B.E. INFORMATION TECHNOLOGY 2nd YEAR 2nd SEMESTER -2023

Subject: Object Oriented Systems

Full Marks – 100 **Time: 3Hour**

General Instructions:

1. **This question paper consists of 5 questions, all are compulsory. However internal choice has been provided on some questions. Read these carefully before attempting any questions.**
2. **Different parts of the same question should be answered together.**
3. **All symbols have their usual meaning unless otherwise stated.**

CO1: Differentiate different object oriented programming language and **Solve** problems by developing Java programs using (i) classes, (ii) inheritance, (iii) nested classes & (iv) Exceptions (K3) **(25 Marks)**

1) Answer **a)** and any **two** from the remaining: **[(5×(1+2))+2×5]**

a) Answer the following with proper explanation(**any five**):

i. Analyze the following code and choose the correct option:

```
class Test {
        int i;
}
class Main {
        public static void main(String args[]) {
        Test t;
        System.out.println(t.i);
}
```

A) 0 **B) Garbage value** **C) Compiler error** **D) Runtime error**

ii. What is the output of the following JAVA program?

```
class Test {
  public static void main(String[] args) {
        Test obj = new Test();
        obj.start();
  }
  void start() {
        String stra = "do";
        String strb = method(stra);
        System.out.print(": " +stra + strb);
  }
  String method(String stra) {
        stra = stra + "good";
        System.out.print(stra);
        return  " good";
  }
}
```

A) dogood : do goodgood
B) dogood : dodo good
C) dogood : gooddogood
D) dogood : do good

iii. Choose the correct option(s)

```
class Base {
  final public void show() {
        System.out.println("Base::show() called");
  }
}

class Derived extends Base {
        public void show() {
        System.out.println("Derived::show() called");
  }
}
```

```
class Main {
        public static void main(String[] args) {
        Base b = new Derived();;
        b.show();
  }
}
```

A) Base::show() called
B) Compiler Error
C) Derived::show() called
D) Runtime Error

iv. Predict the output of the following Java program

```
public class T {
        int t = 20;
 T() {
        t = 40;
 }
}
class Main {
        public static void main(String args[]) {
        T t1 = new T();
        System.out.println(t1.t);
  }
}
```

A) 20 B) 40 C) Compiler Error D) Runtime Error

v. Which of the following is FALSE about abstract classes in Java?

A) If we derive an abstract class and do not implement all the abstract methods, then the derived class should also be marked as abstract using 'abstract' keyword.
B) Abstract classes can have constructors
C) A class can inherit from multiple abstract classes.
D) None of the above.

vi. Analyze the following code and choose the correct option:

```
class Test {
  public static void main(String args[]) {
    int arr[] = new int[2];
    System.out.println(arr[0]);
    System.out.println(arr[1]);
  }
}
```

A) 0 0 B) Garbage value Garbage value C) Compiler error D) Runtime error

b) Consider a case of multi-level inheritance where a class Base is inherited by the class Child which is again inherited by the class GrandChild. Suppose the class Base has a parameterized constructor and a method display(). **[5]**

c) What is the purpose of using interfaces in Java? Consider 2 interfaces IN1 and IN2 each having a display() method each of its own. Now create a class Sample implementing these 2 interfaces. Show how the display() method of the interface IN1 can be invoked using an object of the Sample class. **[1+4]**

d) Discuss the significance of each word in public static void main (String args[]). **[5]**

CO2: Solve problems using thread programming and Input-Output (K3) **[25 Marks]**

2) Answer **a)** and any **two** from remaining: **[(5×(1+2))+2×5]**

a) Answer the following with proper explanation(any **five**):

i. Complete the statement by replacing correct options written below: **The Java uses threads to enable the entire environment to be _____.**
A) Symmetric B) Asymmetric C) Synchronous D) Asynchronous

ii. Which of the following constructor of class Thread is valid one?
A) Thread(Runnable threadOb, int priority)

B) Thread(int priority)
C) Thread(Runnable threadOb, String threadName)
D) Thread(String threadName, int priority)

iii. Analyze the following code and choose the correct option:

```
public abstract class Test implements Runnable{
                public void dosomenthing(){};
}
```

