CYCLE 4

1. Create a Graphics package that has classes and interfaces for figures Rectangle, Triangle, Square and Circle. Test the package by finding the area of these figures.

CODE :-

```
import package_graphics.*;
import java.util.Scanner;
public class Q1
 {
public static void main(String []args)
{
  System.out.println("course_name:OOP LAB");
   System.out.println("Course_code:20MCA132");
   System.out.println("  Name     : Aparna Jayakumar");
   System.out.println("Register_no: SJC22MCA-2012");
   System.out.println("  Date     :21/06/2023");
package_graphics testObj = new package_graphics();
int l,h,r,a,c,d;
Scanner s=new Scanner(System.in);
System.out.println("Enter the length for rectangle");
l=s.nextInt();
System.out.println("Enter the breadth for rectangle");
h=s.nextInt();
System.out.println("Enter the radius of circle");
r=s.nextInt();
System.out.println("Enter the side for Square");
a=s.nextInt();
System.out.println("Enter the breadth for triangle");
c=s.nextInt();
System.out.println("Enter the height for triangle");
d=s.nextInt();
System.out.println("Area of rectangle="+testObj.recArea(l,h));
System.out.println("Area of circle="+testObj.cirArea(r));
System.out.println("Area of square="+testObj.squArea(a));
System.out.println("Area of triangle="+testObj.triArea(c,d));
}
}
```

Packge_graphics

Package_graphics.java

```
package package_graphics;
interface interface_graphics{
   public float recArea(int l, int h);
   public float cirArea(int r);
   public float squArea(int a);
   public float triArea(int l, int h);
}
public class package_graphics implements interface_graphics {
    public float recArea(int l, int h){
        return l*h;
    }
    public float cirArea(int r){
        return r*r*(float)3.14;
    }
    public float squArea(int a){
        return a*a;
    }
    public float triArea(int l, int h){
        return l*h*(float)(.5);
    }
}
```

Output

```
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q1.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q1
course_name:OOP LAB
Course_code:20MCA132
  Name     : Aparna Jayakumar
Register_no: SJC22MCA-2012
  Date     :21/06/2023
Enter the length for rectangle
2
Enter the breadth for rectangle
3
Enter the radius of circle
3
Enter the side for Square
4
Enter the breadth for triangle
2
Enter the height for triangle
4
Area of rectangle=6.0
Area of circle=28.26
Area of square=16.0
Area of triangle=4.0
```

2. Create an Arithmetic package that has classes and interfaces for the 4 basic arithmetic operations. Test the package by implementing all operations on two given numbers

Code :-

```
import arithmetic.ArithmeticOperations;
import java.util.Scanner;
public class Q2 {
public static void main(String[] args)
{
System.out.println("Name:Aparna Jayakumar\nReg No:22MCA012\nCourse
Code:20MCA132\nCourse Name:OBJECT ORIENTED PROGRAMMING
LAB\nDate:26/06/2023\n\n");
 ArithmeticOperations operations = new ArithmeticOperations();
Scanner scanner = new Scanner(System.in);
System.out.print("Enter the first number: ");
double num1 = scanner.nextDouble();
System.out.print("Enter the second number: ");
double num2 = scanner.nextDouble();
System.out.println("Addition: " + operations.add(num1, num2));
System.out.println("Subtraction: " + operations.subtract(num1, num2));
System.out.println("Multiplication: " + operations.multiply(num1, num2));
System.out.println("Division: " + operations.divide(num1, num2));
}
}
```

Arithmetic

Addition.java

```
package arithmetic;
public interface Addition {
   public double add(double num1, double num2);
}
```

Arithemeticoperations.java

```
package arithmetic;
public class ArithmeticOperations implements Addition, Subtraction, Multiplication,
Division {
   @Override
   public double add(double num1, double num2) {
      return num1 + num2;
   }  @Override
   public double subtract(double num1, double num2) {
      return num1 - num2;
   } @Override
   public double multiply(double num1, double num2) {
      return num1 * num2;
   } @Override
   public double divide(double num1, double num2) {
      if (num2 == 0) {
         throw new ArithmeticException("Division by zero error!");
```

```
        }
return num1 / num2;
    }
}
```

Division.java

```
package arithmetic;
public interface Division {
    public double divide(double num1, double num2);
}
```

Multiplication .java

```
package arithmetic;
public interface Multiplication {
    public double multiply(double num1, double num2);
}
```

