THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATIONS
Diploma

DATABASE SYSTEMS

26th April 2006, 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: SWIFT for use in Question 5 and Question 6.

1. Security and integrity are two database terms which are commonly used together, yet each has a different meaning.

a) Distinguish between security and integrity by giving a BRIEF definition of each. **(6 marks)**

b) Explain what is meant by entity integrity and referential integrity **(4 marks)**

c) The insurance policies have attributes policyNo, startDate, premium, renewalDate, policyType. Policy holders have attributes holderNo, holderName, holderAddress and holderTelno. Write SQL statements to create table definitions for the Insurance Policy table and the Policy Holder table. Make sure you use appropriate domains/data types for each attribute and also define suitable primary keys for each relation. A policy holder can have more than one Insurance Policy so you must define a suitable foreign key in the appropriate relation. **(6 marks)**

d) Give a detailed explanation of the database features that can be used to achieve security and integrity. Give examples using a DBMS you are familiar with to support your answer. **(9 marks)**

2. *a)* Describe the ANSI-SPARC three-level architecture under the following headings:
i) The external level, the conceptual level, and the internal level.
ii) The external/conceptual mapping and the conceptual/internal mapping.

Illustrate your answer with examples. What would be the effect if a DBMS only supported the conceptual and internal levels but not the external level? **(9 marks)**

b) Describe how the three-level architecture provides both logical and physical data independence. Illustrate your answer with an example. **(8 marks)**

c) A database management system uses a data dictionary for holding meta-data.

i) Explain what is meant by meta-data. There are many data dictionary views (e.g. USER_TABLES, USER_SYS_PRIVS etc) which a user can access to obtain metadata. Give an example using sql code which extracts/manipulates meta-data from one or more data dictionary views of your choice.

ii) Provide a detailed description of the role of a data dictionary and meta-data in a database management system. **(8 marks)**

3. In web-based auction sites 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)**

4. Consider the following database scenario:

"A part manufacturing company has one engineering department in Manchester and two manufacturing plants, one in London and one in Hong Kong. Each part type is produced at only one manufacturing plant. Currently, the company has one database located in the Engineering department in Manchester. Applications at the manufacturing plants access this database via a communication network for whatever data they need.

One of the relations in this centralised database system is the PART relation, where data about the manufactured parts are kept. The attributes of the PART relation are: the part's number (Part#), part's name (Name), part's manufacturing cost (Cost), the part's drawing number that specifies its design (Drawing#), the name of the plant where the part is manufactured (Plant), and the quantity manufactured up to now (Qty).

An instance of the **PART** relation is the following:

PART					
Part#	**Name**	**Cost**	**Drawing#**	**Plant**	**Qty**
p2	Widget	200	123-7	London	500
p7	Gizmo	600	501-9	Hong Kong	1000
p3	Thing	100	238-2	Hong Kong	2000
p1	Gadget	1000	310-0	Hong Kong	40
p8	Acme	150	400-6	London	3000

The company has decided to move to a distributed database system where each of the sites has its own database."

i) Propose a fragmentation design of the PART relation that reflects the distribution of the company's sites and their functionality. **(8 marks)**

ii) Write an SQL statement for each of the fragments obtained in your design. **(9 marks)**

iii) Justify your proposed fragmentation design for the PART relation. **(8 marks)**

Refer to Appendix A for this question

5. *a)* Construct an ER diagram containing Entity Types, Relationship Types and Degrees to give a high level model of the SWIFT information system described in Appendix A. Your model should have no more than 10 Entity Types and you should state the diagram notation you have used. **(10 marks**)

b) Extend your ER diagram by assigning the columns listed in the tables in Fig A1 and Fig A3 to the appropriate Entity/Relationship Types. Use your ER diagram to explain the interdependencies that exist between the data contained in Fig A1 and Fig A3. **(7 marks)**

c) Explain with the aid of examples obtained from Appendix A the concept of ***Domain Integrity*** in a data model and explain how ***Domain Integrity*** is translated into SQL code. **(8 marks)**

