

**THE BCS PROFESSIONAL EXAMINATIONS
BCS Level 5 Diploma in IT**

April 2008

EXAMINERS' REPORT

Systems Design

Question 1

- a) The table below is taken from a University staff resourcing system. Normalise the table to produce a set of relations in Third Normal Form. You must show all of your working.

(16 marks)

Course Code	Course Description	Tutor Code	Tutor Name	Room Number	Room Tel. Number	Hours per week
BABC	BA Business Computing	1276	Sue Smith	317A	2771	7
		1283	Mark Liddle	317A	2771	7
		1237	Moira Jones	229	2755	3
BScNC	BSc Network Computing	1276	Sue Smith	317A	2771	3
		1283	Mark Liddle	317A	2771	4
		1237	Moira Jones	229	2755	1
		1765	Dave Brown	317A	2771	6
BSCCOMP	BSc Computing	1276	Sue Smith	317A	2771	3
		1283	Mark Liddle	317A	2771	3
		1237	Moira Jones	229	2755	8
		3256	Mary Kent	217	3633	10

b) The seven relations below are all in Third Normal Form and have been produced by normalisation. Construct an entity relationship diagram from these relations. You do not need to show optionality or relationship names.

(9 marks)

COURSE	COURSE/MODULE LINK	MODULE
<u>Course Code</u> Course Title	<u>Course Code</u> <u>Module Code</u>	<u>Module Code</u> Module Title Tutor Code
TUTOR	TUTOR GROUP	ROOM
<u>Tutor Code</u> Tutor Name Tel. No.	(<u>Module Code</u>) (<u>Tutor Group Number</u>) No. of students Room Number	<u>Room Number</u> Building Code
BUILDING		
<u>Building Code</u> Building Name		

Answer Pointers

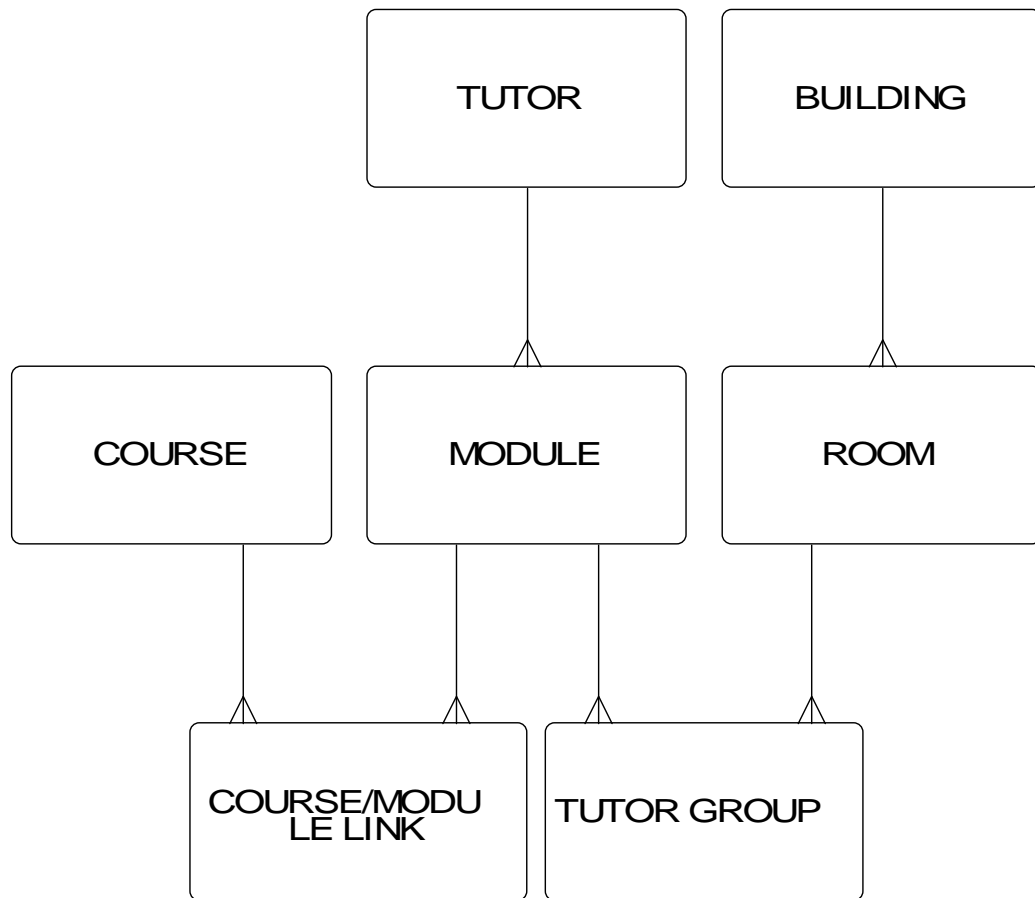
a) A sample answer is below. Candidates may have answered this in a different way to the sample answer but marks were awarded for each stage of the process.