Subtraction .java

```
package arithmetic;
public interface Subtraction {
    public double subtract(double num1, double num2);
}
```

Output

```
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q2.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q2
Name:Aparna Jayakumar
Reg No:22MCA012
Course Code:20MCA132
Course Name:OBJECT ORIENTED PROGRAMMING LAB
Date:26/06/2023


Enter the first number: 2
Enter the second number: 4
Addition: 6.0
Subtraction: -2.0
Multiplication: 8.0
Division: 0.5
```

3. Write a user defined exception class to authenticate the user name and password.

Code:-

```
import java.util.Scanner;
class authException extends Exception
{
public authException(String s) {
super(s);
}
}
public class Q3
{
public static void main(String[] args) {
  System.out.println("course_name:OOP LAB");
  System.out.println("Course_code:20MCA132");
  System.out.println("  Name     : Aparna Jayakumar");
  System.out.println("Register_no: SJC22MCA-2012");
  System.out.println("  Date     :16/06/2023");
String username = "student";
String passcode = "student123";
String user_name,password;
Scanner sc = new Scanner(System.in);
try
{
System.out.println("Enter the username:");
user_name = sc.nextLine();
System.out.println("Enter the password:");
password = sc.nextLine();
if(username.equals(user_name) && passcode.equals(password))
{
System.out.println("Authentication successful...");
}
else
throw new authException("Invalid user credentials");
```

```
}
catch(authException e)
{
System.out.println("Exception caught "+e);
}
}
}
```

Output

```
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q3.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q3
course_name:OOP LAB
Course_code:20MCA132
  Name     : Aparna Jayakumar
Register_no: SJC22MCA-2012
  Date     :16/06/2023
Enter the username:
aparna
Enter the password:
1234
Exception caught authException: Invalid user credentials
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q3.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q3
course_name:OOP LAB
Course_code:20MCA132
  Name     : Aparna Jayakumar
Register_no: SJC22MCA-2012
  Date     :16/06/2023
Enter the username:
student
Enter the password:
student123
Authentication successful...
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$
```

4. Find the average of N positive integers, raising a user defined exception for each negative input.

Code:-

```
import java.util.Scanner;
class NegException extends Exception
{
public NegException(String s)
{
super(s);
}
}

public class Q4 {
public static void main(String[] args)
{
   System.out.println("course_name:OOP LAB");
   System.out.println("Course_code:20MCA132");
   System.out.println("  Name     : Aparna Jayakumar");
   System.out.println("Register_no: SJC22MCA-2012");
   System.out.println("  Date     :16/06/2023");
int i;
double sum=0,avg=0;
Scanner sc=new Scanner(System.in);
System.out.println("Enter n numbers:");
int n=sc.nextInt();
for(i=1;i<=n;i++)
{
try
{
System.out.println("Enter number"+i);
int a=sc.nextInt();
if(a<0)
{
i--;
throw new NegException("Negative numbers not allowed,Try again");
```

```
}
else
{
sum=sum+a;
}
}
catch(NegException e)
{
System.out.println("NEGETIVE EXCEPTION OCCURED:"+e);
}
}
avg=sum/n;
System.out.println("Average is "+avg);
sc.close();
}
}
```

Output

```
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q4.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q4
course_name:OOP LAB
Course_code:20MCA132
  Name     : Aparna Jayakumar
Register_no: SJC22MCA-2012
  Date     :16/06/2023
Enter n numbers:
4
Enter number1
9
Enter number2
-8
NEGETIVE EXCEPTION OCCURED:NegException: Negative numbers not allowed,Try again
Enter number2
3
Enter number3
5
Enter number4
2
Average is 4.75
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$
```

5. Define 2 classes; one for generating multiplication table of 5 and other for displaying first N prime numbers. Implement using threads. (Thread class)

