilevel inheritance 3. Multiple inheritance 4. Hybrid inheritance.

1. Single inheritance

In single inheritance one child class is derived from one base class.

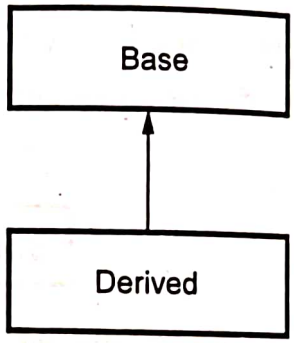


Fig. Q.10.1 Single inheritance

```
#include <iostream>
using namespace std;
class Base
{
public:
    int x;
    void set_x(int n)
    {
        x = n;
    }
    void show_x()
    {
        cout << "\n\t x = " << x;
    }
};
class derived : public Base
{
    int y;
public:
```

```
    void set_y(int n)
    {
        y = n;
    }
    void show_xy()
    {
        cout < "\n\t x = " << x;
        cout < "\n\t y = " << y;
    }
};
int main()
{
    derived obj;
    int x, y;
    cout << "\n Enter the value of x";
    cin >> x;
    cout << "\n Enter the value of y";
    cin >> y;
    obj.set_x(x);//inherits base class
    obj.set_y(y); // access member of derived class
    obj.show_x();//inherits base class
    obj.show_xy(); // access member of derived class
    return 0;
}
```

2. Multilevel inheritance :

It is a kind of inheritance in which the derived class is derived from a single base class which itself is a derived class.

```
class A
{
    protected:
        int x;
```

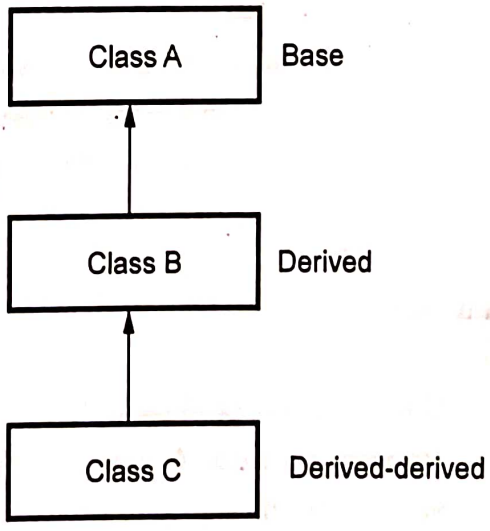


Fig. Q.10.2 Multilevel Inheritance

```
    public:
    void get_a(int a)
    { x=a; }
    void put_a()
    { cout<< "\n The value of x is "<< x; }
};
class B:public A
{
    protected:
        int y;
    public:
        void get_b(int b)
        {  y=b;   }
        void put_b()
        { cout<<"\n The value of y is "<<y;  }
};
class C:public B
{
    int z;
    public:
        void display()
        {
            z=y+10;
            put_a();//member of class A
            put_b();//member of class B
            cout<<"\n The value of z is "<<z;
        }
};
int main()
{
    C obj;//object of class C
    //accessing class A member via object of class C
    obj.get_a(10);
    //accessing class B member via object of class C
```

Output

The value of x is 10
The value of y is 20
The value of z is 30

```
    obj.get_b(20);
    ////accessing class C member via object of class C
    obj.display();
    cout<<endl;
    return 0;
}
```

3. Multiple Inheritance :

In multiple inheritance the derived class is derived from more than one base class.

