

OLLSCOIL NA hÉIREANN
THE NATIONAL UNIVERSITY OF IRELAND

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**SECOND UNIVERSITY EXAMINATION IN INFORMATION
TECHNOLOGY**

**DATABASE SYSTEMS 1
CT230**

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Candidates are required to answer **THREE** questions.
All questions carry equal marks.
Time allowed: **TWO** hours

- Q. 1. (a) Distinguish between the traditional file processing approach and the database approach, describing the advantages and disadvantages of each approach.
- (b) Discuss criterion that can be used to classify Database Management Systems, distinguishing between the *relational*, *hierarchical* and *network* data models in your answer.
- (c) With the aid of examples, distinguish between the following:
- (i) composite, atomic and derived attributes.
 - (ii) single-valued and multi-valued attributes.
 - (iii) primary, candidate and foreign keys.

2.

Given the following relational schema and interpretation (with keys underlined):

SUPPLIER(SNo, SName, status, city)

PART(PNo, PName, size, material, colour)

JOB(JNo, JName, city, company, start_date)

SHIPMENT(SNo, PNo, JNo, quantity, unit_price)

A supplier (with associated number, name, status and city location) supplies parts (with associated number, name, size, material type and colour) to jobs (with associated numbers, names, city location) in certain companies and with certain start dates. These parts have an associated unit price and are shipped in a certain quantity.

- (a) With the aid of examples based on the relational schema given, describe each of the following:

- (i) key constraints.
- (ii) entity integrity constraints.
- (iii) referential integrity constraints.

- (b) Give a relational algebra solution and an SQL solution for the following information need:

List the part number and unit prices of all parts supplied in quantity greater than 900.

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

- (i) List all suppliers who supply a part to a job with job number *J4*.
- (ii) Find the total price of all parts for all jobs shipped to a company with company name *Dell*.
- (iii) List the supplier number and supplier name of all suppliers who supply a part with part number *P4* or supply to a job with job number *J3*.

- Q. 3.** (a) Describe the three schema architecture for database abstraction. In the context of the architecture, explain what is meant by a *mapping*.
- (b) With the use of examples, distinguish between the following:
- (i) Primary and clustering indexes.
 - (ii) Dense and non-dense (sparse) indexes.
 - (iii) Sequential and hashed file organisation.
- (c) Sorting is one of a number of algorithms used in query processing. Explain why the SQL command DISTINCT is required and describe how the command can be implemented using a sorting algorithm, briefly outlining an approach that can be used.

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

- (b) With respect to query processing and optimisation, describe the following terms:
- (i) Query tree
 - (ii) Cost estimates
 - (iii) Materialisation evaluation
 - (iv) Evaluation Plan

- (c) Using the relational schema and interpretation defined in **Q. 2.**, develop an SQL query to satisfy the following information need:

List the supplier number and supplier name, of all suppliers in London, who supply a part with a blue colour and plastic material.

Using the SQL query you develop, produce the associated canonical tree. Discuss query optimisation heuristics, and using these heuristics illustrate how the tree would be modified to represent a more efficient evaluation plan. Show the tree after each optimisation step.

Q. 5. (a) Define the following terms:

- (i) Functional dependency.
- (ii) Partial dependency.
- (iii) Transitive dependency.

(b) Outline the motivations for normalisation. Give definitions for:

- (i) First normal form.
- (ii) Second normal form.
- (iii) Third normal form.

(c) An un-normalised staff relation has the following structure:

staff(s_no, s_name, s_address, dept_no, dept_name, manager_no,
skill_id, skill_name, s_course_date, s_course_duration)

A staff member has an associated number (s_no, which is unique for each staff member), name and address and works in a particular department with a number (unique), name and manager. The staff member can undertake a number of courses to gain new skills for their job. skill_id uniquely identifies the skill, which has also a name (skill_name). For each skill, one course exists. s_course_date describes the date when a course was undertaken for that skill and s_course_duration describes the time taken to complete the course.

- (i) Show where duplication results from this relation design.
- (ii) Normalise the relation to third normal form, showing the stages involved.