Code :-

```
import java.util.Scanner;
 class prime extends Thread{
    int num;
    public prime(int n){
        this.num=n;
    }
    public void run(){
        int x, y, flg;
        System.out.println("All the Prime numbers within 1 and " + num + " are:");
        for (x = 1; x <= num; x++) {
            if (x == 1 || x == 0)
                continue;
            flg = 1;
            for (y = 2; y <= x / 2; ++y) {
                if (x % y == 0) {
                    flg = 0;
                    break;
                }
            }
            if (flg == 1)
                System.out.print("prime number ="+x + "\n ");
        }
    }
}
 class mul extends Thread{
    public void run(){
        System.out.println("\n");
        for(int i =0;i<11;i++){
            System.out.println("5*"+i+" = "+5*i);
```

```
        }
    }
}
public class Q5{
    public static void main(String[] args) {
      System.out.println("course_name:OOP LAB");
   System.out.println("Course_code:20MCA132");
   System.out.println("  Name     : Aparna Jayakumar");
   System.out.println("Register_no: SJC22MCA-2012");
   System.out.println("  Date     :26/06/2023");
        System.out.println("Enter The number");
        Scanner sc = new Scanner(System.in);
        int number = sc.nextInt();
        mul obj1 = new mul();
        obj1.start();
        prime obj2 = new prime(number);
        obj2.start();
        System.out.println("\n");
    }
}
```

Output

```
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q5.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q5
course_name:OOP LAB
Course_code:20MCA132
  Name     : Aparna Jayakumar
Register_no: SJC22MCA-2012
  Date     :26/06/2023
Enter The number
6


5*0 = 0
5*1 = 5
5*2 = 10
5*3 = 15
5*4 = 20
5*5 = 25
5*6 = 30
5*7 = 35
5*8 = 40
5*9 = 45
5*10 = 50


All the Prime numbers within 1 and 6 are:
prime number =2
 prime number =3
 prime number =5
```

6. Define 2 classes; one for generating Fibonacci numbers and other for displaying even numbers in a given range. Implement using threads. (Runnable Interface)

Code : -

```
import java.util.Scanner;
class Fib extends Thread{
int f,n1=0,n2=1,n3;
Fib(int c){
this.f=c;
}
public void run(){
System.out.println("fib is "+n1);
System.out.println("fib is "+n2);
for(int i=2;i<this.f;++i) {
n3=n1+n2;
System.out.println("fib is "+n3);
n1=n2;
n2=n3;
}
}
}
class even extends Thread{
int range;
even(int range){
this.range=range;
}
public void run(){
for(int i=0;i<this.range;i++){
if(i%2==0){
System.out.println("even num is "+i);
}
}
}
}
```

```
public class Q6 {
public static void main(String [] args){
   System.out.println("course_name:OOP LAB");
   System.out.println("Course_code:20MCA132");
   System.out.println("  Name     : Aparna Jayakumar");
   System.out.println("Register_no: SJC22MCA-2012");
   System.out.println("  Date     :16/06/2023");
int c,range;
Scanner sc=new Scanner(System.in);
System.out.println("enter the count of Fibinooci");
c=sc.nextInt();
Fib fi=new Fib(c);
System.out.println("enter the range of even number");
range=sc.nextInt();
even ev = new even(range);
fi.start();
ev.start();
}
}
```

Output

```
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q6.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q6
course_name:OOP LAB
Course_code:20MCA132
  Name     : Aparna Jayakumar
Register_no: SJC22MCA-2012
  Date     :16/06/2023
enter the count of Fibinooci
3
enter the range of even number
4
fib is 0
even num is 0
even num is 2
fib is 1
fib is 1
```

7. Producer/Consumer using ITC

Code:-

```
import java.util.LinkedList;
class Buffer {
   private LinkedList<Integer> buffer;
   private int capacity;

   public Buffer(int capacity) {
      this.buffer = new LinkedList<>();
      this.capacity = capacity;
   }

   public void produce(int value) throws InterruptedException {
      synchronized (this) {
         while (buffer.size() == capacity) {
            wait();
         }

         buffer.add(value);
         System.out.println("Produced: " + value);
         notifyAll();
      }
   }

   public void consume() throws InterruptedException {
      synchronized (this) {
         while (buffer.isEmpty()) {
            wait();
         }

         int value = buffer.removeFirst();
         System.out.println("Consumed: " + value);
```

```
            notifyAll();
        }
    }
}

class Producer implements Runnable {
    private Buffer buffer;
    private int numProductions;

    public Producer(Buffer buffer, int numProductions) {
        this.buffer = buffer;
        this.numProductions = numProductions;
    }

    @Override
    public void run() {
        for (int i = 0; i < numProductions; i++) {
            try {
                buffer.produce(i);
                Thread.sleep(1000);
            } catch (InterruptedException e) {
                e.printStackTrace();
            }
        }
    }
}

class Consumer implements Runnable {
    private Buffer buffer;
    private int numConsumptions;

    public Consumer(Buffer buffer, int numConsumptions) {
        this.buffer = buffer;
        this.numConsumptions = numConsumptions;
    }
```

```
    @Override
    public void run() {
        for (int i = 0; i < numConsumptions; i++) {
            try {
                buffer.consume();
                Thread.sleep(2000);
            } catch (InterruptedException e) {
                e.printStackTrace();
            }
        }
    }
}

public class Q7{
    public static void main(String[] args) {
    System.out.println(" Name:Aparna Jayakumar Reg No:22MCA012 \n      course
Code and Name: 20MCA132 \n Date:23/06/2023 \n");
        Buffer buffer = new Buffer(5);
        int numProductions = 10;
        int numConsumptions = 10;

        Producer producer = new Producer(buffer, numProductions);
        Consumer consumer = new Consumer(buffer, numConsumptions);

        Thread producerThread = new Thread(producer);
        Thread consumerThread = new Thread(consumer);

        producerThread.start();
        consumerThread.start();
    }
}
```

