THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATIONS
BCS Level 5 Diploma in IT

DATABASE SYSTEMS

2nd May 2008, 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.*

Calculators are **NOT** allowed in this examination.

1. Using your own SQL code examples, discuss and explain all the relevant concepts that must be addressed by a database developer when implementing the following Data Definition Language (DDL) constructs:

   a) Table creation

   (10 marks)

   b) Index creation

   (10 marks)

   c) View creation

   (5 marks)

2. a) Describe the ANSI-SPARC three-level architecture under the following headings.

      i) The external schema, conceptual level, and internal schema
      ii) The external/conceptual mapping and the conceptual/internal mapping.

      Illustrate your answer with examples.

      (15 marks)

   b) Describe how the three-level architecture provides both logical and physical data independence. Illustrate your answer with suitable examples.

      (10 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 *serializability*.

   (9 marks)

   b) Describe briefly the kinds of problems that might appear when a schedule is not serializable.

   (8 marks)

c) Explain what is a locking mechanism and how it can be used to resolve these problems.

(8 marks)

4. Consider the following relations:

BOOKS (BookNo#, Primary_author, Topic, Total_stock, Price**)**
BOOKSTORE (StoreNo#, City, State, Postcode, Inventory_value**)**
STOCK (StoreNo#, BookNo#, Quantity**)**

Where **BookNo** is the primary key of BOOKS, **StoreNo** is the primary key of BOOKSTORE, and **(StoreNo, BookNo)** is the composed primary key of STOCK. Also, the **Total_ stock** is the total number of books in stock, and **inventory_value** is the total inventory value for the store in pounds.

a) Give an example of two simple predicates that would be meaningful for the BOOKSTORE relation for horizontal partitioning.

(7 marks)

b) How would a derived horizontal partitioning of STOCK be defined based on the partitioning of BOOKSTORE?

(6 marks)

c) Show predicates by which BOOKS may be horizontally partitioned by topic.

(6 marks)

d) Show how the STOCK may be further partitioned from the partition in (b) by adding the predicates in (c)

(6 marks)

5. The following relational schema is used to record information about Movies (also known as Films); the Actors who appear in a Movie; the person called a Producer who produced the Movie.

```
Movie(title,year,length,productionCert)
AppearsIn(movieTitle,movieYear,ActorName)
Producer(name,address,certificate)
Actor(Actorname,gender,birthdate)
```

You may assume that the underlined and bold attributes are primary keys and that productionCert is a foreign key to certificate.

a) Write the following queries in SQL:

i) What are the names of male Actors who act in a Movie with Title “Star Wars”?

(5 marks)

ii) What is the average length of those movies that have a length of more than 2 hours?

(5 marks)

b) Apart from the primary keys what attributes would you apply an index in order to improve the performance of Query (a)(i) above? Justify your answer.

(5 marks)

c) Explain what integrity checks should be in force if a row is added to the Appearsin table. Write the SQL code that would ensure data integrity is maintained.

(5 marks)

d) Using the SQL query below explain the function of the IN operator.

```
SELECT name
FROM Producer
WHERE cert IN (SELECT productionCert
FROM Movie
WHERE title IN (SELECT movieTitle
FROM AppearsIn
WHERE Actorname='Clint Eastwood'));
```

(5 marks)

6. ***Refer to the GP/OHS application in Appendix A.***
You are part of a team designing the data model for the GP/OHS. Before you distribute the databases into fragments or replicas you need to provide an Entity Relationship data model of the entire system.

a) Produce an Entity Relationship Data (ERD) Model and a physical schema (set of normalised tables) for the GP/OHS application. To assist you the entity and attribute types that you need to include in your model and schema appear in **bold font** in the Case Study and in figures A1 and A2.

You **should** state the ERD modelling symbols you have used.
You **should** state any assumptions that you have made but you should not contradict anything in the discourse.
You **should** include primary and foreign keys but no other attributes ate required. Should this be 'are'?
You **should** indicate how you translate your ERD into a set of normalised tables.

(16 marks)

b) Discuss the data distribution strategies that could be applied to the GP/OHS application.

(9 marks)

Appendix A: Discourse - GP Out of Hours Service (for use in Question 6)

A general practitioner (**GP**) is a medical doctor who provides primary care; in other words treats common illnesses, provides preventive care and health education. GPs are based at a GP practice. **Patients** are registered with a **GP practice**. Patients usually make an appointment to see a GP at a GP practice during normal working hours.

The **GP Out-of Hours Service** (GP/OHS) is a contracted service run by a regional local body through which patients can request primary care at their home instead of visiting a GP practice outside normal working hours. A number of GP practices are contracted to support this service. A number of GPs from a practice are said to be 'on call' to **visit** patients usually at a patient's home.

Patients' summary medical records (including diagnosis and treatment history) are held on a national database run by the Care Records Service (CRS) on a database called CRS DB.

Patients' detailed medical records including specific image-based medical data, such as X-ray photographs, are held on a regional health authority database called CCS running on a computer system called Central Control.

In order to monitor the location and status of GPs during the GP/OHS (for example they may be attending a call) CCS records the status and geographical location of every doctor while on call.

GPs carry with them a hand-held device called a PDA (personal digital assistant) that they use to store patient medical data in a PDA database (or PDA DB). The database running on this system stores information arising from a visit, such as the patient's **diagnosis** and **treatment**. It is important that the GP has an up-to-date medical history of the patient and that any **medications dispensed** do not conflict with existing **medications** that a patient is taking. Therefore PDA DB can upload data from the CRS DB. An example of this information is shown in the screen shots of Figs A1 and A2.

Each GP has a chauffeur who drives the GP to the patient's address. The GP's PDA DB holds an initial list of patients to visit. The GP/chauffeur can at any time receive instructions to visit another patient who is not on the list and who needs treatment.

Fig A1 Example Form1: Patient Medication History

	Patient Details	Patient Added Information	Medical/Social Records
Mary Williams	**Dob 13/04/2022**	**15 Spencer Gardens, Stockton-On-Tees**	**NHS No 9999999972**

GP Record	Dr Smith	The Medical Centre, Stockton-on-Tees			Tel 01642 654321	
Summary	**Medication**	Sensitivities	Full Notes	Lab Tests	Images	Operations

Date	Drug	Dosage	Supply Amount
10/08/2001	**ASPIRIN tablets 75mg**	**take one daily**	**56 tab**
10/01/2001	**FLUOXETINE capsules 20mg**	**take one daily**	**30 cap**
10/11/2000	**FLUOXETINE capsules 20mg**	**take one daily**	**30 cap**

Fig A2 Example Form2: Patient Treatment History

	Patient Details	Patient Added Information	Medical/Social Records
Mary Williams	**Dob 13/04/2022**	**15 Spencer Gardens, Stockton-On-Tees**	**NHS No 9999999972**

GP Record	Dr Smith	The Medical Centre, Stockton-on-Tees	Tel 01642 654321

Summary	Medication	Sensitivities	Full Notes	Lab Tests	Images	Operations

Date	Problem
10/11/2000	**Moderate depression**
14/10/1998	**Sensorineural deafness**
16/06/1995	**Cerebral thrombosis**
16/06/1995	**Hemiparesis**
01/12/1990	**Total hysterectomy & B.S.O.**
01/12/1990	**Endometrial Ca**

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