UNIVERSITY OF LONDON

291 0209 ZB

B. Sc. Examination 2008

for External Students

COMPUTING AND INFORMATION SYSTEMS AND CREATIVE COMPUTING

2910209 Database Systems

Eastern

Duration: 3 hours
Date and Time : Tuesday 6 May 2008 : 2.30 – 5.30 pm

This paper consists of **5** questions. Each question carries **25** marks. Answer only **4** of them. You may choose **any 4** questions. Full marks will be awarded for **complete** answers to **4** questions.

The mark carried by each part is printed within square brackets. **Gauge the time to be spent on each part by the number of marks awarded.**

No calculators may be used.

THIS PAPER MUST NOT BE REMOVED FROM THE EXAMINATION ROOM

1. A company which runs scuba-diving vacations wants to set up a database to aid their business. The company owns a group of cabins on an island. It also owns several boats. It takes scuba-divers out to various specific locations, such as shipwrecks and coral reefs, for dives.

They take bookings from Holiday-Parties, made up of one or more Holiday-Makers. One of the Holiday-Makers always serves as the Group Leader. Each Holiday-Maker is identified by his Holiday-Party Code plus a unique number. Each Holiday-Party chooses one of their members as Group Leader. The company also records each Holiday-Maker's first name and family name.

Holiday-Makers stay in Cabins. There may be one, two, or more Holiday-Makers to a Cabin. A Cabin has a unique Cabin-Name, and a daily rate, and can have one, two, or three bedrooms. The company wants to record this information. No Cabin ever has members of more than one Holiday-Party in it at the same time, but of course a Holiday-Party may occupy more than one cabin. The stay of a Holiday-Party has a start-date, and a leave-date.

A Dive consists of a group of Holiday Makers, who may be from several Holiday Parties. (And all, or only some, of the members of a Holiday-Party may come on a particular Dive.) A Dive takes place on a given date, either in the morning, or in the afternoon, at a specific Location.

A Dive is always accompanied by a company Employee, called a Divemaster, and two or more other company employees who remain on board the boat. Employees are identified by Employee-Numbers; Locations are identified by GPS-Coordinates translated into an eight-digit number. For each Location we record a description, and a journey-time from the dock, and a depth. Each Employee has his Employee-Number recorded, and his First and Family names.

A. Draw an Entity/Relationship Diagram that expresses the relationships among the entity types described above. You need not indicate the attributes of each entity type.

[9 marks]

B. Design a fully normalized relational schema that can capture the data relationships expressed in your Entity-Relationship diagram. Be sure to indicate the primary and foreign keys of each relation

[16 marks]

[Total: 25 marks]

2. Consider the following relation, which contains information on weddings (names and dates), the venue the wedding will take occur in, the location of the venue, the person who will conduct the ceremony (the officiant), and the officiant's telephone number.

WEDDINGS

PRIMARY KEY: WEDDING-PARTY

WEDDING-PARTY	DATE	VENUE	LOCATION	OFFICIANT	TELEPHONE
O'Brien, Patrick & Bridie	06.10.2003	Holy Trinity	Bramley	Rev Smiles	897 636
Sanders, John & Sophie	07.10.2003	Holy Trinity	Bramley	Father Brown	896 540
Suleman, Ibn & Fatima	20.10.2003	Suleymaniye Mosque	Woking	Imam Saud	896 543
Perry, Gerald and Irene	20.10.2003	St Peter's	Shalford	Father O'Toole	896 540
Austen, Michael & Jan	20.10.2003	Holy Trinity	Bramley	Father Brown	896 540
Sharif, Atta & Zuju	02.08.2003	Suleymaniye Mosque	Woking	Imam Saud	896 543
Murphy, Sean & Fionna	16.11.2003	St Thomas More	Bramley	Father O'Toole	896 540
Goldman, Robert & Sarah	16.11.2003	Synagogue Beth-El	Shalford	Rabbi Green	897 509

A given couple will be married on only one date, and in one venue, and by only one person. A given venue has a single location. A particular officiant has a single telephone number. Other semantic relationships can be deduced from studying the table.

A. Identify the Functional Dependencies in this table.

[3 marks]

B. This table is susceptible to update, deletion, and insertion anomalies. Give an example, based on the table, of each kind.

[6 marks]

C. Bring the table to BCNF, specifying the Primary Keys of each table, and showing the extension of the resulting relations.

[9 marks]

D. Write brief definitions of **seven** of the following terms, illustrating your answer with reference to an example where possible.