UNF	UNF LEVEL	1NF	2NF	3NF
<u>Course Code</u> Course Desc. Tutor Code Tutor Name Room No. Room Telno. Hours pw	1 1 2 2 2 2 2	<u>Course Code</u> Course Desc. <u>Course Code</u> <u>Tutor Code</u> Tutor Name Room No. Room Telno. Hours pw	<u>Course Code</u> Course Desc. <u>Course Code</u> <u>Tutor Code</u> Hours pw <u>Tutor Code</u> Tutor Name Room No. Room Telno.	<u>Course Code</u> Course Desc. <u>Course Code</u> <u>Tutor Code</u> Hours pw <u>Tutor Code</u> Tutor Name Room No. <u>Room No.</u> Room Telno.

- 1 mark for identifying key field in UNF
- 1 mark for identifying repeating groups
- 2 marks for first relation in 1NF
- 2 marks for second relation in 1NF
- 0.5 marks for first relation in 2NF
- 2 marks each for second and third relation in 2NF
- 0.5 marks for first relation in 3NF
- 1 mark for second relation in 3NF
- 2 marks each for third and fourth relation in 2NF

16 marks in total

b)



Marks were awarded for each link – half a mark for joining correct entities, half a mark each for degree at either end, giving a total of 1.5 marks for each link. If two entities were linked which should not be linked, 1.5 marks will be deducted in each case, down to a mark of zero. This is to prevent candidates linking every entity together.

Examiner's Comments

This was not a popular question with only 63% of students attempting it. Of those who attempted it, 60% achieved a pass mark, with a couple of candidates achieving no marks at all. In part (a), understanding of the normalisation process was varied. Many students did not highlight key attributes. Most students identified the repeating groups but went astray in 2nd and 3rd Normal Forms. In part (b), many students did not seem to appreciate that the key to the linkages is via compound and foreign keys. Many students used UML notation which was fine.

Question 2

- a) Explain how each of the following UML techniques is used in the design of an object-oriented system. Illustrate your answers with an example:
- i) statechart or state diagrams **(6 marks)**
 - ii) use cases **(6 marks)**
 - iii) sequence diagrams **(6 marks)**
- b) Discuss how the three techniques in part (a) relate to each other. **(7 marks)**

Answer Pointers

2 (a) (i)

Statechart diagrams:

- model the behaviour of a single object class
- identify the states of an object
- identify the events which affect an object
- identify by arrows the transitions between states caused by these events
- use guard conditions to see whether a transition can occur

Explanation 3 marks, illustration 3 marks

2 (a) (ii)

Use cases:

- model the system from a user's perspective
- are associated with an elementary business process
- are supported by a scenario which describes the different paths through a use case
- are combined into a use case diagram which shows the interaction between the actors (users) and the use cases and between the use cases themselves

Explanation 3 marks, illustration 3 marks

2 (a) (iii)

Sequence diagrams:

- usually support an individual use case
- provide a dynamic view
- show interactions between objects in a time sequence
- become more detailed as the design progresses

Explanation 3 marks, illustration 3 marks

2 (b)

Use cases describe a process from a user's perspective. A use case may involve a number of objects and the interactions between these objects for a particular use case are shown in a sequence diagram. Objects progress through states and these can be gleaned from the sequence diagrams. The collection of all these states and the transitions between them are shown on a statechart diagram.

7 marks

Examiner's comments

This was the most popular question with 100% of students attempting it. Of those who attempted it, 63% achieved a pass mark. Although most candidates demonstrated an understanding of the different techniques and supplied reasonable examples, answers were rather brief and did not describe the techniques very fully. In part (b) very few candidates related the techniques together which was what was required. Many candidates described the techniques in isolation and therefore did not really answer the question.

