BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 5 Diploma in IT

OBJECT ORIENTED PROGRAMMING

Monday 25th September 2017 – Afternoon
Answer **any** FOUR questions out of SIX. All questions carry equal marks
Time: TWO hours

Answer any Section A questions you attempt in Answer Book A
Answer any Section B questions you attempt in Answer Book B

The marks given in brackets are **indicative** of the weight given to each part of the question.

Calculators are **NOT** allowed in this examination.

Section A
Answer Section A questions in Answer Book A

A1.

a) Explain the terms *abstract data type* and *encapsulation* and describe how they implement coupling and cohesion in an object oriented system. **(10 marks)**

b) Discuss the role of *structured* and *procedural* languages in the genealogy of object oriented languages. **(9 marks)**

c) Explain the difference between *typed* and *untyped* languages. In your explanation, include ONE example of each. **(6 marks)**

A2.

a) Give an example of each of the following diagrams and describe the context in which you would use them when developing an object oriented system:

i) *Object interaction diagram;*
ii) *Object state transition diagram*.

(10 marks)

b) Design patterns can be categorised into three broad categories:

i) *Creational*;
ii) *Structural*;
iii) *Behavioural*.

Briefly describe what these categories represent and give ONE example of each category, stating what their motivation is and the basis of the solution they offer.

(15 marks)

A3.

Sports World is an Events Management Company that organise the running of major sporting games, such as the Olympic Games.

Before being used to host a sporting event, venues are assessed by an Administrator who checks that they are for fit for purpose. If the venue can hold more than 10,000 people, the Administrator conducts additional health and safety checks to ensure that the venue is safe.

A year before the games begin, a Team of Staff are appointed to run the day-to-day operations, including booking successfully assessed/safety-checked venues. Six months before the games begin, the Team of Staff produce a Programme that lists the date, time and location of each sporting event. At this point, Athletes can register for an event by giving their name, address, date of birth and best time for their event. Some overseas athletes need to apply for a visa and the system needs to record whether they were successful.

A week before the games begin, a Team of Staff produce a Schedule that shows when the registered athletes will participate in their event. At the end of each event, the Team of Staff produce a Table of Results that records the positions of each athlete.

Once all the events are completed, the Administrator checks the Table of Results for accuracy and produces a Medals Table.

a) Produce a Use Case diagram for the above scenario. **(15 marks)**

b) Discuss how Use Case diagrams and descriptions provide an overview of the user requirements of a system. Within your answer include examples from the above scenario. **(10 marks)**

Section B
Answer Section B questions in Answer Book B

B4.

In number theory, a value can be categorised as a natural number (a whole number >0, often denoted $\mathbb{N}$), an integer (zero or a positive or negative whole number, including the natural numbers, often denoted $\mathbb{Z}$), or a real number (which includes the natural numbers and integers, along with all other positive and negative numbers that are not integers, often denoted $\mathbb{R}$).

a) In an object oriented programming language of your choice, write a definition for a `number` class that contains:

(i) a single field suitable for storing either a natural number, or an integer, or a real number;

(ii) setter and getter methods for manipulating this field;

(iii) a constructor that initialises new objects of `number` to have the value 1 (unity);

(iv) a method that determines which kind of number is currently stored (returning 0 if the number is real and an integer and a natural number, 1 if the number is real and integer but not a natural number, and 2 if the number is real but neither an integer nor a natural number). **(15 marks)**

b) Write a new method `isPrime()` that returns true or false, depending upon whether the number held is a prime number. A prime number is a natural number >1 that is divisible only by 1 and itself. **(10 marks)**

B5.

Consider the code fragment written below:

```
public class A
{
  private   int  a;
  protected int  b;
  public    int  c;
  public         A();
  public    void seta(int new_a);
  public    void setb(int new_b);
  public    void setc(int new_c);
  public    int  geta();
  public    int  getb();
  public    int  getc();
}

public class B
{
  private   A    myA;
  private   int  d;
  public         B();
  public    void setd(int new_d);
  public    int getd();
}
```

a) State the relationship between class `A` and class `B`, and show how this code fragment would be represented in a UML class diagram. **(10 marks)**

b) State the name of one other kind of inter-class relationship, and show both a code fragment in which this relationship is implemented, and how it would be represented in a UML class diagram. **(15 marks)**

B6.

a) Define *class variable* and *instance variable*, and provide a code fragment that implements these concepts in an object oriented programming language of your choice, and demonstrates how they may be used. **(10 marks)**

b) Explain why a developer might declare a member function as private, and show an example code fragment, in an object oriented programming language of your choice, that contains both public and private methods to demonstrate how they may be used. **(15 marks)**