BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 5 Diploma in IT

DATABASE SYSTEMS

Tuesday 3rd April 2012 - Morning
Answer 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.   The following report shows the money taken by films being shown at several cinemas across the UK. Each cinema has a manager who records the amount of money taken whilst the film is shown at that location.

The following table shows sample occurrences of the data which is a complete representation of the scenario:-

Fno	Fname	Cno	Cname	CLocation	Mno	Mname	Takings
15	Arthur	1	Odeon	Newcastle	01	Green	£220
		2	ABC	Newtown	01	Green	£170
		3	Embassy	Croydon	03	White	£500
45	Titanic	1	Odeon	Newcastle	01	Green	£600
		2	ABC	Cardiff	01	Green	£880
		3	Embassy	Croydon	03	White	£290
		4	Odeon	Edinburgh	04	White	£430
71	Rocky	1	Odeon	Newcastle	01	Green	£180
		5	Gaumont	Warwick	02	Wood	£125
78	Jaws	2	ABC	Cardiff	01	Green	£150
		3	Embassy	Croydon	03	White	£200
		6	Gaumont	Bristol	05	Brown	£290
88	Arthur	7	Odeon	Croydon	02	Wood	£225

a)   Identify any repeating groups in the above representation and describe how they can be removed to produce a relation in first normal form. Identify the key attributes of the resultant relation.

(4 marks)

b)   Normalise the data, showing functional dependencies and how you progress from 1NF through 2NF to a set of 3NF relations.

At each stage show the primary key and any foreign keys of each relation and state assumptions that you make about any of the relationships between the columns of data.

(10 marks)

c)   Foreign keys are normally designed to protect data in tables that are in a parent-child relationship. If a column in a table is declared to be a foreign key, what integrity checks will be placed on data in the two tables involved in the foreign key definition?

(4 marks)

d)   Many DBMS allow foreign keys to be defined with the CASCADE DELETE option. Explain the effect of this option on the two tables involved in the foreign key definition.

(3 marks)

e)   Explain why it is customary to base primary keys on numeric (NUMBER) columns rather than character (VARCHAR) columns.

(4 marks)

A2. a)   Explain why security of data in a database is becoming an increasing concern.

(6 marks)

b)   Discuss techniques and precautions that can be used when

i)   allowing users to connect to the database.

(5 marks)

ii)   authorising users to perform certain actions within the database.

(5 marks)

iii)   Explain the effect of the following SQL statements when executed bu a user called amy. Employees is a table owned by a user called amy.

```
GRANT CREATE VIEW TO joe, fred;
REVOKE DELETE ON employees FROM JOE;
```

(4 marks)

c)   To protect database data, backups of the database are taken. Discuss techniques and measures that can be taken in order to ensure the security and effectiveness of database backups.

(5 marks)

A3. a) In a distributed database, tables are often fragmented and/or replicated.

   i) Describe horizontal and vertical fragmentation of tables using examples where necessary and state reasons why it might be done. In each case show how fragments may be recombined to return the entire set of data in a table.

   (4 marks)

   ii) Describe replication of tables and discuss why this may be desirable and the problems it might cause.

   (5 marks)

   iii) Describe the difference in behaviour when updating tables involved in:

      1) synchronous replication
      2) asynchronous replication

   (4 marks)

   b) A main responsibility of the Database Administrator (DBA) is to ensure the availability of the database. To recover from failures that affect the database, the DBA uses a range of features such as after images, before images, transaction logs, checkpoints and backups within techniques such as rollforward, rollback and restore.

   Show how recovery may be achieved from the following failures:

   i) An update transaction is almost complete but fails to access the final table it needs to complete its changes.

   (3 marks)

   ii) A network connection fails resulting in the sudden crash of a database session conducted by a remote user.

   (4 marks)

   iii) A non-mirrored disk belonging to the database overheats and all of its data is permanenetly lost.

   (5 marks)

B4.   a)   Define the term 'Relation' – in the context of the Relational model of data.

(3 marks)

      b)   Describe the function of each of the following:

           i)   Views
           ii)   Stored Procedures

(6 marks)

      c)   Write CREATE TABLE statements for a relational model derived from the Form given in Figure A1 (Appendix A). Include a small selection of attributes with data types and all foreign key constraints.

(8 marks)

      d)   Using the TABLES in part c) above, create an example View and an example Stored Procedure and show how they could implement a processing requirement described in the Case Study (Appendix A).