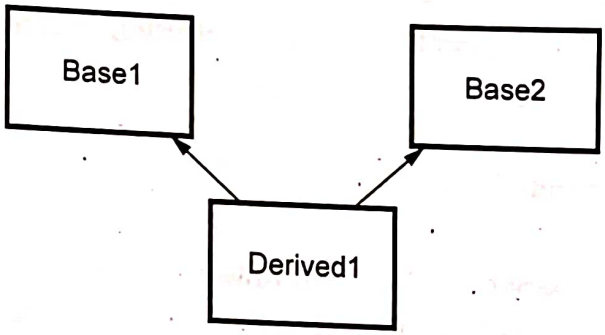


Fig. Q.10.3 Multiple inheritance

The implementation of multiple inheritance is as shown in Fig. Q.10.3

```
class Base1
{
   protected:
      int a;
   public:
      void set_a (int x)
      { a=x;  }
};
class Base2
{
   protected:
      int b;
   public:
      void set_b (int y)
      { b=y;  }
};
class Derived: public Base1, public Base2
{
```

```
    public:
        void addition()
        {
            int c;
            //reading value of a from Base1 class
            //reading value of b from Base2 class
            //perfoming addition of two numbers in Derived class
            c=a+b;
            cout<<"\n The Addition of two numbers = "<<c;
        }
};
int main ()
{
    Derived obj;//using object of derived class
    obj.set_a(10);//accesing Base1 class member function
    obj.set_b(20);//accessing Base2 class member function
    obj.addition();//accessing Derived class member function
    return 0;
}
```

The above program will use value of **a** from **Base1** class, value of **b** from **Base2** class and in **Derived** class the addition function for adding these two values is written. The output of above program will be 30.

4. Hierarchical Inheritance :

In this type of inheritance, there is single base class from which more than one derived classes can be derived. Fig. Q.10.4. Following program illustrates this idea.

```
class Base
{
    protected:
        int a;
    public:
        void set_a (int x)
        { a=x; }
```

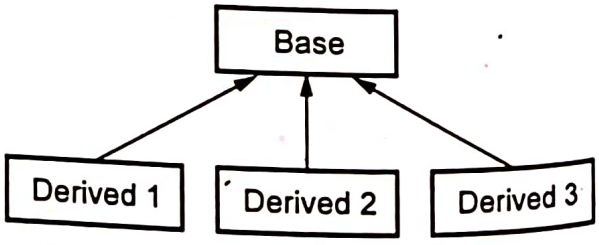


Fig. Q.10.4 Hierorchical Inheritance

```
};
class Derived1:public Base
{
    public:
        void add_ten()
        {
            int ans;
            ans=a+10;
            cout<<"\n After adding 10, result = "<<ans;

        }
};
class Derived2:public Base
{
    public:
        void Subtract_ten ()
        {
            int ans;
            ans=a-10;
            cout<<"\n After subtracting 10, result = "<<ans;

        }
};
class Derived3:public Base
{
    public:
        void mul_ten()
        {
            int ans;
            ans=a*10;
            cout<<"\n After multiplying by 10, result = "<<ans;
        }
};
int main ()
```

```
{
    Derived1 obj1;
    Derived2 obj2;
    Derived3 obj3;
    obj1.set_a(10); //using base class functionality
    obj1.add_ten();//using derived class functionality
    obj2.set_a(10); //using base class functionality
    obj2.Subtract_ten();//using derived class functionality
    obj3.set_a(10); //using base class functionality
    obj3.mul_ten();  //using derived class functionality
    return 0;
}
```

The above program passes value 10 to the base class functionality and performs addition by 10, subtraction by 10 and multiplication by 10 using three derived classes respectively.

2.10 : Ambiguity in Multiple Inheritance

Q.11 Explain the ambiguity problem in inheritance with suitable example.

Ans. : • Ambiguity is the problem that arise in multiple inheritance. It is also called as **diamond problem.**

Consider the following Fig. Q.11.1. (Refer Q.11.1 on next page)

• Now the code for the above design can be written as

```
class A
{
 public:
     read();
     write();
};
class B:public A
{
 public:
```

```
    read();
    write();
};
class C:public A
{
 public:
    write();
};
class D:public B,public C
{
 public:
        write();
};
```