Question 3

a) Explain the following object-oriented concepts:

- i) inheritance **(4 marks)**
- ii) polymorphism **(4 marks)**
- iii) aggregation **(4 marks)**

b) A company operates a complex set of benefits for its employees. The employees are either sales employees, who earn a basic salary plus 20% commission, or non-sales employees who earn a salary only. However, sales employees' salaries are calculated using a different algorithm to non-sales employees.

Managers are either sales managers or non-sales managers and all managers earn additional money from a profit share scheme.

The sales managers also earn a group commission of 3% on each sales employee's sales in the sales manager's group. The salary of all managers is calculated using the same algorithm as non-sales employees.

A sales manager may also make individual sales and accrue standard sales employee's commission.

All types of employee share several attributes, but also have attributes of their own.

The following operations (possibly with multiple methods) are used for the various employees:

```
salaryCalc();  
profitShare();
```

commission();
groupcommission();

Draw a class diagram, using the above operations and the necessary inheritances, which shows how the pay will be calculated for the following staff:

a non-sales employee
a sales employee
a non-sales manager;
a sales manager

There is no need to identify any attributes or introduce any new operations. Any assumptions you make must be stated and justified.

(13 marks)

Answer pointers

3 (a) (i)

Inheritance is a mechanism which allows new classes to be defined in terms of existing classes. The new class automatically includes (inherits) the features of the class it is created from and can then add features to reflect its specialisation, change or suppress inherited features.

4 marks

3 (a) (ii)

Polymorphism means the ability to respond to a message in different ways depending on the recipient object. This means that the originating object does not need to know which class is going to receive the message as it is the receiving object's responsibility.

4 marks

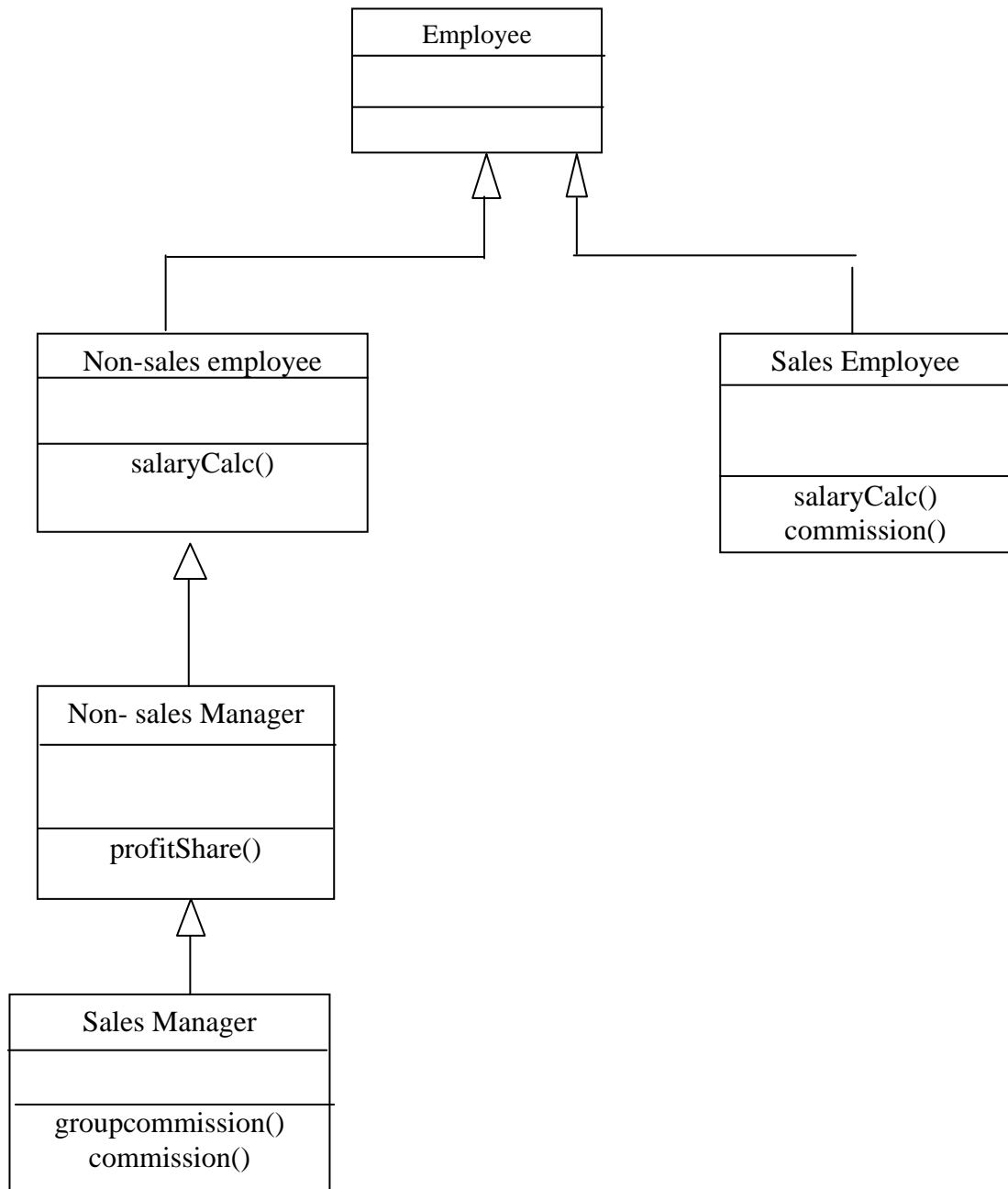
3 (a) (iii)

