A11577

THE UNIVERSITY OF BIRMINGHAM

Degree of MSc in Computer Science

06 113584

Fundamentals of Databases

Friday 10<sup>th</sup> May 2002      0930 - 1130

[Answer ALL Questions]

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Any calculator

1.  Consider the following schemata

Table "staff"

| Attribute | Type |
|-----------|------|
| sid | integer |
| title | character varying (6) |
| firstname | character varying (15) |
| lastname | character varying (20) |
| email | character varying (40) |
| office | integer |
| phone | integer |

Table "lecturing"

| Attribute | Type |
|-----------|------|
| cid | integer |
| sid | integer |
| year | integer |
| numbers | integer |

Table "courses"

| Attribute | Type |
|-----------|------|
| level | integer |
| cid | integer |
| name | Character varying |
| credits | integer |
| semester | integer |

and develop SQL queries for the following questions:

(a)  Which courses are taught at level 2 or below?                        [5%]

(b)  Which courses contain the word "Introduction" in the name and are not at level 1?
                                                                          [5%]

(c)  Which courses were attended by more than 80 students in at least one of the years covered by the database?                                          [5%]

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(d)    Which courses have been taught by the same staff member in all years covered by
       the database?                                                          [5%]

(e)    List the courses together with the average number of students enrolled in them.
                                                                              [5%]

2.    (a)    Suppose we have relations R and S with schemata {A, B, C} and {B, C, D},
             respectively.

             (i)    What is the schema of $R \bowtie S$ ?                      [5%]
             (ii)   State precisely which tuples will belong to $R \bowtie S$, given tables for R and S.
                    (You do <u>not</u> need to illustrate your answer with an example.)
                                                                              [5%]

      (b)    (i)    With regards to the relations in question 1, translate the following relational
                    algebra expression into plain English:
                    $$\pi_{lastname,name}(\sigma_{year=1999 \wedge level=1}(staff \bowtie lecturing \bowtie courses))$$  [5%]
             (ii)   Translate the expression into SQL.                        [5%]

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3.   (a)   What is the purpose of schema normalisation?                              [5%]

     (b)   State the definition of Boyce-Codd-Normal-Form.                            [5%]

     (c)   Given the schema S={A, B, C, D} and the functional dependencies
           $AB \rightarrow CD$, $C \rightarrow A$, and $BC \rightarrow D$,
           consider the following decompositions of S:

           (i)    {A, B, C} , {A, B, D}                                              [5%]
           (ii)   {B, C, D} , {C, A}                                                 [5%]
           (iii)  {A, B, D} , {C, A}                                                 [5%]

           Which of these decompositions are lossless?
           Which are redundancy reducing?
           Which are in Boyce-Codd-Normal-Form?
           Which are dependency preserving?

4.   (a)   Develop an entity-relationship diagram which models the following real-world
           situation.

           "A tourist information system is to provide information about tourist attractions in
           British cities.  For each city, the system must know about the county the city  is
           located in.  Attractions must include at least all major parks, museums, and theatres.
           For each attraction the system must be able to provide information about the street it
           is located in.  It should also know about other main streets, how long they are, and
           which intersects with which."

           (Please note that some points will be awarded to a proper documentation of the
           development steps.)

                                                                                     [20%]

     (b)   Annotate the diagram with multiplicities and transform it into tables.  For each
           entity and each relationship say which table describes it.  For each table list the
           attribute names and underline the primary key attributes.  You do not need to write
           out any SQL "create" commands.                                            [10%]