**CROSS RIVER UNIVERSITY OF TECHNOLOGY (CRUTECH)**
**CALABAR**

**DEPARTMENT OF COMPUTER SCIENCE**

**First Semester Examination for 2017/2018 Session**
**CSC 3105: Object-Oriented Programming**
Saturday, 19 May 2018-Time: 2hours 30 minutes

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|---|---|---|---|---|
| Full Name | | | | SET |
| Level | | Reg. No. | | **A** |

Instructions to Candidates

You have been given five questions: Answer two from section A, and two from Section B

Fill out **your name, level and reg-no** as required on both this paper and your answer booklet within 15minutes of the start of this paper.

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## Section A

### Question A1

(a) Each entry below consists of three key themes in object-oriented programming. For any TWO of them, you are to write short notes defining and relating these themes (i) Phenomena, Concepts and Classes (ii) Objects, Properties and Methods (iii) Encapsulation, Abstract Classes and interfaces (iv) Inheritance, Multiple inheritance and Class Hierarchy

(b) (i) What is Polymorphism? (ii) Describe, with examples, the TWO forms of Polymorphism (iii) Outline up to three points of difference between them, in the format which follows:

| S/No. | Point of Difference | Type 1 | Type 2 |
|---|---|---|---|
| | | | |

**Question A2**

(a) Why are object constructors generally **public** by default?

(b) Fields (also called data members, attributes or properties) can never be declared as **abstract.** Briefly explain why this is so.

(c) Write briefly on two forms of control flow in object-oriented programs. For each form, describe all the control structures used in each of them, using examples from either Java or Python.

## Question A3

(a) Interfaces and abstract classes are similar in that both constructs specify a contract which must be adhered to in using them. Using the tabular format given below, establish FOUR points of difference between abstract classes and interfaces.

| S/No. | Point of Difference | Abstract classes | Interfaces |
|---|---|---|---|
| | | | |

(b) Describe briefly the differences in implementation of interfaces between Java and Python

**SECTION B**

**Question B1**

**(a)** Write the general syntax for the definition of a function or procedure in: (i) Python (ii) Java

**(b)** (i) What are packages in Java?
(ii) How do they help you as a programmer?
(iii) Name two commonly used packages in Java, and describes the general use of each one.

## Question B2

Consider the following Java class that is intended to represent a specific day in a ten-week University term,

Public class Term Day {
Public int da; // The day of the week as a number Ø – 6
Public int week; // The week of the term as a number Ø-9}

(a) Create a class Encapsulated Term Day, which applies the principles of data encapsulation as an alternative to Term Day. Your modified class should throw an exception if an invalid day of the week or week number is specified.

(b) The use of two int variables to represent the day and the week required 64 bits of storage. How many bits are actually requires? Adapt Encapsulated Term Day class *creatively* to achieve the same functionality using only one member variable of a primitive type. You should justify your choice of type (Only specify the medications you need to make).

**Question B3**

A novice programmer writes the following code in Java, in order to be able to completely clone an object of type car.

```
Public class Tyre {
        Private int tread remaining

        Public void SetTrend (int t) {
                treadRemaining = t;
        }
        Public int GetTread () {
                Return treads Remaining;
        }
}

Public class Car extends Vehicle implements Cloneable {
        Private Tyre tyres [] = new Tyre [4];

        Public Car() {
        For (int i=0;   i <4;  i++) tyres [i] = new Tyre[];
        }

        Public object clone () throws CloneNotSupportedException {
        Car c = new Car();
        c . Tyres = this . Tyres;
        return c;
}
```

(a) Identify the type of interface that cloneable is. What is the defining characteristic of such interfaces?
(b) Identify and explain two reasons why this code may not function as intended
(c) Rewrite the code to address the problems you have identified and allow Car objects to be fully cloned. (Just specify the medications you need to make).

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## Section A

### Question A1

(a) What is inheritance? (ii) Describe, with examples, the TWO forms of inheritance

(b) Describe the concept of cyclic inheritance, and explain very briefly why this concept cannot fit into OOP.

### Question A2

(a) What does the Java keyword final represent?

(b) Briefly explain each of the following terms (i) static method (ii) dynamic typing (iii) protected (iv) this

(c) List the keywords associated with exceptions in Java, giving a one sentence description of what each one is for.

**Question A3**

(a) Using the tabular format given below, establish FOUR points of difference between method Overloading and method Overriding

| S/No. | Point of Difference | Abstract classes | Interfaces |
|---|---|---|---|
| | | | |

(b) Describe briefly the OOP phenomenon exemplified in common by these two terms

**Section B**

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Question B1

```
Scanner input = new scanner (system in);
```

(a) Explain what the code above does in a Java program

(b) What Java package must necessarily be imported in order for this code to be valid and run properly?

(c) Give an idea (in code) of what the next line would be if the assigned variable were to hold the value of an integer.