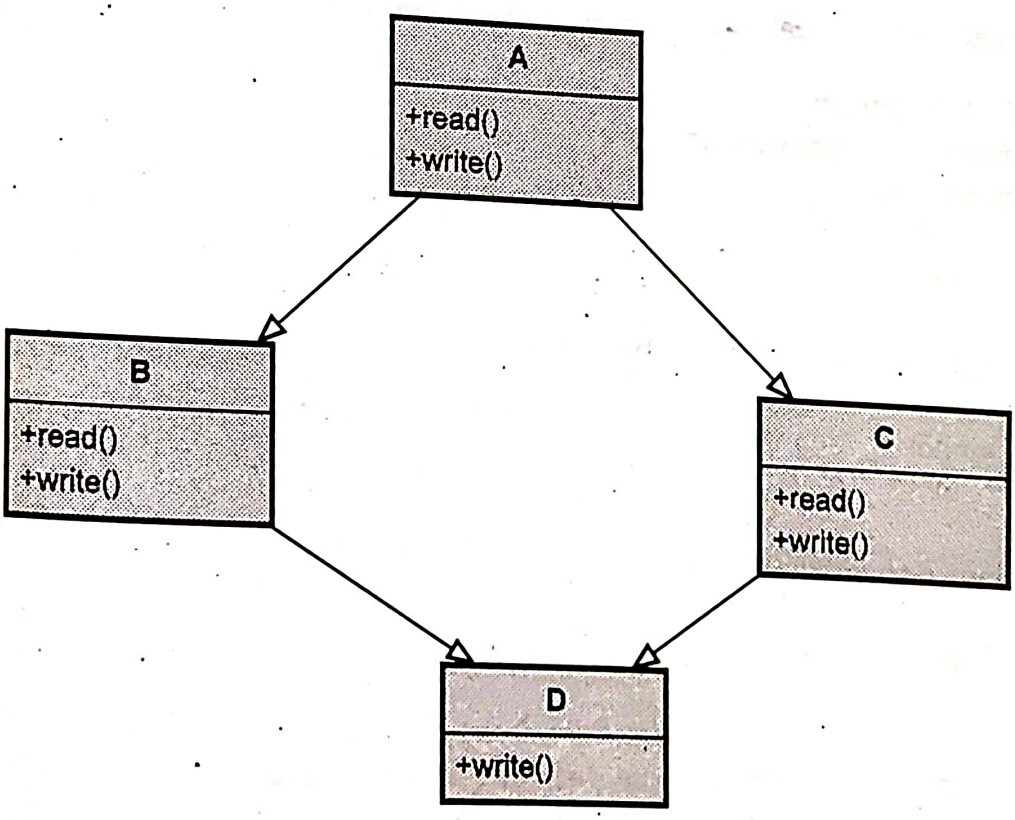


Fig. Q.11.1 Ambiguity in Inheritance

- We try to inherit the **write()** function of base class A in class B and C, which will be alright. But if try to use the **write()** function in class D then the compiler will generate error, because it is ambiguous to know which **write()** function to choose whether of class B or class C. This ambiguity occurs because the compiler understands that the class D is derived from both class B and class C and both of these classes have the versions of **write()** function. So the **A** class gets duplicated inside the class D object.

2.11 : Virtual Base Class

Q.12 What is virtual base class ? Explain it with suitable example.

Ans. : In order to prevent the compiler from giving an error due to ambiguity in multiple path or multiple inheritance, we use the keyword virtual. That means when we inherit from the base class in both derived classes, the base class is made virtual. The code that illustrates the concept of virtual base class is as given below -

C++ Program

```
#include<iostream.h>
class base {
    public:
     int i;
};
class derived1:virtual public base
{
 public:
     int j;
};
class derived2:virtual public base
{
     public:
     int k;
};
//derived3 is inherited from derived1 and derived2
//but only one copy of base class is inherited.
class derived3:public derived1,public derived2
{
```

```
public:
    int sum()
    {
        return i+j+k;
    }
};
void main()
{
 derived3 obj;
    obj.i=10;
    obj.j=20;
    obj.k=30;
    cout<" The sum is  = "<obj.sum();
}
```

Output

The sum is = 60

Program Explanation

In above program if we do not write the keyword virtual while deriving the classes derived1 and derived2 then compiler would have generated error messages stating the ambiguity in accessing the member of base class.

The sum is a function which can access the variables i, j and k of parent classes. In main function we have created an object obj of derived3 class and using this object i, j and k can be accessed.

2.12 : Abstract Class

Q.13 What is abstraction ? Why it is important ? Describe abstract base class. Illustrate an example to explain it.

☞ [SPPU : May-15, Marks 8]

Ans. : • Abstraction is a mechanism by which only essential information is presented to the outside world and background details are hidden.

• Due to abstraction only essential information is presented to the user.