Output

```
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q7.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q7
 Name:Aparna Jayakumar Reg No:22MCA012
 course Code and Name: 20MCA132
 Date:23/06/2023

Produced: 0
Consumed: 0
Produced: 1
Consumed: 1
Produced: 2
Produced: 3
Consumed: 2
Produced: 4
Produced: 5
Consumed: 3
Produced: 6
Produced: 7
Consumed: 4
Produced: 8
Produced: 9
Consumed: 5
Consumed: 6
Consumed: 7
Consumed: 8
Consumed: 9
```

8. Program to create a generic stack and do the Push and Pop operations.

Code :-

```
import java.util.*;
class operations{
public void operation()
   {
      int top =-1,ch,n,e;
       Scanner inp = new Scanner(System.in);
       System.out.println("Enter Size of Stack");
       n = inp.nextInt();
       int size=n-1;
       int[] arr = new int[n];

       do {
          System.out.println("\n============\n  MENU : \n1.push \n2.pop
\n3.Display \n4.Exit \n============");
          System.out.println("Enter your choice");
          ch = inp.nextInt();
          switch(ch)
          {
             case 1 :
                if(top == size)
                {
                   System.out.println(" ***  Stack is Full *** ");

                }
                else
                {
                   System.out.println("Enter Element : ");
                   e = inp.nextInt();
                   top++;
                   arr[top] =e;
                }
```

```
    break;

case 2 :
    if(top == -1)
    {
        System.out.println("\n***  Stack is empty *** ");

    }
    else
    {

        System.out.println("\n"+ arr[top] + " is removed ");
        top--;

    }
    Break;
case 3 :
    if(top == -1)
    {
        System.out.println(" ***  Stack is empty ***");
    }
    else
    {
        System.out.println("\n***  Stack : ***\n");
        for(int i=top;i>=0;i--)
        {
            System.out.println("  " +arr[i]);
            System.out.println("-----");
        }
    }
    break;

case 4 :
    System.exit(0);
```

```
            default : System.out.println("Invalid Choice");



          }
       }while(ch !=4);
}
}
public class Q8 {
 public static void main(String[] args) {
   System.out.println("course_name:OOP LAB");
  System.out.println("Course_code:20MCA132");
  System.out.println("  Name     : Aparna Jayakumar");
  System.out.println("Register_no: SJC22MCA-2012");
  System.out.println("  Date     :22/06/2023");
      operations obj = new operations();
      obj.operation();
   }
}
```

Output

```
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q8.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q8
course_name:OOP LAB
Course_code:20MCA132
  Name     : Aparna Jayakumar
Register_no: SJC22MCA-2012
  Date     :22/06/2023
Enter Size of Stack
1

=============
  MENU :
1.push
2.pop
3.Display
4.Exit
=============
Enter your choice
1
Enter Element :
23

=============
  MENU :
1.push
2.pop
3.Display
4.Exit
=============
Enter your choice
3

***  Stack : ***

  23
-----
```

```
=============
  MENU :
1.push
2.pop
3.Display
4.Exit
=============
Enter your choice
2

23 is removed

=============
  MENU :
1.push
2.pop
3.Display
4.Exit
=============
Enter your choice
4
```

