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| DUBLIN CITY UNIVERSITY |
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SEMESTER TWO EXAMINATIONS 2009

MODULE:
(Title & Code) CA218 Introduction to Databases

COURSE: BSc. in Computer Applications (S.E. Stream)
BSc. in Computer Applications (I.S. Stream)

YEAR: 2

EXAMINERS:
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TIME ALLOWED: 2 hours

INSTRUCTIONS: Answer Q. 1, 2, 3 and either Q. 4. or 5.

Please do not turn over this page until instructed to do so

The use of programmable or text storing calculators is expressly forbidden.
Please note that where a candidate answers more than the required number of questions,
the examiner will mark all questions attempted and then select the highest scoring ones

QUESTION 1

[TOTAL MARKS: 25]

SQL Assume the following SQL table definitions, which model a van manufacturer application:

```
CREATE TABLE Manufacturer (  
    MName VARCHAR(20), # Employees INT, Country VARCHAR(20),  
    PRIMARY KEY (MName))  
CREATE TABLE Builts (  
    MName VARCHAR(20), VName VARCHAR(20), Since DATE,  
    PRIMARY KEY (MName, VName))  
CREATE TABLE Van (  
    VName VARCHAR(20), # Doors INT, FuelCons INT,  
    PRIMARY KEY (VName) )
```

Van manufacturers are described by their name, number of employees and country in which they are located, e.g. 'Toyota', 100000, and 'Japan'. Vans are described by a name, the number of doors and their fuel consumption (e.g. in litres per 100km). The Builts-table associates vans with their manufacturers. It also contains the date of the production start (the attribute 'Since').

Write SQL-SELECT statements for each indicated query for question 1(a), 1(b) and 1(c). Write an SQL-DML statement for 1(d).

1(a) [7 Marks]

Which manufacturers (print their name and country) produce vans with two doors. Give a nested and a non-nested query.

1(b) [6 Marks]

For each manufacturer, which produces at least two vans, print out the average fuel consumption of vans produced by that manufacturer together with the manufacturer's name. Sort your output by manufacturer names. Your query shall be optimised, i.e. it shall not access tables unless necessary.

1(c) [6 Marks]

Retrieve the names of all manufacturers whose number of employees is the highest.

1(d) [6 Marks]

Delete all vans whose production started before the average production start (attribute 'Since'). Assume that comparisons work on date-attributes and that you can calculate the average.

[End of Question 1]

QUESTION 2

[TOTAL MARKS: 25]

Relational Data Model

2(a)

[9 Marks]

Assume the following two relations S and T:

| S | A | B |
|---|---|---|
| | 1 | 0 |
| | 0 | 1 |

| T | C | D |
|---|---|---|
| | 0 | 0 |
| | 0 | 1 |
| | 1 | 1 |

Evaluate the following relational algebra expression. Give the result of each step (i.e. the result of each subexpression).

$$R = \pi_D \left(\sigma_{D=1 \text{ and } A \leq D} [S \bowtie_{B=C} T] \right)$$

2(b)

[8 Marks]

Describe the following integrity constraints of the relational data model: primary key, referential integrity, and entity integrity.

2(c)

[8 Marks]

Give an example of a relational table. Describe the table in terms of elements of the relational data model such as attribute, tuple etc.

[End of Question 2]

QUESTION 3

[TOTAL MARKS: 25]

Database Design

3(a)

[9 Marks]

Give functional dependencies for the table $T(A, B, C, D, E)$ with primary key (A, B) such that

1. T is in 1NF and not in 2NF,
2. T is in 2NF and not in 3NF,
3. T is in 3NF and not in BCNF

Explain your answers. You can use functional dependency diagrams for illustration.

3(b)

[9 Marks]

A motel shall be modelled. A motel is described by its name, address and the number of rooms. Motels have bedrooms. Each bedroom of a motel is characterised by a room number (identifying) and the number of beds. Motels accommodate guests. Their arrival and departure in each hotel they stay shall be modelled. Guests are located in rooms. Guests have a name (identifying) and an address. Draw an Entity-Relationship Model for this problem. Identify clearly the cardinality of the relationships, stating your assumptions where necessary.

3(c)

[7 Marks]

Map the problem in part (b) to a Relational Schema. Outline clearly the steps in the process.

[End of Question 3]

QUESTION 4

[TOTAL MARKS: 25]

Database Concepts, Models, and Languages

4(a)

[15 Marks]

Define what is meant by views. Consider the employee relation EMPQ(No, Name, Department, Phone, Address, DateOfBirth, Salary, Qualifications) which might be used by a Personnel department. Use this example to discuss views. Choose two typical applications of the view concept, explain these applications and define two SQL views for these two applications. Discuss the disadvantages (or problems) of views.

4(b)

[10 Marks]

Describe the relationship between SQL and the Relational Data Model. Does the language SQL implement the full Relational Data Model? Is every SQL statement expressible in terms of the Relational Data Model?

[End of Question 4]

QUESTION 5

[TOTAL MARKS: 25]

[Database Management Systems]

5(a)

[7 Marks]

What is the system catalog? What does it contain? How is it usually implemented?

5(b)

[9 Marks]

Describe how indexing and hashing can be used to improve the implementation of operations on databases. Consider their advantages and disadvantages under the headings of Search, Insert, Delete and Modify.

5(c)

[9 Marks]

Describe the 3-level architecture of database management systems.

[End of Question 5]

[END OF EXAM]