- Abstract base class is class which contains at least one pure virtual function. The pure virtual function has a keyword **virtual** and it is assigned with 0.
- The abstract class is used to specify interface which is implemented by all the subclasses.
- Following C++ code represents the abstract base class.

```
class area
{
    double dim1, dim2;
    public:
      void setarea(double d1, double d2)
      {
          dim1 = d1;
          dim2 = d2;
      }
      void getdim(double &d1, double &d2)
      {
          d1 = dim1;
          d2 = dim2;
      }
      virtual double getarea() = 0; // pure virtual function
};
class square : public area
{
    public:
        double getarea()
        {
          double d1, d2;
          getdim(d1, d2);
          return d1 * d2;
        }
};
class triangle : public area
```

```
{
    public:
        double getarea()
        {
            double d1, d2;
            getdim(d1, d2);
            return 0.5 * d1 * d2;
        }
};
int main()
{
    area *p;
    square s;
    triangle t;
    int num1=10;
    int num2=20;
    cout<<"\n Calculating area of square";
    s.setarea(num1,num2);
    p = &s;
    cout <<"\nArea of square is : " << p->getarea();
    cout<<"\n Calculating area of triangle";
    t.setarea(num1,num2);
    p = &t;
    cout << "\nArea of Triangle is: "<< p->getarea() ;
    return 0;
}
```

The above program will display area of square as 200 and area of triangle is 100.

Q.14 What are abstract classes ? Write a program having student as an abstract class and create many derived classes such as engineering, science, medical etc. from the student class. Create their object and process them.

Ans. :

```
#include<iostream>
#include<cstring>
```

```
using namespace std;
class Student
{
 char name[10];
public:
    void SetName(char n[10])
    {
        strcpy(name,n);
    }
    void GetName(char n[10])
    {
        strcpy(n,name);
    }
    virtual void qualification()=0;
};

class Engg:public Student
{
public:
    void qualification()
    {
        char n[10];
        GetName(n);
        cout<<n<<" is a an engineering student"<<endl;
    }
};
class Medical:public Student
{
public:
    void qualification()
    {
        char n[10];
        GetName(n);
        cout<<n<<" is a medical student"<<endl;
```

```
    }
};
int main()
{
    Student *s;
    Engg e;
    Medical m;
    char nm[10];
    cout<<"\n Enter the name: "<<endl;
    cin>>nm;
    e.SetName(nm);
    s=&e;
    s->qualification();
    cout<<"\n Enter the name: "<<endl;
    cin>>nm;
    m.SetName(nm);
    s=&m;
    s->qualification();
    return 0;
}
```

Output

```
Enter the name:
Ramesh
Ramesh is a an engineering student

Enter the name:
Suresh
Suresh is a medical student
```

2.13 : Friend Class

Q.15 Explain the friend class concept.

Ans. : Similar to a friend function one can declare a class as a friend to another class. This allows the friend class to access the private data members of the another class.

For example

```
class A
      {
        private:
          int data;
          friend class B;//class B is friend of class A
        public:
        A()//constructor
        {
          data = 5;
         }
      };
  class B
     {
       public:
         int sub(int x)
         {
          A obj1; //object of class A
          //the private data of class A is accessed in class B
          // data contains 5 and x contains 2
          return obj1.data – x;
         }
    };
```

2.14 : Nested Class

Q.16 What is nested class ? Write a C++ program to demonstrate the concept of nested class.

Ans. : When one class is defined inside the other class then it is called the nested class. The nested class can access the data member of the outside class. Similarly the data member of the nested can be accessed from the main. Following is a simple C++ program that illustrates the use of nested class.

```
/**************************************************************************
The program for demonstration of nested class
**************************************************************************
******************/
#include<iostream.h>
class outer
{
 public:
    int a;     // Note that this member is public
    class inner
    {
     public:
       void fun(outer *o,int val)
     {
         o->a = val;
         cout<<"a= "<<o->a;
       }
    };//end of inner class
};//end of outer class
void main()
{
   outer obj1;
   outer::inner obj2;
   obj2.fun(&obj1,10); //invoking the function of inner class

}
```

Output

```
a= 10
```

2.15 : Pointers : Declaration and Initialization

Q.17 Define pointer and explain its initialization.

Ans. : Definition : A pointer is a variable that represents the memory location of some other variable. The purpose of pointer is to hold the memory location and not the actual value. For example -

```
a=10; /*storing some value in a*/
ptr=&a;/*storing address of a in ptr*/
b=*ptr;/*getting value from address in ptr and storing it in b*/
```

2.16 : Memory Management : New and Delete

Q.18 Explain the purpose of new and delete operators with suitable examples.

