BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 5 Diploma in IT

OBJECT ORIENTED PROGRAMMING

Tuesday 20th March 2018 - 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 what is meant by the following terms:

i)   Class;
ii)   Object instance;
iii)   Abstract class;
iv)   Method overloading;
v)   Method overriding.

(15 marks)

(b) Explain how the Liskov substitution principle is used in object oriented systems. Your answer should include an example to illustrate how this is used.

(10 marks)

A2

(a) Give an outline of what you would expect to find in the description of a design pattern for reusable object oriented software. State the reasons why a programmer would want to use a design pattern when developing a system.

(10 marks)

(b) Describe in detail **THREE** design patterns with which you are familiar. Your answer should include the circumstances in which they are applicable and an example of their use (note, actual code is not necessary).

(15 marks)

A3

(a) Given the class diagram below, which represents part of a Library system, state which of the object diagrams (i-vi) are legitimate instances. Assume that all links in the object diagram are instances of the association shown in the class diagram. If an object diagram is not legitimate explain why not.

(10 marks)
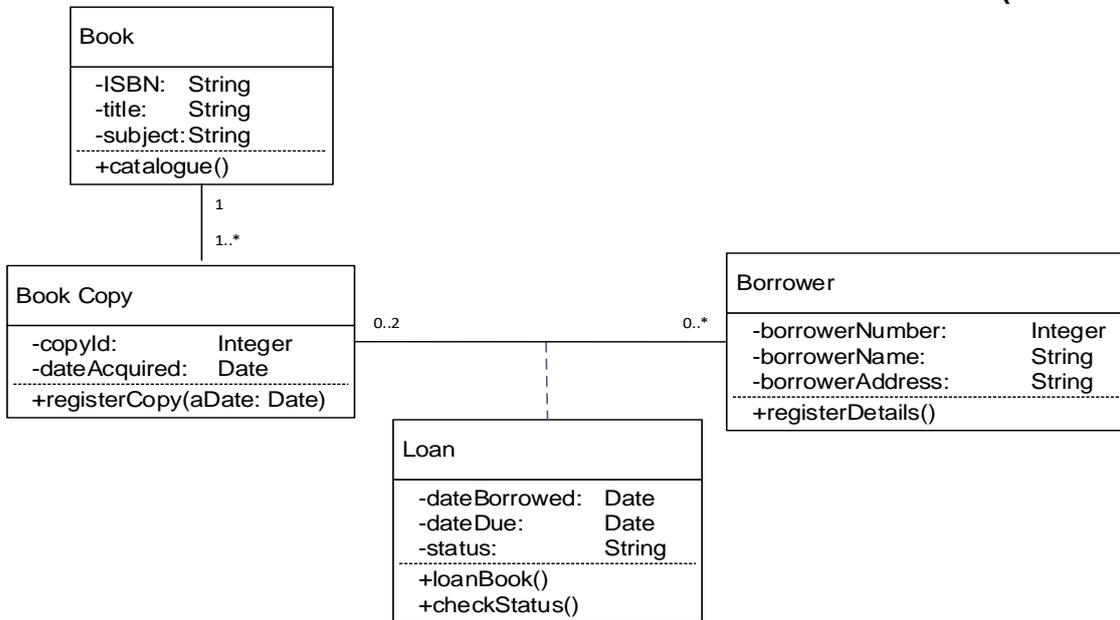
(b) List the techniques that could be used to test the above library system and explain the advantages and disadvantages of each technique. Include some discussion of when the techniques can be used during system development, assuming an object-oriented approach has been used throughout.

(15 marks)

B4

The fidelity of an audio clip is defined by a number of parameters, including the number of channels (1 or 2), the resolution (8, 16 or 24 bits per sample), and the sampling rate (22050, 44100, or 88200 samples per second).

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

  (i) fields for storing the `channels`, `resolution` and `sampleRate` with appropriate visibility;

  (ii) setter and getter methods for manipulating these fields, such that the setters methods ensure that `channels` can only have values 1 or 2, `resolution` can only have values 8, 16 or 24, and `sampleRate` can only have values 22050, 44100 or 88200;

  (iii) a constructor that initialises new objects to have the lowest quality, where `channels` is set to 1, `resolution` is set to 8, and `sampleRate` is set to 22050.

  (15 marks)

(b) Write a new method called `isStudioQuality` that will return true or false, depending upon whether the audio clip stored has the maximum possible quality (i.e., two channels, 24-bit resolution, and a sample rate of 88200 samples per second).

  (5 marks)

(c) Write a new method called `dataSize` that accepts the duration that an audio clip lasts in seconds (as an integer), and returns the number of bytes that this audio clip would occupy on disk or in memory.

The formula for calculating number of bytes, b, where is d duration (in seconds), c is channels, r is resolution (in bits), and s is sample rate, is:

$$b = d \times c \times \left(\frac{r}{8}\right) \times s$$

  (5 marks)

B5

(a) When would private and protected class members be used in an object oriented program? Clearly distinguish between them.

(5 marks)

(b) How are private and protected class members represented in a UML class diagram? Give an example class definition in UML that contains a field of each type.

(5 marks)

(c) Name and describe one other class member visibility modifier, and state how it would be represented in a UML class diagram.

(5 marks)

(d) When would composition and aggregation inter-class relationships be used in an object oriented program? Briefly describe the difference between them.

(5 marks)

(e) Show how composition and aggregation inter-class relationships would be represented in a UML class diagram.

(5 marks)

B6

The Fibonacci numbers are a sequence of integers starting 1, 1, generated such that every subsequent number is the sum of the previous two. For example, the third number in the Fibonacci sequence is 2 (because 1+1=2), and the fourth number is 3 (because 2+1=3).

Fibonacci numbers are used in several algorithms in Computer Science, including the Fibonacci Search and in the generation of fractals.

(a) In an object oriented programming language of your choice, create a class called `fibonacciClass` capable of holding Fibonacci numbers in an array called `F`.

Include a data member called `currentNumbersHeld` that will record how many of the numbers are currently being held. Include a constant called `maxNumbers`, set to `100`, that stipulates the maximum number of Fibonacci numbers that can be held. At this stage, do not add any methods.

(5 marks)

(b) Add a getter method that returns `currentNumbersHeld`.

(5 marks)

(c) Add a method called `generateSequence` that will populate the array with the Fibonacci numbers accepting one integer argument, `N`, that specifies how many numbers to generate. Check that `N` is ≤ `maxNumbers`. If `N` exceeds `maxNumbers`, generate the maximum number of Fibonacci numbers.

(10 marks)

(d) Implement a method called `displaySequence` that will display the Fibonacci sequence currently stored in the array in the format

```
F[1] = 1
F[2] = 1
F[3] = 2
```

and so on.

(5 marks)

END OF EXAM