(8 marks)

B5.   a)   Explain with aid of examples what is meant by logical and physical data independence in a database system.

(10 marks)

      b)   Realisation of logical and physical data independence may be difficult to achieve in practice in commercial DBMS products. Explain why this might be the case.

(5 marks)

      c)   Most DBMS products use a data dictionary (also called the system catalogue) to hold meta-data. What is meta-data? Give examples of the type of data held in the data dictionary and explain what it is used for.

(10 marks)

B6.   Refer to the MSIS Case Study (Appendix A). Design an ER data model for the MSIS. The text highlighted (in bold font) is provided to help you identify entity types.

You are marked on the accuracy and expressiveness of your design and marked according to the following guidelines:

i)   Entity Types

(5 marks)

ii)   Relationship Types/name

(5 marks)

iii)   ER diagram

(10 marks)

iv)   A written description of ONE **1 to Many** relationship from your ER diagram including an explanation of the participation constraints and modelling conventions that were used.

(5 marks)

State any assumptions you made – these must not contradict the discourse.

Appendix A Case Study: (MSIS)

1. FINDS
The **Museums Service Information System** (MSIS) maintains a catalogue of about 5000 **Finds** excavated following an archaeological **excavation (or 'dig')**.
Figure A1 represents an example of cataloguing 2 finds that were excavated at a particular **site**.
A Find is recorded as either:

- **Individual:** a catalogued **item** that is intact (e.g. a sword)

- **Whole: a collection** of catalogued items (e.g. bones, tile) that either partially or completely form a single catalogued item (e.g. a skeleton, mosaic respectively).

- **Mixed** a collection of non-catalogued items that are kept together as a single catalogued item. (e.g. shard of pottery). The collection may be of the same type (e.g. mixed pottery) and of similar age.

Once Finds have been catalogued they are stored at the district museum. **Artefacts** such as photographs, drawings from the excavation accompany each Find, either digitised, on paper or both as Media Sources (see Figure A1).

2. SITES
A Site is a location of special archaeological interest. Only a small proportion of sites have been excavated. But a record of the site is important to protect it from development.

3. USERS
A Chief Archaeologist is responsible for all aspects of an excavation and the catalogue of Finds. A Museum Service Curator is responsible for the upkeep of Finds and exhibiting a number of selected Finds at **exhibitions** at a museum.

Archaeologists who are members of the excavation team fill in the form (Figure A1) and can upload the information with any digital media to the Museum Service web site. The web site supports on-line access to summary information in the catalogue of Finds to anyone to search/browse the catalogue and get information about exhibitions.

Figure A1: Standard Data Input Form:

[**SiteNumber**] eg   1290/HG/4
[**Site spatial coordinates** in degrees] LAT 55.8672 LONG 23.9811
[**Excavation Number**]   1 of 1
[**Excavation Duration**]   12/Oct/98-22/Oct-98
[**Chief Archaeologist**]   T.JOHNSON
[**Description of Site**]   Early bronze age burial site with re-occupation afterwards mainly for farming. Also site of battle - 1066.
[**Period of Site Occupation Period1**]   2nd Century BC
[**Period of Site Occupation Period2**]   1066
[**Period of Site Occupation Period3**]   12th-14th Century
[**Media Sources LISTED BELOW**
  X **Scaled line drawings of the position and location of the site.**
  X **Colour illustrations (hand drawn) visualising the site.**
  X+ **Colour 35mm photographic slides of a site.** (bitmap image format)
    Videos (cassette tape) containing presentations on site history.
  X+ **Aerial Photographs taken over the site.** (original Jpeg images)
   Microfiche slides of old documents associated with a Site.]

    ==
    [**LIST OF FINDS EXCAVATED AT THIS SITE**]
    [**Number of catalogued types=**] 2
    [**FindNumber**]   9701
    [**Type**]   Mixed
    [**Date of Find**]   180-220BC
    [**Description**] Probable grave remains mainly bones but no skeleton
    [**Cross Referenced FindNo**] 9702
    [**Cross Reference Sitenumber**] n/a
    [**Comments**]   an item removed from the grave remains
    [**Amount/Units**]:   200 items of bones of mixed origin

    [**FindNumber**]   9702
    [**Type**]   Individual
    [**Date of Find**]   180BC
    [**Description**]   24ct Gold Tunic ring from a chieftain
    [**Cross Referenced FindNo**]   826
    [**Cross Reference Sitenumber**] HT98/96
    [**Comments**]   similar ring found at the above site
    [**Amount/Units**]