Ans. : The dynamic memory allocation is done using an operator **new.**

For example :

```
int *p;
p=new int;
```

We can allocate the memory for more than one element. For instance if we want to allocate memory of size in for 5 elements we can declare.

```
int *p;
p=new int[5];
```

The memory can be deallocated using the delete operator.

For example : `delete p;`

C++ Program using new and delete operators

```
int main ( )
{
 int i,n;
 int *p;
 cout << "How many numbers would you like to type? ";
 cin >> i;
 p= new int[i];//dynamic memory allocation
 if (p == 0)
```

```
    cout << "Error: memory could not be allocated";
  else
  {
   for (n=0; n<i; n++)
   {
    cout << "Enter The Number: ";
    cin >> p[n];
   }
   cout << "You have entered: ";
   for (n=0; n<i; n++)
    cout <<" " <<p[n];
   delete[] p;//dynamic memory deallocation
  }
  return 0;
}
```

2.17 : Pointers to Object

Q.19 Is it possible to use pointer to object ? If yes, explain how.

Ans. : Yes, it is possible to use pointer to object. Following C++ code shows how to use pointer to object

```
class Test
{
 int a;
public:
 Test(int b)
 {
   a = b;
 }
 int getVal()
 {
   return a;
 }
};
int main()
```

```
{
 Test obj(100), *ptr_obj;
 ptr_obj = &obj;

 cout <<"Value obtained using pointer to object is ..."<<endl;
 cout<<ptr_obj->getVal()<<endl;
 return 0;
}
```

Address of **obj** is stored in pointer variable.

2.18 : this Pointers

Q.20 Write short note on - this pointer. ☞ [SPPU : Dec.-14, Marks 3]

OR Explain the term - this pointer. ☞ [SPPU : Dec.-15, Marks 2]

OR What is the use of this pointer ? ☞ [SPPU : Dec.-19, Marks 2]

Ans. : The this pointer is a special type of pointer which is used to have the access to the address of its object. This pointer is passed as a hidden parameter to the member function call. For example -

```
class test
   {
    private:
       int num;
    public:
       void get_val(int num)
       {
      //this pointer retreives the value of obj.num
      //this pointer is hidden by automatic variable num
         this ->num=num;
       }
       void print_val()
       {
        cout<<"\n The value is "<<num;
       }
   };
```

2.19 : Pointers Vs. Arrays

Q.21 What is the difference between Pointers and Arrays ?
Ans. :

Sr.No.	Array	Pointer
1	Array is a collection of similar data type elements.	Pointer is a variable that can store an address of another variable.
2	Arrays are static in nature that means once the size of array is declared we can not resize it.	Pointers are dynamic in nature, that means the memory allocation and deallocation can be done using new and delete operators .
3	Arrays are allocated at compile time	Pointers are allocated at run time.
4	Syntax: type var_name[size];	Syntax: type *var_name;

2.20 : Accessing Arrays using Pointers

Q.22 Write a program using pointer for searching the desired element from the array.
Ans. :

```
#include<iostream>
using namespace std;
void main()
{
   int a[10], i, n, *ptr, key;
   cout<<"\n How Many elements are there in an array ? ";
   cin>>n;
   cout<<"\n Enter the elements in an array ";
   for (i = 0; i<n; i++)
      cin>>a[i];
```

```
    ptr = &a[0];/*copying the base address in ptr */
    cout<<"\n Enter the Key element ";
    cin>>key;
    for (i = 0; i<n; i++)
    {
        if (*ptr == key)
        {
            cout<<"\n The element is present ";
            break;
        }
        else
            ptr++; /*pointing to next element in the array*/
                /*Or write ptr=ptr+i*/
    }
}
```

2.21 : Pointer Arithmetic

Q.23 Explain various pointer arithmetic operations.