9. Using generic method perform Bubble sort.

Code :-

```
import java.util.*;
class Q9 {
 void sort(int arr[])
   {
     int n = arr.length;
      for(int i =0;i < n-1;i++)
      {
         for(int j=0;j<n-i-1;j++)
         {
            if(arr[j] > arr[j+1])
            {
               int temp = arr[j];
               arr[j]=arr[j+1];
               arr[j+1]= temp;
            }
         }
      }
   }
void display(int arr[])
   {
      System.out.println("Sorted Array :");
      int n = arr.length;
      for(int i=0;i<n;i++)
      {
         System.out.print(arr[i]+ " ");
      }
   }
public static void main(String[] args)
   {
      int n,e;
      System.out.println("Enter size of Array :");
```

```
        Scanner inp =new Scanner(System.in);
        n = inp.nextInt();
        int[] arr = new int[n];
        for(int i=0;i<n;i++)
        {
           System.out.println("Enter element :");
           e = inp.nextInt();
           arr[i]=e;
        }
        Q9 ob = new Q9();
        ob.sort(arr);
        ob.display(arr);
        System.out.println("\n");
}
}
```

Output

```
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q9.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q9
Enter size of Array :
3
Enter element :
45
Enter element :
23
Enter element :
67
Sorted Array :
23 45 67
```

10. Maintain a list of Strings using ArrayList from collection framework, perform built-in operations.

Code :-

```
import java.util.*;
public class Q10 {

    public static void main(String[] args) {
   System.out.println("course_name:OOP LAB");
   System.out.println("Course_code:20MCA132");
   System.out.println("  Name     : Aparna Jayakumar");
   System.out.println("Register_no: SJC22MCA-2012");
   System.out.println("  Date     :23/06/2023");

        ArrayList<String> obj = new ArrayList<String>();
        obj.add("JAVA");
        obj.add("C");
        obj.add("PYTHON");
        obj.add("CSS");
System.out.println("\n Original ArrayList:");
        for(String str:obj)
            System.out.println(str);
obj.add(1, "PHP");
System.out.println("\n ArrayList after add operation:");
        for(String str:obj)
            System.out.println(str);
obj.remove("PHP");
System.out.println("\n ArrayList after remove operation:");
        for(String str:obj)
            System.out.println(str);
obj.remove(3);
System.out.println("\n Final ArrayList:");
        for(String str:obj)
            System.out.println(str);
```

```
Collections.sort(obj);
System.out.println("\n  ArrayList after sorting:");
      for (String str : obj)
         System.out.println(str);
System.out.println("\n Object at index 2:"+obj.get(2));
System.out.println("\n Six is in the ArrayList :"+obj.contains("degree"));
System.out.println("\n Two is in the ArrayList :"+obj.contains("dell"));
System.out.println("\n Size of the ArrayList:"+obj.size());
obj.clear();
 System.out.println("\n** ArrayList Removed **");
}
}
```

Output

```
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q10.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q10
course_name:OOP LAB
Course_code:20MCA132
  Name     : Aparna Jayakumar
Register_no: SJC22MCA-2012
  Date     :23/06/2023
Original ArrayList:
JAVA
C
PYTHON
CSS
ArrayList after add operation:
JAVA
PHP
C
PYTHON
CSS
ArrayList after remove operation:
JAVA
C
PYTHON
CSS
Final ArrayList:
JAVA
C
PYTHON
ArrayList after sorting:
C
JAVA
PYTHON
 Object at index 2:PYTHON
 Six is in the ArrayList :false
 Two is in the ArrayList :false
 Size of the ArrayList:3
** ArrayList Removed **
```

11. Program to remove all the elements from a linked list

Code :-

```
import java.util.*;
public class Q11 {
    public static  void main(String[] args){
      System.out.println("course_name:OOP LAB");
   System.out.println("Course_code:20MCA132");
   System.out.println("  Name     : Aparna Jayakumar");
   System.out.println("Register_no: SJC22MCA-2012");
   System.out.println("  Date     :21/06/2023");
       LinkedList<String> L=new LinkedList<>();
       L.add("JAVA");
       L.add("PYTHON");
       L.add("CSS");
       L.add(0,"PROGRAMING LANGUAGE");
       System.out.println(L);
       L.remove("CSS");
       System.out.println(L);
       L.remove(2);
       System.out.println(L);
       L.removeLast();
       System.out.println(L);
       L.removeFirst();
       System.out.println(L);
    }
}
```

