GX 0070

Ollscoil na hÉireann, Gaillimh
National University of Ireland, Galway
Semester I Examinations 2005 / 2006

Exam Code(s)	2IF and 2IF External Repeat 2BA and 2BA External Repeat 3BO Erasmus
Exam(s)	2nd Year Information Technology Examination 2nd Year BA Examination 3rd Year Biomedical Science Examination Erasmus
Module Code(s)	CT230 and CT241
Module(s)	Database Systems I and Information Systems I
Paper No.	
Repeat Paper	
External Examiner(s)	Professor J.A. Keane Professor SI McClean
Internal Examiner(s)	Dr. M. Madden Ms. J. Griffith

Instructions: Answer **QUESTION 1** and **TWO other** questions.
All questions carry equal marks.

Duration	**2 hours**
No. of Pages	4
Department(s)	Information Technology
Course Co-ordinator(s)	

Requirements:
MCQ
Handout
Statistical Tables
Graph Paper
Log Graph Paper
Other Material

Q. 1. **(COMPULSORY)**
Given the following relational schema (with keys underlined) and interpretation:

degree(DCode, DName, Faculty, Level, Duration)
module(MCode, MName, Dept, SemExam, ECTS)
part_of(MCode, DegCode)
prerequisite(ModCode, PreCode)

Information is held on degrees and modules provided by a college. The relation **degree** holds details on each degree in the college. The details held in the relation are: DCode (degree code - the primary key), degree name, faculty which runs the degree, level (e.g., undergraduate, postgraduate) and duration of the degree (in years). The relation **module** lists all the module (course) details. The details held in the relation are: MCode (module code - the primary key), module name, the department that offers the module, the semester that the module is examined (1 or 2), and ECTS credits of the module (5, 6, 10, etc.). A module can be a part of many degrees and the relation **part_of** lists the modules which comprise a degree. The relation **prerequisite** lists the modules (PreCode) which are prerequisites for other modules (ModCode). A module can have many prerequisites and a module can be a prerequisite many times.

(i) Give relational algebra solutions to satisfy the following information needs:

(a) List the names of all degrees offered by the college. *(3)*
(b) List the names of all the 5 ECTS modules that are examined in Semester 1. *(3)*
(c) List all the module names taught as part of the degree with the Degree Code 'GY303'. *(3)*

(ii) Develop SQL queries to satisfy the following information needs:

(a) List the degree name and associated faculty of all undergraduate degrees. *(3.5)*
(b) List the number of exams that take place in semester 1. *(3.5)*
(c) For all modules worth 10 ECTS and offered as part of a 4 year degree course, list the module name, the degrees in which it is taught and the faculty that offers those degrees. *(3.5)*
(d) For each module, list the module code, the module name and the number of prerequisites for that module. *(3.5)*
(e) For all semester 1 modules, with prerequisite module code 'MA101', list the module name and the degree in which it is taught. *(3.5)*
(f) List the names of degrees where the degrees have more than 20 modules. *(3.5)*

Q. 2. (i) Explain the limitations of the file system approach to data management. Explain how a DBMS approach overcomes these limitations. *(6)*
Outline any advantages of the file system approach over the DBMS approach. *(2)*

(ii) With respect to the relational model, and with the aid of examples, describe each of the following concepts:
(a) Relation. *(2)*
(b) Attribute. *(2)*
(c) Tuple. *(2)*
(d) Domain. *(2)*

(iii) With the aid of examples describe each of the following:
(a) Derived attribute. *(2)*
(b) Multi-valued attribute. *(2)*
(c) Primary key attribute. *(2)*
(d) Foreign key attribute. *(2)*

(iv) With respect to the relational model, describe what is meant by entity integrity constraints and referential integrity constraints. *(4)*
Discuss why it is desirable to enforce these constraints. *(2)*

Q. 3. (i) What is meant by query processing? *(4)*
With the aid of a diagram, outline the main steps involved in processing a query. *(6)*

(ii) With respect to query processing, and with the aid of an example, describe what is meant by a *query tree*. *(4)*
Outline the steps involved in executing the query tree, mentioning *materialization evaluation* and *evaluation plans* in your answer. *(6)*

(iii) What is meant by query optimisation? *(2)*
Distinguish between *cost-based optimisation* and *heuristic-based optimisation*. *(2)*
Using the relational schema and interpretation defined in **Q. 1.** and the SQL query that satisfies the following information need:

> For all modules worth 10 ECTS and offered as part of a 4 year degree course, list the module name, the degrees in which it is taught and the faculty that offers those degrees.

develop a query tree, using query heuristics, that represents an efficient evaluation strategy for the developed query. Explain the steps taken. *(6)*

Q. 4. An un-normalised relation for orders in a company has the following schema:

```
order(o_no, o_date, customer_no, customer_name,
customer_address, customer_balance, product_no,
p_description, quantity_required, unit_price)
```

where associated with each order is an order number, order date, customer name, customer number, customer address and customer balance of the customer who has placed an order, and details on the product ordered (product number, product description, quantity of product ordered and unit price of product). An order may contain many products and a customer may place many different orders.

(i) What is meant by the term *normalisation.* *(2)*
Explain, with the aid of the above `order` relation as an example, how anomalies may arise in relations that are not normalised. *(4)*

(ii) With respect to normalisation, and with the aid of examples, explain the following terms:

(a) Functional dependency. *(3)*
(b) Partial dependency. *(3)*
(c) Transitive dependency. *(3)*
(d) First normal form. *(3)*
(e) Second normal form. *(3)*
(f) Third normal form. *(3)*

(iii) Normalise the `order` relation to third normal form, showing the stages involved. *(6)*

Q. 5. (i) Describe what is meant by each of the following:

(a) File blocks and blocking factor. *(5)*
(b) Sequential file organisation and hashing file organisation. *(5)*

(ii) What is meant by *indexed file organisation*? *(4)*
With the aid of an example, describe the approach of primary indexing. *(4)*
Distinguish between dense and sparse (non-dense) indexes. *(2)*

(iii) With the aid of an example, outline the steps involved in both a linear search and a binary search approach. *(10)*