A) The program will not compile because it does not implement the run() method.
B) The program will not compile because it does not contain abstract methods.
C) The program compiles fine.
D) None of the above

iv. Analyze the following code and choose the correct option:

```
public class Test implements Runnable
{
  public void run()
  {
    System.out.printf("Successful ");
  }
  public static void main(String[] args) throws InterruptedException
  {
    Thread thread1 = new Thread(new Test());
    thread1.start();
    thread1.start();
    System.out.println(thread1.getState());
  }
}
```

A) Successful Successful TERMINATED
B) Compiler error
C) Successful TERMINATED
D) Runtime Error

v. Analyse the following code and choose the correct option:

```
public abstract class Test implements Runnable{
                public static void main(String[] args){
                        Thread t = new Thread(this);
                        t.start();
                }
                public void run(){
                        System.out.println("test");
                }
}
```

A) The program does not compile as this cannot be referenced in a static method.
B) The program compiles fine, but it does not print anything because t does not invoke the run() method
C) The program compiles and runs fine and displays test on the console.
D) None of the above

vi. Analyse the following code and find out the correct option when you attempt to compile and run the following code:

```
public class Test extends Thread{
                public static void main(String[] args){
                        Test t = new Test();
                        t.run();
                        t.start();
                }
                public void run(){
                        System.out.print("run-test ");
                }
}
```

A) run-test run-test
B) run-test
C) Compilation fails due to an error on line 4
D) Compilation fails due to an error on line 7

b) Indicate the functionalities of sleep() and wait() functions along with all of its overloaded versions. What are the utilities of join() and notify() methods? **[3+2]**

c) Write a Java class having a method that will open a text file in read mode, select all the words containing atmost one vowel and write them into another file. Take the input of the source and destination file names from command line arguments. **[5]**

d) Write a Java class "Student" having member variables name, roll, stream and cgpa of string, integer, string and double types respectively. Now find out the name and roll of the student who has got the highest cgpa in IT stream out of a total of 400 students of CSE, Electrical, Mechanical, Pharmaceutical and IT streams. Use BufferedReader class to take the input of the data members of the students from user. **[5]**

CO3: Develop programs using advanced programming paradigms: (i) Introspection apabilities, (ii) Generic Programming. (K3)	**(20 Marks)**

3) Answer **a)** and any **two** from remaining: **[8+2×6]**

a) **Develop** a program where arrays of different datatypes (**int, float, char**) are passed to a generic function. Assume, the function sorts the array elements using Bubble Sort technique. **[8]**

b) **Develop** a program to show how you can access the forbidden fields and forbidden methods of a class using reflection. Also show (within the same snippet) how a final field of a class can be modified. **[4+2]**

c) **Define** a generic class with a member method sorting(A,P) that take arrays A of different datatypes (**int, float, char**) as input and sorts it in ascending order. Now define another method find(A,P) that checks whether the element P is present (and at what position) within the sorted array A using binary search technique. **[6]**

d) **Explain** the limitations and restrictions of generics in Java considering the situation of i) Creating Arrays of Parameterized Types and ii) Using the instanceof Operator with Generic Types. **[6]**

CO4: Model and **Sketch** software systems by using different artifacts of Unified Modeling Language(K3)	**[20 Marks]**

4) Answer **a)** and any **two** from remaining: **[8+2×6]**

a) Consider a university system that consists of multiple schools, departments, students, courses, and instructors.
Based on this scenario, design a class diagram to represent the relationships and attributes of these entities in the system. Use appropriate UML notations, also keeping in mind the following while designing the class diagram:
(i) Correctly identify and represent the entities.
(ii) Establish the relationships between entities.
(iii) Including relevant attributes for each entity. **[8]**

b) Identify the actors and the use cases of a library management system. Then draw the use case diagram. **[6]**

c) **Sketch** a hierarchical structure to categorize Basic building blocks of UML diagram. **[6]**

d) **Sketch** a top-level state machine diagram for Bank Automated Teller Machine ATM **[6]**

CO5: Explain and **illustrate** basics of design patterns by developing programs. (K3)	**[10 Marks]**

5) Answer the following: **[2+(4+4)]**

a) What are the SOLID principles of object-oriented design?

b) **Explain** Open-Closed Principle and Liskov Substitution Principle using appropriate code examples.