☞ [SPPU : Dec.-18, Marks 4]

Ans. : Pointer arithmetic means performing arithmetic operations on pointers. Following are various pointer arithmetic operations -

Operation	Meaning
x=*ptr1 * *ptr2	Multiplication of two pointer variables is possible in this way.
x=ptr1–ptr2	The subtraction of two pointer variables.
ptr1– – or ptr1 ++	The pointer variable can be incremented or decremented.
x=ptr1+10	We can add some constant to pointer variable.
x=ptr1–20	We can subtract a constant value from the pointer.

ptr1<ptr2	The relational operations are possible on pointer variable while comparing two pointers.
ptr1>ptr2	
ptr1==ptr2	
ptr1<=ptr2	
ptr1>=ptr2	
ptr1!=ptr2	

2.22 : Arrays of Pointers

Q.24 What is array of pointers ? Explain with pseudo code.

Ans. : The array of pointers means the array locations are containing the address of another variable which is holding some value. For example,

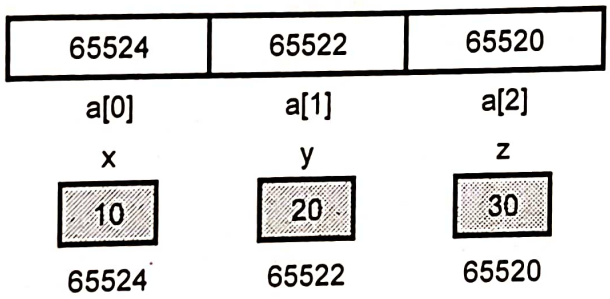


Fig. Q.24.1 Array of pointers

The array of pointers is the concept which is mainly used when we want to store the multiple strings in an array. Here we have simply taken the integer values in three different variables x, y and z. The addresses of x, y and z are stored in the array a. This concept is implemented by following simple C++ program.

```
#include<iostream>
using namespace std;
void main()
{
   int *a[10];/*array is declared as of pointer type*/
   int i, x, y, z;
```

```
    cout<<"\n Enter The Array Elements ";
    cin > x >> y >> z;

    a[0] = &x;/*storing the address of each variable in array location */
    a[1] = &y;
    a[2] = &z;

    for (i = 0; i<3; i++)
    {
        cout<<"\nThe element "<<*a[i]<<" is at location "<<a[i];
    }
}
```

Output

```
Enter The Array Elements
    10
    20
    30
    The element 10 is at location 65524
    The element 20 is at location 65522
    The element 30 is at location 65520
```

2.23 : Function Pointers

Q.25 Explain the concept of function pointers with suitable example. ☞ [SPPU : May-19, Marks 5]

Ans. : • The pointer to the function means a pointer variable that stores the address of function.

- The function has an address in the memory same like variable. As address of function name is a memory location, we can have a pointer variable which will hold the address of function.

- **Syntax**

```
Return_Type *pointer_variable (data_type);
```

- **For example,**

```
float (*fptr)(float);
```

Here **fptr** is a pointer to the function which has float parameter and returns the value float.

The following program illustrates the use of pointer to the function

```
void main()
{
   void display(float(*)(int), int);
   float area(int);
   int r;
   cout<<"\n Enter the radius ";
   cin>>r;
   display(area, r);/*function is passed as a parameter to another
function*/
}
void display(float(*fptr)(int), int r)
{
   /*call to pointer to function*/
   cout<<"\n The area of circle is "<(*fptr)(r);
}
float area(int r)
{
   return (3.14*r*r);
}
```

Q.26 Write a program to find the sum of an array Arr by passing an array to a function using pointer. ☞ [SPPU : Dec.-17, Marks 4]

Ans. :

```
#include <iostream>
using namespace std;
int fun(const int *arr, int size)
{
  int sum = *arr;
  for (int i = 1; i < size; ++i)
```

```
  {
    sum = sum+ *(arr+i);
  }
  return sum;
}

int main()
 {
  const int SIZE = 5;
  int numbers[SIZE] = {10, 20, 90, 76, 22};
  cout << "The sum of array is: "<<fun(numbers, SIZE) << endl;
  return 0;
}
```

Q.27 Explain pointer to a variable and pointer to a function. Use suitable example. ☞ [SPPU : May-18, Marks 4]

Ans. : • **Pointer to variable :** A pointer is a variable that represents the memory location of some other variable. The purpose of pointer is to hold the memory location and not the actual value.

• Consider the variable declaration

```
int *ptr;
```

ptr is the name of our variable. The * informs the compiler that we want a pointer variable, the int says that we are using our pointer variable which will actually store the address of an integer. Such a pointer is said to be **integer pointer.**

• **Pointer to function :** The pointer to the function means a pointer variable that stores the address of function.