Aggregation is a whole-part association between the aggregate (whole) and its components (parts) in which the parts can exist separately.

4 marks

3 (b)

There are a number of ways of doing this. A sample answer is below, but the Sales Manager could equally well be under the Sales Employee and inherit the "commission" method.



3 marks each for the top two inheritances, 3.5 marks each for the next two.

Examiner's comments

This was a reasonably popular question with 67% of students attempting it. It was answered well with 75% those who attempted it, achieving a pass mark. Inheritance and aggregation were well understood and explained but many candidates did not seem to know about polymorphism. Part (b) was answered reasonably well but most candidates did not seem to realise that managers were employees as well and so could inherit methods from non-management employees.

Question 4

Write short notes on each of the following web page components, stating the relevance of each in systems design.

- a) Web Page Frames
- b) Cascading Style Sheets (CSS)
- c) Java Beans
- d) Cookies
- e) JPEG images

(5 x 5 marks)

Answer pointers

a) **Web page frames** split the browser window into sections so that some sections can remain static, while other sections can change according to the information they are displaying. Frames can be extremely useful but don't always display properly and can make printing difficult.

b) **Cascading Style Sheets.** Allow presentation rules to be summarised, so as to be kept consistent and changed easily, through separation of content and presentation. Thus they can help maintain a consistent look and feel for a set of web pages. A style sheet is made up of style rules that tell a browser how to present a document. Style sheets also offer flexibility in terms of the presentation effects that they provide. Properties such as colour, background, margin, border etc. can be applied to all elements. With just HTML, you rely on attributes like BGCOLOR, which are only available for certain elements. Style sheets give the flexibility of applying a style to all paragraphs, or all level-two headings, or all emphasised text for example.

c) **Java beans** are reusable software components that can be visually implanted into builder tools. They carry the concept of re-using components long used in conventional engineering into software construction. Their main features are:-
Introspection analysis of operation of bean
Customisation ability to alter appearance of bean
Properties allowing bean to be manipulated within a program
Persistence allowing altered beans to be restored to original state.

d) **Cookies** are parcels of text sent by a server to a web browser, and then sent back unchanged by the browser each time it accesses that server. Cookies are used for authenticating, tracking, and maintaining specific information about users, such as site preferences or the contents of their electronic shopping carts. Cookies have privacy implications, since they can be used for tracking browsing behaviour, Most browsers allow users to decide whether to accept cookies, but rejection makes some websites unusable. For example, shopping baskets implemented using cookies do not work if cookies are rejected.

e) **JPEG** stands for Joint Photographic Experts Group. JPEG is one of the image file formats that can be embedded in web pages. JPEG images can be significantly compressed, compared for example with GIF. There are a number of quality levels, which can be selected according to the application. The format allows full-colour images to be downloaded from web sites in acceptable timescales, important since photographic images are getting steadily larger. JPEG is not really suitable for simple line drawings, which are better held as GIF files.

