THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. DEGREE PROGRAMME –LEVEL-04
DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE
FINAL EXAMINATION 2012/2013
COMPUTER SCIENCE
CPU2242: OBJECT ORIENTED PROGRAMMING USING C++ AND JAVA

DURATION: THREE HOURS ONLY (3 HRS)

Date:03.06.2013 Time: 1.00pm – 4.00pm

Answer FOUR questions only.

1)

a) State whether the following statements are **TRUE** or **FALSE** and justify your answer.

i) C++ considers the variables ***number*** and ***NuMbEr*** to be identical.

ii) `int 4seasons;` is a valid variable declaration in C++.

iii) The modulus operator (%) can be used only with integer operands.

iv) The following code prints values from 1 to 10:

```
n=1;
while (n < 10);
    System.out.println(n++);
```

v) The expression `( ( x > y ) && (a < b))` is true if either x > y is true or a < b is true.

(25 marks)

b) What is the most suitable data types (in C++) to represent each of the following items? By providing the suitable variable declarations, briefly explain the reasons to select the particular data type for each item.

i) Gender of a person
ii) Boltzmann's constant ($1.3806488 \times 10^{-23}$)
iii) Number of professors in a university
iv) Average daily temperature of a city during a month
v) Marks of 8 subjects of 40 students in a class

(25 marks)

c) A company has four different types of employees and each type of employee has its own pay code as listed in the **Table 1** below. Write a program to compute the weekly pay for each employee. Assume that there can be a maximum of 100 employees in the company.

Use a switch case to identify the employee type and dynamically get inputs required for each case.

Emp. Type	Emp. pay code	Salary Description
Managers	1	Receive a fixed weekly salary of Rs. 25,000
Hourly workers	2	Receive a Normal hourly wage up to 40 hours they work and "time-and-a-half" (1.5 times their hourly wage) for overtime hours worked. Normal wage rate = Rs. 50 per hour. Get 'number of hours worked' from the user.
Commission workers	3	Receive Rs.250 plus 5.7 percent of their gross weekly sales. Get 'gross weekly sales' value from the user.
Piece workers	4	who receive a fixed amount of money per item they produce – each pieceworker in this company works on only one type of item. Get 'money per item' and 'number of items produced' from the user.

Table 1

(50 marks)

2) A university community has thousands of members. Class **CommunityMember** consist of **Employee**, **Student** and **Alumnus** classes. **Employee** class consist of **AcademicStaff** and **NonAcademicStaff**. **Student** class consists of **UnderGraduateStudent** and **GraduateStudent** classes. All community members have common attributes of **name** and **age**. Employee, Student and Alumnus classes have additional attributes **empId**, **studentId**, **aluId** respectively. Further, AcademicStaff, NonAcedemicStaff, UnderGraduateStudent, GraduateStudent has the unique attributes of **courseId**, **departmentId**, **facultyId** and **supervisorId** respectively.

a) What is meant by inheritance in OOP? What are the advantages of using inheritance? Discuss your answer by giving a classification (inheritance) hierarchy to represent the above information.

(25 marks)

b) Write down suitable class definitions for the classification hierarchy defined in **part (a)**. Each Class should have methods to initialise (constructors) and display information.

(50 marks)

c) Write another Class called **MainClass** with a proper `main()` method to test the classes you defined in **part (b).**

(25 marks)

3)

a) Explain **polymorphism** in the context of OOP? What is meant by **overloading** and **overriding**? Discuss your answer using method prototypes.

(20 marks)

b) Define a class called **RationalNumber** with attributes **numerator** and **denominator**. Add a user-defined constructor to this class, which initialize a new **RationalNumber** object with two user-given input parameters.

(20 marks)

c) Define a reciprocal method, which returns the reciprocal of an instance. (If the rational number is 5/7, then the reciprocal is 7/5)

(10 marks)

d) Define an appropriate method called **addition** in **RationalNumber** class to add two rational Numbers. Similarly, define **subtraction**, **multiplication** and **division** methods to subtract, multiply, divide two numbers.

(30 marks)

e) Overload your **addition** and **multiplication** methods with additional parameter called **NumberThree**. This is to add and multiply three rational numbers, respectively, instead of two.