**Question B2**

Your boss wrote a program that was supposed to compute the frequency (the number of occurrences) of characters 'a' and 'b' of a string
Str and print it to the console. For instance, if str = "abbcba", then
The method should print to the console. Frequency: a:2,b:3
Unfortunately, things didn't really work out as expected: in fact, the program doesn't even compile still, it's your boss, you can't just throw it away and write a new program. Make the changes necessary for the program compile and calculate the correct result.

```
Public static void frequency (Char str) {
        int count A;
        for (int i = 0; i < str. Length (); i++) {
        if (str. charAt(i) == 'a' ) {
            countA++;
        } else if (str. charAt(i) == b) {
                countB++;
        } else {
            System.Out.PrintIn("frequency:  a:"+count(A+"  b:  "+
    count B);
        }
    }
}
```

**Question B3**

Consider a class Pipe with two private fields, diameter (of type double) and number (of type int), and a public constant field named TOLERANCE, defined as 10E-2. Provide an implementation of class pipe, with two different ways to compare pipes: one compares pipes by their diameter, up to the TOLERANCE value, and the other compares pipes by the number of pipes.

**Note:** The only types and methods you can use from Java packages are:

- Java. Lang. comparable with method public int compareTo (T obj);
- Java util comparator with method public int compare (T obj1, T obj2) ; and
- Java util. Arrays with methods:
  Public static void sort (object {} a); and
  Static <T> void sort (T[] a, comparator <? Super T> c).

(a) Provide an implementation of the pipe class
(b) Provide the pipe comparison by their diameter
(c) Provide the pipe comparison by number of pipes
(d) Provide a main method in a main class where five pipes are built and sorted in an array of pipes

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## Section A

### Question A1

(a) Define and explain briefly (i) encapsulation (ii) inheritance (iii) method overloading (iv) duck typing (v) package

(b) Describe the concept of multiple inheritance, and explain very briefly how this is handled in (i) Java (ii) python

### Question A2

(a) In Java, there are THREE specific connotations representing using the term interface. Identify and explain these connotations.

(b) Describe, concisely, the use of Abstract Base Classes in Python

**Question A3**

(a) What are nested classes?
(b) Describe the various forms of nested classes.

## Section B

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**Question B1**

Public static void main (String [] args)

(a) Explain what the line of code shown above does in Java program
(b) In what form might a Java program exist in order to run in the same way as a. exe file runs on windows?
(c) What does the Java virtual machine (JVM) do for Java programs?

**Question B2**

Create a java class Employee with data member's employeeNumber, name, designation and salary. Write the following methods:

(a) getEmployee () to take user input
(b) showOrder() to display grade of employees based on salary
(c) showEmployee () to display employee details
(d) What is a constructor? Can there be there be more than one constructor for a class? Justify.
(e) Differentiate a local variable and a data member with an example.

**Question B3**

Consider the following Java classes

```
Class A {
        Public void foo (object 0) {System out. PrintLn( "A"); }
}
Class B {
        Public void foo (string 0) {System out print in ("B");}
 }
Class C extends A
        Public void foo (string s) {System out print in ("C");}
}
Class D extends B {
        Public void foo (Object 0) {System out print in ("D") }
Class main {
        Public static void main (String {} args) {
                        A a = new C (); a. foo("Java");
                        C c = new C (); c. foo("Java");
                        B b  = new D(); b. foo("Java");
                        D d = new D (); d. foo("Java");
```

(a) What is the output of the execution of the method main () in class Main?
(b) Explain your answers

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## Section A

### Question A1

(a) Identify the four different accessibilities used in OOP

(b) Specify when each of the four different accessibilities (public, private, etc) should be used in OOP

(c) Explain the difference between public interface and implementation

### Question A2

(a) What is Polymorphism? (ii) ii) Describe, with examples, the TWO forms of Polymorphism (iii) Outline up to three points of difference between them, in the format which follows:

| S/No. | Point of Difference | Type 1 | Type 2 |
|---|---|---|---|
| | | | |

(b) When described in interface, fields (also called data members, attributes or properties) are deemed static by default. Briefly explain why this is so.

**Question A1**

(a) Define the term control flow
(b) Write briefly on the various form control flow in object oriented program

## SectionB

**Question B1**

(a) Name three UML diagrams, and briefly describe their relevance
(b) Describe all the selection control structures, using UML activity diagrams to illustrate the form of control flow for each of them.

**Question B2**

Consider the following Java class that is intended to represent a specific day in an ten-week University term

```
Public class Term Day {
 Public  int day; // The day of the week as  a number of 0 – 6
Public int week; // The week of the term as a number 0– 9
}
```

(a) Create a class ImmutableTermDay that is an immutable version of TermDay. (The term immutable means 'not subject to change).
(b) The use of two int variables to represent the day and the week requires 64 bits of storage. How many bits are actually required? Adapt EncapsulatedTermDay class creatively to achieve the same functionality using only one member variable of a primitive type. You should justify your choice of type (only specify the modifications you need to make).

**Question B3**

Imagine a class ComplexNumber which reflects the set of complex numbers: these are numbers which take the form.

*a + jb*, where a and b are real numbers, and the imaginary number $j = \sqrt{-1}$

As such, this class would have a real part re and an imaginary par im

(a) Write a Java class called ComplexNumber, which can be instantiated with either a or be being an integer

(b) Override the toString () method for ComplexNumber to return the form specified above (e.g. 5.32 + 6j)

(c) Write a method multiply () which returns the product of 2 such numbers as a ComplexNumber.