THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATION
Diploma

DATABASE SYSTEMS

25th April 2005, 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.*

Attached Appendix A: SWIS (Simply a Web Information Service)

1. Relational theory and relational algebra are the foundation of modern relational databases. For EACH of the following terms, describe and discuss the concept involved. You should support your answer with your own simple examples and any appropriate diagrams.

a) Union Compatibility
b) Referential Integrity
c) Entity Integrity
d) Results Set
e) Domain Integrity **(5 x 5 marks)**

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

a) Presenting aggregated and summarised data **(10 marks)**
b) Searching for incomplete or uncertain data **(10 marks)**
c) Extracting data from multiple tables **(5 marks)**

3. Highlight the problems and solutions for the management of concurrency in database systems by answering the following sub questions:

a) Explain the concepts of *transaction schedule*, and *serialisability*. **(8 marks)**
b) Describe briefly the kinds of problems that might appear when a schedule is not serializable. **(9 marks)**
c) Explain what is a locking mechanism and how it can be used to resolve these problems. **(8 marks)**

4. The table (**Figure 1**) on the next page represents a sample report layout for a construction company that manages several projects. Each project has its own number (P-No), name (P-Name), and employees assigned to the project. Each employee has an employee number (E-No), name (E-Name), and a job classification (Job-Class). The company charges its client by billing the hours spent on each contract. The charge per hour (Chrg-Hr) rate is dependent on the employee position or job classification (Job-Class). The total charges (Tot-Chrg) is the product of hours billed (Hrs-Billed) and charges per hour (Chrg-Hr).

P-No	P-Name	E-No	E-Name	Job-Class	Chrg-Hr	Hrs-Billed	Tot-Chrg
1	Harricane	101	John News	Elect. Eng.	65	13	845
		102	David Senior	Comm. Tech.	60	16	960
		104	Anne Ramoras	Comm. Tech.	60	19	1,140
2	Coast	101	John News	Elect. Eng.	65	15	975
		103	June Arbough	Biol. Eng.	55	17	935
3	Satellite	104	Anne Ramoras	Comm. Tech.	60	18	1,080
		102	David Senior	Comm. Tech.	60	14	1,920

Figure 1: A Sample Report Layout

A database designer was asked to develop a database from which the information contained in the Sample Report in **Figure 1** above could be generated. For this, he/she designed the **Project Table** (in **Figure 2** below) the structure of which matches the above report formats. He/she omitted the total charge attribute because he/she thought that it could be calculated using charge per hour (Chg-Hr) and Hours billed (Hrs-Billed).

P-No	P-Name	E-No	E-Name	Job-Class	Chrg-Hr	Hrs-Billed
1	Harricane	101	John News	Elect. Eng.	65	13
		102	David Senior	Comm. Tech.	60	16
		104	Anne Ramoras	Comm. Tech.	60	19
2	Coast	101	John News	Elect. Eng.	65	15
		103	June Arbough	Biol. Eng.	55	17
3	Satellite	104	Anne Ramoras	Comm. Tech.	60	18
		102	David Senior	Comm. Tech.	60	14

Figure 2: Project Table

You are asked to answer the following two questions:

a) As the Project Table in **Figure 2** (above) developed by the database designer is susceptible to update anomalies, provide ONE example of anomalies for EACH of the following:
   ii) insertion
   iii) deletion
   iii) update anomalies **(9 marks)**

b) Using the functional dependency diagrams (fd1, fd2, etc…), describe and illustrate the process of normalisation from First Normal Form to third Normal Form for the Project Table in Figure 2 (above). In this process of normalisation, we assume that the **Project** attributes P-No, E-No and Job-Class could be used to determine the values of (P-Name), E-Name and Job-Class), and (Chrg-Hr) respectively. **(16 marks)**

5. Please refer to Appendix A on the back page for this question.

Produce a logical data model for the SWIS order processing system.

Your logical data model must include the following:

a) A description of the different user VIEWS that are supported. **(5 marks)**
b) An Entity Relationship (ER) model diagram. **(10 marks)**
c) The tables required including the primary and foreign keys and some sample attributes. **(6 marks)**
d) A justification of your modelling decisions and any assumptions you needed to make. **(4 marks)**

6. Please refer to Appendix A on the next page for this question.

SWIS and its suppliers are investigating the use of web technologies to allow remote access to their databases. One functional requirement will be to allow SWIS read access to a supplier's database so that it can check the availability of products that a customer has ordered.

Describe THREE different configurations of a distributed information system that would support the business activities of SWIS and in particular, the functional requirement referenced above.

Your answer should be assisted by the inclusion of diagrams and sketches to explain concepts and any technical details. **(25 marks)**

Appendix A: SWIS (Simply a Web Information Service) for use in answering Question 5 and 6.

SWIS is a successful E-Commerce (web-based) business that customers use to purchase products at discounted prices over the internet.

SWIS makes money when it purchases products in large quantities following many customer orders for the same product. SWIS has negotiated deals with suppliers in which the higher the quantity of products purchased then the greater the discount and the greater the saving on the supplier's quoted price. These savings are passed proportionately onto the customer who will pay less than the price the supplier would quote an individual customer. SWIS provides a value-added service that will find the cheapest price, availability and order dates of products from a range of suppliers. Therefore at the time of ordering the customer will only know the lowest quoted supplier's price they will pay for a particular product. It is only when the products are ready for dispatch that a customer will know whether there is a discount on a supplier's quoted price. Another value-added service that SWIS provides is a comparative product review of similar products. SWIS requires customers to be registered before they can order products and/or use a value-added service.

There is a range of suppliers that SWIS deals with and each supplier allows SWIS read-only access to their product data, for example to determine stock levels and purchase price.

There are many customers who can make many orders. An order can contain many different products (called a shopping cart). The products on an order can be sourced from different suppliers.

The most complex type of order that SWIS needs to process is a multiple customer, multiple product and multiple supplier order. For example SWIS creates individual supplier orders from individual customer orders involving many products that are sourced from many suppliers. SWIS owns a Warehouse that holds the products sent from suppliers prior to dispatch/delivery to customers.