• **Syntax**

```
Return_Type *pointer_variable (data_type);
```

For example

```
float (*fptr)(float);
```

Here **fptr** is a pointer to the function which has float parameter and returns the value float. Note that the parenthesis around fptr; otherwise the meaning will be different.

The following program illustrates the use of pointer to the function

```
#include<iostream>
using namespace std;
void main()
{
    void display(float(*)(int), int);
    float area(int);
    int r;
    cout<<"\n Enter the radius ";
    cin>>r;
    display(area, r);/*function is passed as a
        parameter to another function*/
}
void display(float(*fptr)(int), int r)
{
    /*call to pointer to function*/
    cout<<"\n The area of circle is "<(*fptr)(r);
}
float area(int r)
{
    return(3.14*r*r);

}
```

2.24 : Pointers to Pointers

Q.28 What is pointers to pointers ? Explain.

Ans. : A pointer can point to other pointer variables which brings the multiple level of indirection.

```
void main()
{
```

```
    int a;
    int *ptr1, **ptr2;
    a = 10;
    ptr1 = &a;
    ptr2 = &ptr1;
    cout<<"\n a = "<<a;
    cout<<"\n *ptr1 = "<<*ptr1;/*value at address in ptr1*/
    cout<<"\n ptr1 = "<<ptr1;/*storing address of a*/
    cout<<"\n *ptr2 = "<<*ptr2;/*storing address of ptr1*/
    cout<<"\n ptr2 = "<<ptr2;/*address of ptr2*/

}
```

In above program address of variable **a** is stored in a pointer variable **ptr1**. Similarly address of pointer variable **ptr1** is stored in variable **ptr2**. Thus **ptr2** is a pointer to pointer because it stores address of (65524) a variable which is already holding some address (65526). Hence we have declared ptr2 as :

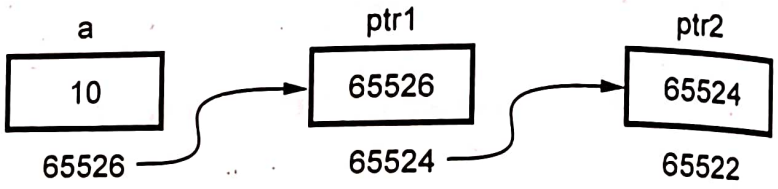


Fig. Q.28.1 Pointer to Pointer

```
int **ptr2;
```

2.25 : Pointers to Derived Classes

Q.29 Is it possible to declare a pointer pointing to a derived class ? If yes, justify.

Ans. : • It is possible to declare a pointer that points to the derived class.

• Using this pointer, one can access the data attributes as well as member functions of derived class.

Example Program

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

```
{
public:
    int a;
};
class Derived :public Base
{
public:
    int b;
    void display()
    {
        cout << "\n a= " << a << "\n b= " << b;
    }
};
int main()
{
    Derived obj;
    Derived *ptr; //Pointer to derived class
    ptr = &obj;
    ptr->a = 100;
    ptr->b = 200;
    ptr->display();
}
```

Output

```
a= 100
b= 200
```

2.26 : Null Pointer

Q.30 What is NULL pointer ? Explain.

Ans. : • Pointer that are not initialized with valid address may cause some substantial damage. For this reason it is important to initialize them. The standard initialization is to the constant NULL.

• Using the NULL value as a pointer will cause an error on almost all systems.

- Literal meaning of NULL pointer is a pointer which is pointing to nothing.
- NULL pointer points the base address of segment.

Following is a simple program that illustrates the problem of Null pointer

```
/*****************************************************************
Program for illustrating null pointer problem
*****************************************************************
***********/
#include <iostream.h>
#include <string.h>
void main()
{
    char *str=NULL;
    strcpy(str,"HelloFriends");
    cout<str;
}
```

In above program we are trying to copy some string in the Null pointer. One can not copy something to Null pointer. Due to which the Null Pointer problem occurs.

2.27 : Void Pointer

Q.31 What is void pointer ?

Ans. : • The void pointer is a special type of pointer that can be used to point to the objects of any data type. It is also known as generic pointer.

- The void pointer is declared like normal pointer declaration, using the keyword void.
- For example :

```
void *ptr;
```

END...