THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATION
Diploma

OBJECT ORIENTED PROGRAMMING

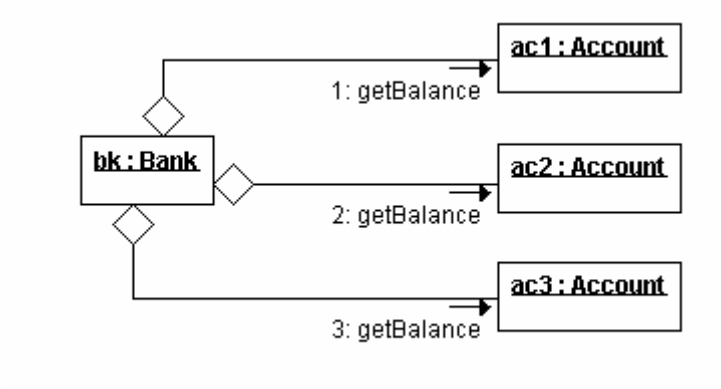
6th May 2003, 2.30 p.m.-4.30 p.m.
Answer FOUR questions out of SIX. All questions carry equal marks.
Time: TWO hours.

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

1. *a)* Collaboration diagrams and sequence diagrams are described as interaction diagrams.

Describe what is shown by these two types of diagram. Identify the individual strengths of collaboration and sequence diagrams. **(6 marks)**

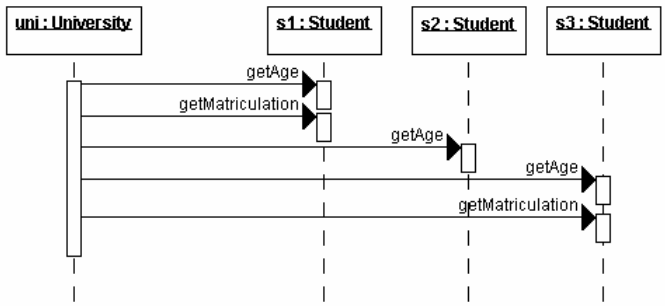
b) In the following collaboration diagram, a Bank object is shown sending the message getBalance to each of its three Account objects to obtain a total of the balances. Show the same interaction presented as a sequence diagram.



(8 marks)

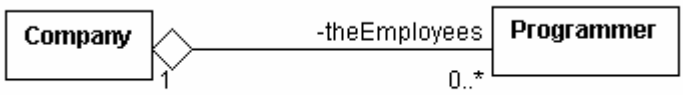
c) In the following sequence diagram, a University object is shown sending the message getAge to each of its three Student objects, and for those that are over the age of 21, they are also sent the message to obtain their matriculation number. Present the same interaction using a collaboration diagram.

(8 marks)



d) What is a collaboration diagram without any messages known as? Explain its purpose. **(3 marks)**

2. The following class diagram presents an organisation with any number of programmer employees.



a) Provide a revised class diagram in which the organisation has both programmers and project leaders as employees. Each project leader supervises any number of programmers. Give an argument for the revisions that you have introduced. **(7 marks)**

b) Both the original class diagram and the revised class diagram have one-to-many relationships. Explain how they might be realised in application code. **(5 marks)**

c) If the employees were to be arranged in order of employee number, identify what changes would be required in the code. Explain what coding practices might be used to minimise the impact of these changes. What would be the effect on the class that represents the employees? **(7 marks)**

d) If the application was required to look up the details for an employee using their employee number as a key, describe the revisions that would be necessary to correctly handle this one-to-many relationship. **(6 marks)**

3. *a)* Describe the usage of the following use case UML extension stereotypes:
i) <<uses>>
ii) <<extends>> **(6 marks)**

b) A local government authority has implemented a discussion forum where citizens may post messages in order to discuss local issues.

Citizens may post and read messages. In order to ensure that only people from the area under the control of the authority post messages, every user must be registered. When a citizen reads or posts a message the citizen's identity must be authenticated. This is achieved via a user name and password mechanism.

Messages are grouped together depending on their topic. Before posting or reading a message, a citizen must select the group they are interested in.

The authority has a policy that prohibits the posting of abusive messages. To enforce this, moderators review the groups and delete any messages which they decide contravene the authority's guidelines. Deletion of a message is very similar to reading a message. A moderator will read a message and then click on a deletion button. Moderators must be authenticated by the system in the same way as citizens.

User accounts are created by an administrator. Administrators also create groups. Prior to creating a user account or a discussion group an administrator must be authenticated in the same manner as any other user of the system.

Draw a use case diagram that describes the system. **(12 marks)**

c) Write down a use case description that describes the normal sequence of events that takes place when a moderator deletes a posting. **(7 marks)**

4. *a)* Describe a design pattern with which you are familiar. Your answer should contain a description of the motivation for the use of this design pattern. **(8 marks)**

b) Explain the circumstances in which you would use the design pattern you described in your answer to *a)*. **(8 marks)**

c) Using an object oriented programming language with which you are familiar give an example of the use of the pattern you described in your answer to *a)*. **(9 marks)**

5. *a)* Define the following terms. For each term show how the concept is realized in an object oriented language with which you are familiar:

i) Class
ii) Object
iii) Inheritance
iv) Overloading
v) Overriding

(15 marks)

b) Write an account of the rationale for the development of object oriented programming. Explain how structured programming concepts and the use of abstract data types have contributed to the development of the object oriented paradigm. Your answer should emphasize the utility of the concepts listed in part *a)* of the question and additionally explain the importance of encapsulation and polymorphism in object oriented languages.

(10 marks)

6. Operations and attributes of a class are given the following *visibility scopes*: public, protected and private.

a) Explain the meaning of these three scoping terms. **(9 marks)**

b) Describe how you would use each visibility scope for both an attribute and an operation. Identify and explain where good programming practice is being adopted. **(12 marks)**

c) Identify a fourth level of scoping that might prove useful. What are the merits and the deficiencies of this scheme? **(4 marks)**