**THE BRITISH COMPUTER SOCIETY**

THE BCS PROFESSIONAL EXAMINATION
Diploma

**DATABASE SYSTEMS**

14th October 2004, 10.00.a.m-12.00 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)*   In your own words, briefly describe *why* a relational database design must be normalised prior to SQL implementation. You should include any issues which may arise from using un-normalised relations. (You **DO NOT** need to describe the detailed mechanics of normalisation but you **DO** need to comment upon the role of functional dependency).                                        **(5 marks)**

    *b)*   Using your own simple examples, describe in detail the objectives (i.e.what is to be achieved) and the mechanics (i.e. how it is achieved) of each of the following normalisation stages.  (You should annotate and explain your examples clearly):

    *i)*     First Normal Form (1NF)
    *ii)*    Second Normal Form (2NF)
    *iii)*   Third Normal Form (3NF)
    *iv)*   Boyce-Codd Normal Form (BCNF)                                              **(20 marks)**

2.  Using your own simple SQL code examples, discuss and explain how SQL handles the following SELECT-related constructs. You must clearly annotate and explain each example used and comment upon any relevant issues.

    *a)*   Set Operators                                                                        **(5 marks)**
    *b)*   Joins                                                                                    **(5 marks)**
    *c)*   Logical Operators                                                                   **(5 marks)**
    *d)*   Character Matching                                                                **(5 marks)**
    *e)*   Aggregate Functions                                                              **(5 marks)**

3.  For EACH of the following database techniques explain how data security is maintained.  Provide examples (in SQL) and diagrams (where applicable) to illustrate the implementation of these techniques.

    *a)*   database access control                                                          **(10 marks)**
    *b)*   database privileges                                                                 **(10 marks)**
    *c)*   SQL *views*                                                                            **(5 marks)**

**4.** *a)* Provide practical examples of the threats and risks that a DBMS must deal with to preserve data accuracy and integrity. **(8 marks)**

*b)* Explain the techniques and mechanisms that a DBMS provides to preserve the accuracy and integrity of the data stored in a database system. Give examples using a DBMS product with which you are familiar. **(10 marks)**

*c)* Describe a range of design techniques that can be applied to identify potential threats on the data accuracy and integrity of data held in a database. **(7 marks)**

**5.** In web-based auction sites such as Ebay, users submit bids and compete with other users bidding for the same product. Bidding continues for a specified period of time before the highest bidder (who becomes the buyer) secures the product. When the seller receives payment he/she posts the product to the buyer. A transaction is completed when the buyer receives the product. Since the seller is anonymous no correspondence from the buyer to the seller occurs, therefore a large amount of trust occurs. The integrity and honesty of sellers is recorded and this is made known to potential bidders.

*a)* Describe the requirements of a DBMS and database server needed to support the application outlined above. **(8 marks)**

*b)* Explain the interaction between a database server and a web server in order to present data stored in a database on a web browser. Illustrate your answer with references to application data and program code applicable to a web-based auction site. **(10 marks)**

*c)* Discuss the trade-offs of implementing the program logic and business rules on:
   *i)* the application/web server
   *ii)* the database server **(7 marks)**

**6.** *a)* State the advantages of *Entity-based* data modelling over *Relational-based* data modelling when designing data-centric applications. **(4 marks)**

*b)* Outline how an Entity-based data model can be translated into a Relational-based data model or schema. **(5 marks)**

*c)* Produce an Entity-based data model for the scenario in the Appendix on the next page. Your model must convey sufficient detail for translation to a Relational-based data model or schema – **DO NOT PERFORM THIS TRANSLATION**. You must state the notation you used in your model and state any assumptions you have made. **(16 marks)**

## Appendix (FOR USE WITH QUESTION 6)

## Scenario – Reservation Database

# Introduction

*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.*

### 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.*

### 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.*