Important: STATE any assumptions made in your modelling**.**

6. Query 1 shown below relates to the tables given in **Appendix A** at the end of this paper.

Query 1:

```
SELECT Cname FROM tbl_customers
WHERE CustomerID  IN (
  SELECT d1.CustID
    FROM TBL_Tickets d1,TBL_Tickets d2
     WHERE d1.CustID = d2.CustID
     AND d1.FlightCode != d2.FlightCode
     AND d2.PurchDate != Getdate(today()))
```

a) Explain in words the purpose of Query 1 and work out, using the tables in Appendix A and work out what result is returned. **Please show your working. (8 marks)**

b) Explain what is meant by a JOIN operator and show how Query 1 could be re-expressed using ***explicit*** JOIN operators. **(7 marks)**

c) Describe the different types of JOIN operators that SQL supports and explain with the aid of examples how each type of JOIN is used in practice. **(10 marks)**

Appendix A: SWIFT (Saving With Internet Flight Travel) for use in answering Questions 5 and 6.

SWIFT is an agency that sells discounted seats on flights on behalf of some low cost airlines. These discounted seats are called 'Offers' and are only available for purchase by registered customers over the internet. There are a number of low cost airlines that SWIFT is an agency for and sometimes more than one airline can offer seats with the same start and destination. Each seat offered for sale contains some information that is supplied by the airline operator:-

- The Ticket Number that identifies the seat on a particular flight.
- The start and destination of the city/airport for the journey undertaken.
- The date and time of the flight/journey and the check-in time.

Some information is derivable and depends on the number of confirmed customer bookings/sales of seats, this information is held on the SWIFT database:

- The baggage allowance. The baggage allowance for passengers is reduced if the aircraft is carrying cargo as well as passengers. .
- The price of the seat. The price starts at a low discounted price and increases as the bookings fill up. The earlier the seat is purchased then the cheaper the price that a customer pays. The current price is the price quoted for customers wishing to purchase seats. This may also be the final price, particularly if customers book a seat near the departure date of a flight.

It is the responsibility of SWIFT to determine the price of a seat, they have to be competitive, however they must cover the operating costs of the flights. SWIFT have negotiated a contract whereby they get 12% of the profit that an airline makes each year from the passenger flights it is commissioned to sell seats.

Figure A1 (below) shows a sample ticket purchases and contains data that was captured today (assume the date is 3rd December 2005). **Figure A2** shows the customer details.

Figure A1: TBL_Tickets

TicketNo	CustID	FlightCode	Quantity	PurchDate	Current/Final Price	Price Paid	FlightDate/Time
1962	343371	BG_8971	1	12/Nov/05	231.99	219.56	01/Dec/05 12:23
1963	343371	GTX_281	2	12/Nov/05	211.67	211.59	14/Nov/05 16:34
1964	343371	TL121_281	1	12/Nov/05	2040.72	833.59	04/Dec 05 00:56
1965	034933	GTX_281	15	12/Nov/05	299.69	209.59	16/Nov/05 04:22
1966	984311	PD0045	5	12/Nov/05	102.67	99.59	16/Nov/05 06:09
1967	984311	JDYE_6	10	10/Nov/05	251.99	222.37	30/Nov/05 05:55
1968	343371	TL121_281	1	02/Dec/05	2040.72	2040.72	04/Dec/05 00:56
1969	953534	GTX_281	1	03/Dec/05	21.59	NULL	NULL

Figure A2: TBL_Customers

CustomerID	Member	CustomerName	Address1	Address2
343371	Y	Andrews	123 Abel Ave	London
034933	Y	Ling Wing	6 Princes Street	Hong Kong
984311	N	Hutton	564 Holly Road	Manchester
953534	N	Rivers	80 Grange Way	Glasgow

Figure A3 shows the flights that SWIFT have advertised on their web site.

Figure A3 TBL_Flights

OfferNo	AirlineID	FlightCode	Operating Cost	Seating Capacity	Flight Time	FlightDate
1004	B&G	BG_8971	20119.56	102	12:23	01/Dec/05
1005	B&G	GTX_281	19012.59	261	16:34	14/Nov/05
1006	JH Price	TL121_2	2033.59	100	00:56	17/Nov/05
1007	B&G	GTX_281	19012.59	260	04:22	16/Nov/05
1006	B&G	PD0045	21201.59	261	06:09	17/Nov/05
1008	JH Price	JDYE_6	22008.37	90	05:55	30/Nov/05
1009	B&G	JDYE_6	22008.37	100	11:23	30/Nov/05