

THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATION Diploma

DATABASE SYSTEMS

30th April 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. Read the scenario in **Appendix A** at the end of the paper before answering this question.

The proposed web-based implementation of the booking system would benefit from an N-tier client server platform.

- a) State the advantages of using a web-based implementation instead of the existing system as described. **(5 marks)**
- b) Explain with the aid of a diagram what is meant by an N-tier client server platform. **(5 marks)**
- c) Explain what software facilities would be appropriate for developing the proposed database application, stating what is different from developing a single-user application. **(10 marks)**
- d) Briefly discuss to what extent the existing user interface design might be constrained by moving to the new client server platform. **(5 marks)**

- 2.
- a) Describe the limitations of the file-based approach to data management. **(4 marks)**
 - b) Describe the main facilities provided by a database management system. **(4 marks)**
 - c) What is data independence? Distinguish between logical and physical data independence. Illustrate your answer with an example. **(8 marks)**
 - d) Describe in detail the advantages and disadvantages of database management systems. **(9 marks)**

3. Refer to the tables given in **Appendix B** at the end of this paper to answer this question.

- a) Write an SQL statement that will list the authors of those articles that have been out on loan and returned. The answer should show just the article title and the complete author name. Do not use a subquery. **(10 marks)**
- b) The Journal Library holds 200 journals, 1500 articles, has 100 borrowers and has made 400 loans to date. The loans are for 200 different articles made by 50 borrowers.

Write a series of relational algebra statements to process the same query as specified in part a) above.

Assuming that the relational algebra statements are chained

- i) calculate how many tuples are read as each statement is processed
- ii) calculate how many rows and columns there would be in the resulting relation
- iii) state the total number of tuples read in the processing of the query. **(15 marks)**

Turn over]

4. a) The database design process can be divided into three phases:
- i) conceptual database design,
 - ii) logical database design,
 - iii) physical database design.

Describe each of these design phases in terms of the input to each phase and the output it produces. Illustrate your answer with an example. **(9 marks)**

- b) Identify a particular database design methodology and describe in detail the steps involved in each of the above stages. Illustrate your answer with an example. **(16 marks)**

5. a) Precisely define the following security issues that arise in multi-user information systems:

- authentication of users
- authorisation of users
- confidentiality of data

(9 marks)

- b) Describe the DBMS software facilities that are used to support the above security issues in a multi-user information system. **(9 marks)**

- c) What role does the Database Administrator (DBA) play in an organisation that holds much of its sensitive and confidential data on a centralised DBMS? **(7 marks)**

6. A database is to be designed for a video rental company, which has several branches.

The data held on each branch is the branch address and telephone number. Each branch is given a branch number, which is unique throughout the company. Each branch is allocated staff. The data held on a member of staff is their name, address, position, and salary. Each member of staff is given a number, which is unique throughout the company.

Each branch has a stock of videos. The data held on a video is the catalogue number, video number, title, category, length of the rental period, cost, status, and the names of the main actors and the director. The catalogue number uniquely identifies each video. However, in most cases, there are several copies of each video at a branch, and the individual copies are identified using the video number. A video is given a category such as 'Action', 'Children', 'Drama', 'Horror', or 'SciFi'. The status indicates whether a specific copy of a video is available for rent.

Before hiring a video from the company, a customer must first register as a member of a local branch. The data held on a member is the first and last name, address, and the date that the member registered at a branch. Each member is given a member number, which is unique throughout the company. Once registered, a member is free to rent videos, up to a maximum of ten at any one time. The data held on each video rented is the rental number, the full name and number of the member, the video number, title, the length of the rental period, and the dates the video is rented out and returned. The rental number is unique throughout the company.

- a) Create an Entity-Relationship (ER) diagram for the video company that identifies:

- i) The entity types of the video rental company.
- ii) The relationship types between the entity types.
- iii) The cardinality and participation constraints for each relationship.
- iv) The attributes of each entity and the relationship types.
- v) The primary key attributes for each (strong) entity type.

State any assumptions that you make.

(16 marks)

- b) Describe a set of relational database tables that could be used to implement the ER diagram you created in part a). **(9 marks)**

APPENDIX A: Hotel Booking Scenario (For use with Question 1)

A company owns a chain of travel lodges/hotels at different locations in a country. Each hotel offers a standardised accommodation package and each hotel has around twenty rooms. These rooms are divided equally between combinations of either twin or double-bedded and either smoking or non-smoking. All rooms sleep a maximum of two adults, and are charged on a room per night basis, regardless of whether they are occupied by one or two guests. The charge per room per night is standard throughout the week.

The current information system requires a stand-alone single user computer located at each hotel. Each PC contains standard database software and accounting software packages and data pertinent to a particular travel lodge/hotel.

Processing in the existing system

At present the majority of room reservations are made via telephone enquiries direct to the hotel. Reservations are also made via fax messages and occasionally by post. All reservations are entered into a diary that simply consists of pages plotting dates horizontally against rooms vertically down the left margin of each page. Each square on the resulting grid is large enough to have the guest's details written in when they reserve a room. Reservations are deemed to be unconfirmed unless a credit card number is supplied. Alternatively business reservations can be confirmed by fax, and personal bookings by sending a deposit in the absence of a credit/debit card number. For accounting purposes all confirmed bookings are entered into a PC database package. An accounting package uses data contained in the database to process monthly accounts and balance sheets entirely for hotel/chain managers and accountants.

Business Rules

- A reservation can exist in one of two states, provisional or confirmed.
- A room can only be subject to one reservation, of either type, on a given day, at any given time.
- Any room not subject to either type of reservation is deemed vacant and available for booking.
- A reservation may involve one or more rooms. However, all rooms in a single booking must have the same arrival and departure dates. If different arrival dates apply then separate reservations must be made.
- A single reservation is made in a single name regardless of how many guests it actually involves.
- When a reservation is made the room allocated should always be the room whose vacant period best matches the requested reservation period, given that the room is of the type requested.
- Prices are calculated on a room per night basis and exclude all extras, including breakfasts.
- All rooms can sleep up to two occupants, either in a double or in twin beds.

Appendix B: Sample Tables from a Journal Library (For use with Question 3)

JOURNAL

<u>JournalId</u>	JournalName
3215	Database Weekly
3216	Database Monthly
3217	RDBMS Quarterly
3218	SQL Server Weekly

ARTICLE

<u>ArticleId</u>	ArticleTitle	AuthorId	JournalId
3215	Object-Oriented Optimisation	23	3216
2409	SQL Server – A VB Interface	18	3218
1398	Relational Algebra Part 4	23	3217
1289	Homage to Dr E F Codd	23	3215
2554	TLAs in DBMs	67	3216
1678	Functional Data Modelling 2	18	3215
4561	Network Data Manipulation	18	3216

AUTHOR

<u>AuthorId</u>	AuthorFname	AuthorLname
23	Mich	Murray
18	Peter	Gardenas
67	Malcolm	Sancton

LOAN

<u>ArticleId</u>	<u>BorrowerId</u>	<u>LoanDate</u>	<u>ReturnDate</u>
2409	43	3/2/02	4/2/02
1398	43	3/2/02	4/2/02
1289	17	6/2/02	8/2/02
2554	26	11/2/02	12/2/02
2409	43	14/2/02	
2554	52	14/2/02	

BORROWER

<u>BorrowerId</u>	BorrowerFname	BorrowerLname	BorrowerTelNo
52	Janet	Greer	01582-900456
43	Fred	Bloggs	01933-546321
17	Himi	Dhura	01582-453214
26	John	Smith	01923-560087