Marks Breakdown

Description of each feature (4 marks)

Relevance to Systems Design for each feature (1 marks)

Examiner's comments

This was a reasonably popular question with 67% of students attempting it. It was not answered well though, with fewer than 50% of those who attempted it achieving a pass mark. Relatively few candidates understood the pros and cons of Frames or much about Cascading Style Sheets, or the nature of Java Beans. The answers on Cookies and JPEG were more successful.

Question 5

An application with a large number of windows can be difficult for a user to navigate.

- a) Describe five different ways in which a user of a multi-window computer system might be taken to a new window. **(5 x 2 marks)**
- b) Briefly explain some of the issues to be considered when designing the navigation between windows in a multi-window application, considering how you can make the process easier for the user. **(15 marks)**

Answer pointers

- a) Button click; menu selection; validation error; hotkey/enter; timeout; request for help etc.
(2 marks per method; one for a mention, one for some detail or explanation)
- b) Minimise keystrokes/mouse moves
Clear titles on windows.
Menus/button texts should be
 Meaningful
 Concise
 Consistent
Users shouldn't be surprised by unexpected changes
Careful about multiple screens (two edged)
Consistency between screens
 Title, Navigation buttons, Menus, general look and feel..
 (but not too much consistency! Different screens have different uses)
 "Where am I?" feature
 Help feature

A good range of issues should be mentioned, and evidence of understanding.
Award 1 mark for a mention, 2 if explained, 3 if well understood

Examiner's Comments

This was quite an unpopular question with only 30% of students attempting it. However almost all of them achieved a pass mark, and some answers were very good. Candidates showed a reasonable understanding of the different mechanisms available, and of some of the issues to be considered to ensure usability.

Question 6

Small shops are increasingly using PC based EPOS Till, which can be difficult for sales staff with limited IT experience.

- a) Explain some of the advantages and disadvantages of each of the following input devices as part of an EPOS till system.
- Touch Screen
 - Keyboard
 - Barcode Scanner
 - Mouse

(4 x 5 marks)

- b) Briefly discuss how an EPOS Till design might need to change for the till to be used by customers as a self-service till.

(5 marks)

Answer Pointers

The purpose here is to get the candidates to think about the situation and realise that there are design issues and decisions to make. They should realise the standard input devices have disadvantages and the more specialised devices have some advantages.

a)

Touch Screen – can be a lot simpler for people unused to a keyboard and mouse. It can also be a lot quicker. With a good dialogue design this can provide fast and intuitive navigation since the number of options for a typical sale should be quite small.

A touch screen can use colour and images to help usability. Special functions can easily be provided too.

Keyboard – can provide a lot of power, but can also confuse staff not used to a keyboard.

A keyboard can always be shown on a touch-screen as a last resort, but this can be slow. Some functions will be easier with a traditional keyboard, for example entering new stock descriptions.

Barcode scanner – provided the goods are barcoded, or a crib sheet is provided, this can streamline the checkout process and greatly reduce errors. Barcodes can be used for products and for other things; for example customer accounts. A numeric keypad is useful as well in case the code doesn't scan, or for price reductions or bulk purchases (eg 25 of an item), but this could be on a touch-screen.

Mouse – fine for those familiar with a WIMP interface, but can be quite daunting for people who haven't used one. If there is a standard mouse and keyboard, the till could provide standard PC functions, which may have pros and cons. It could provide management, admin or reporting functions for example.

b)

There is far more scope for things to go wrong with infrequent or first-time users, so a simple interface with fewer components is required. Keyboard and mouse are quite unsuitable. Touch Screen and Barcode Scanner should be quite sufficient, but for loose goods integrated scales would be necessary.

Simple animation can be provided to show the customer how to operate the checkout.

Examiner's Comments

This was a fairly popular question and 75% of students attempted it. Of those who attempted it, almost all achieved a reasonable pass mark.

The first part was well answered and candidates showed a reasonable understanding of the sorts of issue to be considered, and made sensible comments about the advantages and disadvantages of different sorts of technology.

In the second part however, candidates had some difficulty seeing the differences in the situation where any customer might attempt to use a self-service till. A number of answers did not demonstrate awareness of any problem in using a keyboard and mouse in a self service environment.