12. Program to remove an object from the Stack when the position is passed as parameter

Code :-

```
import  java.util.*;
public class Q12 {
   public static void main(String[] args) {
  System.out.println("course_name:OOP LAB");
  System.out.println("Course_code:20MCA132");
  System.out.println("  Name     : Aparna Jayakumar");
  System.out.println("Register_no: SJC22MCA-2012");
  System.out.println("  Date     :23/06/2023");
      Stack<Integer> st = new Stack<>();
      st.push(12);
      st.push(67);
      st.push(89);
      st.push(23);
      System.out.println("Stack = "+st);
      Scanner sc = new Scanner(System.in);
      System.out.println("Enter the position : ");
      int x = sc.nextInt();
      st.remove(x);
      System.out.println("Stack = "+st);
   }
}
```

Output

```
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q12.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q12
course_name:OOP LAB
Course_code:20MCA132
  Name     : Aparna Jayakumar
Register_no: SJC22MCA-2012
  Date     :23/06/2023
Stack = [12, 67, 89, 23]
Enter the position :
2
Stack = [12, 67, 23]
```

13. Program to demonstrate the creation of queue object using the PriorityQueue class

Code :-

```
import java.util.PriorityQueue;

public class Q13 {
   public static void main(String[] args) {
  System.out.println("course_name:OOP LAB");
  System.out.println("Course_code:20MCA132");
  System.out.println("  Name     : Aparna Jayakumar");
  System.out.println("Register_no: SJC22MCA-2012");
  System.out.println("  Date     :23/06/2023");
      PriorityQueue <Integer> pq = new PriorityQueue<>();
      pq.add(10);
      pq.add(20);
      pq.add(15);
      System.out.println(pq);
      System.out.println(pq.peek());
      System.out.println(pq.poll());
      System.out.println(pq.peek());
   }
}
```

Output

```
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q13.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q13
course_name:OOP LAB
Course_code:20MCA132
  Name     : Aparna Jayakumar
Register_no: SJC22MCA-2012
  Date     :23/06/2023
[10, 20, 15]
10
10
15
```

14. Program to demonstrate the addition and deletion of elements in deque

Code :-

```
import java.util.*;
class Q14
{
public static void main(String[] args)
{
  System.out.println("course_name:OOP LAB");
   System.out.println("Course_code:20MCA132");
   System.out.println("  Name     : Aparna Jayakumar");
   System.out.println("Register_no: SJC22MCA-2012");
   System.out.println("  Date     :27/06/2023");
Deque<String> deque = new LinkedList<String>();
deque.add("Java");
deque.addFirst("Python");
deque.addLast("Data Structure");
deque.push("Web-programming");
deque.offer("Networking");
deque.offerFirst("DBMS");
System.out.println("-----------OUTPUT---------");
System.out.println(deque + "\n");
deque.removeFirst();
deque.removeLast();
System.out.println("Deque after removing " + "first and last: " + deque);
}
}
```

Output

```
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q14.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q14
course_name:OOP LAB
Course_code:20MCA132
  Name     : Aparna Jayakumar
Register_no: SJC22MCA-2012
  Date     :27/06/2023
-----------OUTPUT---------
[DBMS, Web-programming, Python, Java, Datastructure, Networking]

Deque after removing first and last: [Web-programming, Python, Java, Datastructure]
```

15. Program to demonstrate the creation of Set object using the LinkedHashset class

Code :-

```
import java.util.LinkedHashSet;
import java.util.Set;

public class Q15 {
  System.out.println("course_name:OOP LAB");
   System.out.println("Course_code:20MCA132");
   System.out.println("  Name     : Aparna Jayakumar");
   System.out.println("Register_no: SJC22MCA-2012");
   System.out.println("  Date     :27/06/2023");
public static void main(String[] args) {
        Set<String> set = new LinkedHashSet<>();
        set.add("Apple");
        set.add("Banana");
        set.add("Orange");
        set.add("Apple"); // Adding a duplicate element

System.out.println("-----------OUTPUT---------");
        System.out.println("Set elements: " + set);
        boolean containsBanana = set.contains("Banana");
        System.out.println("Contains 'Banana'? " + containsBanana);
        boolean removedOrange = set.remove("Orange");
        System.out.println("Removed 'Orange'? " + removedOrange);
        System.out.println("Set after removal: " + set);
}
}
```

Output

```
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q15.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q15
course_name:OOP LAB
Course_code:20MCA132
  Name     : Aparna Jayakumar
Register_no: SJC22MCA-2012
  Date     :27/06/2023
-----------OUTPUT---------
Set elements: [Apple, Banana, Orange]
Contains 'Banana'? true
Removed 'Orange'? true
Set after removal: [Apple, Banana]
```