(20 marks)

4)

a) What is meant by **Encapsulation** in relation to OOP? Explain this using a suitable example.

(10 marks)

b) Define a class to represent **Student** with attributes **studentName**, **studentId**, **registeredYear**, **marks and numberOfCourse**.

('**marks**' is a one dimensional array with maximum size of 100 to store marks of courses the student is following. **NumberOfCourse** stores the number of courses a student has taken actually. When a course mark is entered to the marks array, NumberOfCourse attribute needs to be updated by one.)

(30 marks)

c) Define methods to set values for the attributes mentioned in part (b).

(20 marks)

d) Write a method which will return a student's (approximate) degree duration in years, when the current year is passed as a parameter.

(10 marks)

e) Each student has an **Average**. 'Average' is an **average of marks of courses the student has followed**. Write a method called **getAverage()** that will print and return the 'Average' when it is called.

(15 marks)

f) Write a method called **printGrade()** will print the **Grade** of the student according to the table given bellow. (Hint :- call the getAverage() inside the printGrade() method)

Average	Grade
75 or above	A
60 - 75	B
45 - 60	C
Bellow 45	Fail

(15 marks)

5)

a) Define the terms **Object** and **Class**. Explain these concepts using a suitable example. What is the difference between Object and Class?

(20 marks)

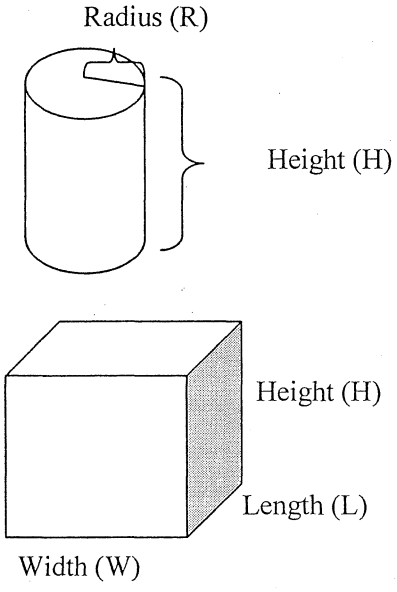
b) What is meant by **abstract class** and **abstract method**? Give examples of an abstract class and abstract method. What are the differences between abstract class and normal class?

(15 marks)

c) A **ThreeDShape** class cannot be instantiated and has the attribute **height**. It also has 2 methods called **getArea()** and **getVolume()** that do not have implementation details. A

Cylinder is a ThreeDShape. Cylinder has a special attribute called **radius**. A **Cuboid** is also a ThreeDShape. Cuboid has two special attributes called **length** and **width**.

getArea() - Calculate and return the entire surface area of the shape.
getVolume() - Calculate and return the volume of the 3D shape.



Total Surface Area of a Cylinder = $2 * \pi * R * R + 2 * \pi * R * H$

Volume of a Cylinder = $\pi * R * R * H$

Total Surface Area of a Cuboid = $2 * (L*W + H*L + H * W)$

Volume of a Cylinder = $H * W * L$

Figure 1

i) Draw a suitable classification (inheritance) hierarchy to represent the above information. Clearly mention if there are any abstract classes and abstract methods. (25 marks)

ii) Write suitable complete class definitions for the classification hierarchy you defined in part (i). Overload getArea() and getVolume() methods for the Cylinder and Cuboid classes by using the descriptions given in Figure 1.

(40 marks)

6)

a) What is the purpose of using **constructors** in a class? Briefly explain about the three basic types of the constructor.

(15 marks)

b) Consider the following Complex class to provide answers for the questions **b) i), b) ii)** and **c)**.

Complex
Attributes
private float real
private float imag
Operations

i) Write a constructor for the above class named "Complex", which initialises all its data members to zero.

ii) Write the coding required to overload a constructor for the Complex class, which initialises its data members to given user inputs.

iii) Overload a constructor which copies one instance of an object to another.

(15 marks)

c) What do you mean by **Operator Overloading**? Write the coding required to overload the + operator, - operator, /operator and *operator and for the above Complex class.

(45 marks)

d) Why we use functions in a program? What are the advantages and disadvantages of passing a parameter to a function by value and by reference?

(15 marks)

e) Why we use **new** and **delete** operators in a program?

(10 marks)