RELATIONAL DATABASES AND INFORMATION SYSTEMS

EXAMPLE OF FINAL EXAM:
Answer any 4 out of the 5 following groups of questions
(all carrying equal weight).

1) Consider the database schema on the relations:

SUPPLIERS(Sid, Name,City)
PARTS(Pid, Pname, Colour)
CATALOG(Sid, Pid, Cost)

where key attributes have been underlined; and relation CATALOG lists prices charged by Suppliers for Parts.

   a) Can two different parts with the same identifier exist in this database?
   b) Can the same part appear in two different tuples of relation CATALOG?
   c) Formulate in relational algebra the query that finds the name of red parts.
   d) Formulate in relational algebra the query that retrieves the Sids of suppliers who supply red parts AND live in Dublin.

2) With reference to the following database schema:

Sailors(sid,sname,rating,age)
Boats(bid,bname,color)
Reserves(sid,bid,day)

   a) Write the SQL query that finds the age of sailors with a rating of 10.
   b) Write the SQL query that finds the names of boats that have been reserved on 15/01/01
   c) Write the SQL query that retrieves the following information for each sailor with a rating of 10:
        -   his/her name and age
        -   the number of different boats he/she reserved

3) a) Represent the following information (specifying identifiers, and cardinalities), using constructs from the Entity-Relationship model (motivate assumptions you make):

Students (characterized by id, name, and address) pass an exam for a given course (characterized by id, name) with a given grade. Courses are taught by lecturers (characterized by lecturer id, lecturer name).

Translate the above E-R diagram into the relational model.

b) Discuss the concept of external identifier in the context of the E-R model and the associated constraint.

c) Provide the precise definition of foreign key and discuss an example.

4) Answer the following questions (motivate your answers and provide examples if appropriate):

a) What is the purpose of normalisation?

b) Consider the schema **BOOKS**(<u>BookTitle</u>, Author, Category, Shelf, <u>Copy#</u>) for the following relation:

BookTitle	Author	Category	Shelf	Copy#
Decameron	Boccaccio	stories	C75	01
The Divine Comedy	Dante	poem	A90	01
The Divine Comedy	Dante	poem	A90	02
Le Bourgeois Gentilhomme	Moliere	play	A90	01
Le Bourgeois Gentilhomme	Moliere	play	A22	02
Ulysses	Joyce	novel	B50	01
Richard III	Shakespeare	play	B33	01

Relation BOOKS stores information about books in a library. Books have a title, an author, a position (shelf) and are subdivided into categories (poem, play, etc.). Several copies of a book can be maintained in the library.

The key is composed of attributes BookTitle and Copy# and the following functional dependency is defined: BookTitle $\rightarrow$ Author, Category

Is the relation in Boyce-Codd Normal form? Is it in 3rd normal form?

c) Provide the definition of Boyce-Codd normal form.

5) a) Explain with examples the operations Cartesian product and difference used in relational algebra.

b) Provide the precise definition of key in the relational model.

c) Describe the standard three-level architecture for a DBMS.

d) Provide an example of a ternary relationship and its representation in the Entity-Relationship model.