16. Write a Java program to compare two hash set

Code :-

```
import java.util.*;
public class Q16 {
public static void main(String[] args) {
 System.out.println("course_name:OOP LAB");
   System.out.println("Course_code:20MCA132");
   System.out.println("  Name     : Aparna Jayakumar");
   System.out.println("Register_no: SJC22MCA-2012");
   System.out.println("  Date     :27/06/2023");
System.out.println("-----------OUTPUT---------");
HashSet<String> h_set = new HashSet<String>();
h_set.add("Red");
h_set.add("Green");
h_set.add("Black");
h_set.add("White");
HashSet<String>h_set2 = new HashSet<String>();
h_set2.add("Red");
h_set2.add("Pink");
h_set2.add("Black");
h_set2.add("Orange");
HashSet<String>result_set = new HashSet<String>();
for (String element : h_set){
System.out.println(h_set2.contains(element) ? "Yes" : "No");
}
}
```

Output

```
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q16.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q16
course_name:OOP LAB
Course_code:20MCA132
  Name     : Aparna Jayakumar
Register_no: SJC22MCA-2012
  Date     :27/06/2023
-----------OUTPUT---------
Yes
No
Yes
No
```

17. Program to demonstrate the working of Map interface by adding, changing and removing elements.

Code :-

```
import java.util.HashMap;
import java.util.Map;
import java.util.TreeMap;
public class Q17{
   public static void main(String[] args) {
    System.out.println("course_name:OOP LAB");
  System.out.println("Course_code:20MCA132");
  System.out.println("  Name     : Aparna Jayakumar");
  System.out.println("Register_no: SJC22MCA-2012");
  System.out.println("  Date     :27/06/2023");
      Map<String, Integer> hashMap = new HashMap<>();
      hashMap.put("John", 25);
      hashMap.put("Alice", 30);
      hashMap.put("Bob", 35);
      Map<String, Integer> treeMap = new TreeMap<>(hashMap);
System.out.println("-----------OUTPUT---------");
      System.out.println("HashMap: " + hashMap);
      System.out.println("TreeMap: " + treeMap);
   }
}
```

Output

```
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ javac Q17.java
sjcet@Z238-UL:~/APARNA JAYAKUMAR/JAVA/CYCLE 4$ java Q17
course_name:OOP LAB
Course_code:20MCA132
  Name     : Aparna Jayakumar
Register_no: SJC22MCA-2012
  Date     :27/06/2023
-----------OUTPUT---------
HashMap: {Bob=35, Alice=30, John=25}
TreeMap: {Alice=30, Bob=35, John=25}
```

18. Program to Convert HashMap to TreeMap

Code :-

```
import java.util.HashMap;
import java.util.Map;
public class Q18{
    public static void main(String[] args) {
     System.out.println("course_name:OOP LAB");
   System.out.println("Course_code:20MCA132");
   System.out.println("  Name     : Aparna Jayakumar");
   System.out.println("Register_no: SJC22MCA-2012");
   System.out.println("  Date     :27/06/2023");
            Map<String, Integer> map = new HashMap<>();
        map.put("John", 25);
        map.put("Alice", 30);
        map.put("Bob", 35);
        System.out.println("\n NAME : Aparna Jayakumar \n REG NO :SJC22MCA-2012
\n DATE : 23-06-2023 \n COURSE CODE : 20MCA132\n COURSE NAME : OBJECT
ORIENTED PROGRAMMING LAB");
System.out.println("-----------OUTPUT---------");
        System.out.println("Initial Map: " + map);
        map.put("Alice", 32);
        System.out.println("Map after changing an element: " + map);
        map.remove("Bob");
        System.out.println("Map after removing an element: " + map);
}
```

Output

```
course_name:OOP LAB
Course_code:20MCA132
  Name     : Aparna Jayakumar
Register_no: SJC22MCA-2012
  Date     :27/06/2023

 NAME : Aparna Jayakumar
 REG NO :SJC22MCA-2012
 DATE : 23-06-2023
 COURSE CODE : 20MCA132
 COURSE NAME : OBJECT ORIENTED PROGRAMMING LAB
-----------OUTPUT---------
Initial Map: {Bob=35, Alice=30, John=25}
Map after changing an element: {Bob=35, Alice=32, John=25}
Map after removing an element: {Alice=32, John=25}
```