THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATIONS
BCS Level 5 Diploma in IT

OBJECT ORIENTED PROGRAMMING

3rd May 2007, 2.30 p.m.-4.30 p.m.
Answer FOUR questions out of SIX. All questions carry equal marks.
Time: TWO hours.

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

Calculators are NOT allowed in this examination.

Questions 1, 2 and 6 refer to the following Unified Modelling Language (UML) class diagram (**Figure 1**). It models a hotel that has a variety of rooms that may be booked by clients.

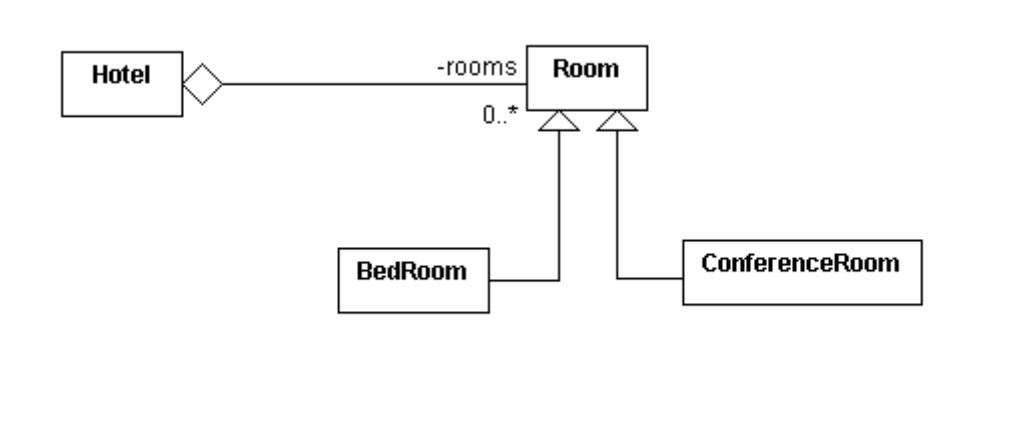

Figure 1

1. Using Figure 1:

a) Construct a UML object diagram showing one ConferenceRoom and two BedRooms that are part of the same Hotel. Give a short explanation of the diagram. **(5 marks)**

b) If the two BedRooms and the one ConferenceRoom are a part of the same Hotel, then explain whether there is a need to distinguish between these differing types of rooms when the Hotel object engages in message passing with them. **(5 marks)**

c) Revise the class diagram in Figure 1 to introduce a StudyRoom class, representing a room that can be booked as part of a conference. Explain the principal revisions that have been made to the diagram. **(5 marks)**

d) Revise the class diagram in Figure 1 so that a ConferenceRoom is associated with a number of StudyRooms when booked by a client when organising a conference. **(5 marks)**

e) Revise the object diagram from part 1(a) showing additionally StudyRooms being associated with a ConferenceRoom. **(5 marks)**

2. *a)* Define the term *class hierarchy*. **(4 marks)**

b) Define the term *abstract class*. **(4 marks)**

c) Draw a revision to the UML class diagram in Figure 1 clearly distinguishing those classes that have been changed into abstract classes. Explain why they have changed. **(6 marks)**

d) Why should object-oriented software be developed in terms of abstract classes? **(6 marks)**

e) Using a programming language of your choice and making any reasonable assumptions, give an outline of the implementation of an abstract class from part 2 *c)*. **(5 marks)**

3. *a)* Give an account of the UML use case diagram. Your answer should discuss its overall purpose and explain the meaning of its various symbols. **(10 marks)**

b) An automated teller machine (ATM) is a computerised device that provides a bank's customers a secure method of performing financial transactions in a public space without the need for a bank clerk. Draw an outline use case diagram for the software that supports a bank's ATM. Having inserted a valid card and password, a user should be able to:

i) withdraw money from the ATM
ii) get a display the current balance
iii) change the password by entering the new details twice **(15 marks)**

4. *a)* Give definitions of the following:

i) abstract data type
ii) encapsulation
iii) interface class
iv) polymorphism
v) the principle of substitution **(15 marks)**

b) Choose THREE of the above and discuss how each has contributed to the development of object-oriented programming. **(10 marks)**

5. *a)* Explain how an understanding of Design Patterns helps the following people:

i) students studying computing
ii) inexperienced software developers
iii) experienced software developers **(15 marks)**

b) Describe a *Design Pattern* with which you are familiar. Your answer should include the motivation for the existence of the *Design Pattern*, its structure, participants and consequences of its use. **(10 marks)**

6. Often in the development of object-oriented systems there is a requirement to manage a collection (or container) of objects.

a) Give two reasons why an array may be unsuitable for this purpose. **(4 marks)**

b) Give one example of a collection class (excluding the array) with which you are familiar. Your answer should explain the main benefits it brings. **(8 marks)**

c) Identify a collection of objects in the UML hotel class diagram in Figure 1. **(3 marks)**

d) Using a programming language of your choice, give an outline implementation for the class that maintains the collection identified in 6 *c)*. Your answer should indicate how objects (or object references) are added to the collection and how each element in the collection can be accessed for display purposes. **(10 marks)**