(1) Candidate key
(2) Foreign Key
(3) Entity integrity
(4) Cardinality
(5) Degree
(6) Functional dependency
(7) Composite (or concatenated) Key
(8) Attribute
(9) Determinant
(10) Tuple

[7 marks]

[total 25 marks]

3. The following tables are a botanical database, recording treatments of plants with growth hormones at an experimental laboratory

DOSE

PLANTCODE	HORMONE	APP-DATE	AMOUNT
P4	D5	01.02.2007	8
P2	D6	12.07.2007	4
P4	D5	10.09.2007	5
P1	D1	02.10.2007	3
P7	D1	20.10.2007	6
P8	D6	05.11.2007	2
P4	D6	30.11.2007	2
P4	D6	02.01.2008	8
P1	D6	03.03.2008	5
P4	D2	01.04.2008	3
P1	D6	05.05.2008	2
P8	D2	31.05.2008	1
P4	D1	05.06.2008	7

HORMONE

HCODE	HNAME	UNIT	START-DATE	PRICE
D1	K223	Tab	20.04.1997	9.15
D2	NeoAuxin	Mg	12.03.2001	12.00
D5	PhotoMult	Mg	10.07.1998	3.89
D6	Anolid	Tab	04.09.2005	4.90
D7	Rootit	Mg	05.08.1999	4.75

PLANTS

PLANTCODE	PlantName	Date Planted	GARDNER
P3	Runner Beans	13.05.2006	Mike
P7	Indian Corn	25.06.2007	Bill
P2	Wheat	03.01.2006	Mike
P8	Barley	12.04.2005	Sean
P4	Oats	13.06.2007	Jerry
P1	Peppers	03.08.2005	Bill

Construct queries in SQL to carry out the following tasks:

1. List the details of all the hormones in the database.
2. Get the names of all hormones in the database together with their code numbers.
3. Retrieve the names of all hormones whose units are Mg's.
4. Get hormone codes of hormones in tablet (Tab) form that have a price of more than £5.50 each.

(question continues on next page)

5. List the plant numbers of plants which have Mike or Bill as their gardener.

6. Get the names of Mike's plants who have been given hormone D6.

7. Find the names of plants which have been given hormones whose price is more than £8.50 per unit.

8. What is the total amount of hormone D6 administered by the laboratory?

9. Get the total quantities of each of the hormones that have been prescribed.

10. Get the total quantities of each of the hormones that have been administered in 2008.

[20 marks]

B. **(1)** Allow user M01 to read the table PLANTS, but to do nothing more to it.

[2 marks]

(2) Allow read, insert and update privileges on the table PLANTS to M02 and M03.

[3 marks]

[Total: 25 marks]

4.

A. Discuss the problems, and possible solutions, posed by the necessity (in some systems) of permitting several users to access data in a DBMS at the same time, including to two or more data items at once. Your answer should cover situations where genuine concurrent access to the same row of the same table, including update rights, is required.

[10 marks]

B. When a computer crash occurs while database transactions are running, we can identify, from the point of view of recovery, five kinds of transaction. Identify each kind of transaction, with respect to when they occur with respect to the last checkpoint, and the crash. In each case, describe the corresponding recovery action that the DBMS must take. Use a diagram to illustrate your explanation.

[10 marks]

C. Where a record-locking approach is taken towards problems of concurrent access, an additional problem may occur where two transactions each need to access the same two records. Describe this problem and briefly indicate one method of dealing with it.

[5 marks]

[Total: 25 marks]

5. A. Briefly describe vertical fragmentation. When might it be implemented? Use the following relation, of which a small sample is shown, as an example, and show how it might be vertically fragmented, if we found that most urgent queries were of the sort, *SELECT Employee-Num WHERE Birthdate =[some date]*. Assume that the relation had 100,000 tuples.

Employee-Num*	Surname	FirstName	Role	Birthdate
13641098	Ahn	Charles	Manager	23-10-60
64193649	Pilger	Susan	Employee	12-09-81
47901636	Fahy	Paul	Employee	09-12-85
55134177	Siddiqi	Mohammed	Manager	15-02-73

. [6 marks]

B. In the context of a database, what is a Data Dictionary? What sort of information is it likely to contain? How would it be used in querying and updating the database?

[6 marks]

C. In the context of a distributed database, briefly define the terms "data replication" and "replication independence". Why are data sometimes replicated in a distributed database?

. [5 marks]

D. Using an example of your own choice, show how a query optimiser can increase the efficiency of query execution in a distributed database where a query involving a selection and a join must unite tuples from two different relations located at different geographical locations.

. [8 marks]

[Total: 25 marks]

END OF EXAMINATION