

PAPER CODE NO.
COMP502

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THE UNIVERSITY
of LIVERPOOL

SUMMER 2000 EXAMINATIONS

Bachelor of Arts : Year 3
Bachelor of Science : Year 3

DATABASE STRUCTURE AND MANAGEMENT

TIME ALLOWED : TWO Hours

INSTRUCTIONS TO CANDIDATES

Answer **THREE** questions only.

If you attempt to answer more than the required number of questions (in any section), the marks awarded for the excess questions will be discarded (starting with your lowest mark).

- (a) Explain what is meant by a transaction in a Relational Database System (RDBMS)? Why are transactions important in the operation of a RDBMS? Give an example of how transactions are constructed in SQL to illustrate your answer. (5 marks)
- (b) The consistency and reliability aspects of transactions are due to the “ACID” properties of transactions. Discuss each of these properties and how they relate to the concurrency control and recovery mechanisms. Give examples to illustrate your answer. (12 marks)
- (c) Discuss two of the following transaction models:
 nested transactions
 sagas
 multi-level transactions
 dynamically restructuring transactions
 giving an example of how each operates. (8 marks)

2

A large estate agency has decided to distribute project management information at the regional level. A part of the current centralised relational schema is as follows:

Employee	(ni_no , first_name, last_name, address, birth_date, sex, salary, tax_code, agency_no)
Agency	(agency_no , agency_address, manager_ni_no, property_type_no, region_no)
Property	(property_no , property_type_no, property_address, owner_no, asking_price, agency_no, contact_ni_no)
Owner	(owner_no , first_name, last_name, owner_address, owner_ad_no)
P_Types	(property_type_no , property_type_name)
Region	(region_no , regional_name)

where

Employee	Contains employee details and the national insurance number ni_no is the key.
Agency	Contains the agency details and agency_no is the key. Manager_ni_no identifies the employee who is the manager of the agency. There is only one manager for each agency.
Property	Contains details of the properties the company is dealing with and the key is property_no . The agency that is currently dealing with the property is specified by agency_no and the contact in the estate agency by contact_ni_no; the owner is given by owner_no.
Owner	Contains details of the owners of the properties and the key is owner_no .
P_Types	Contains the names of property types and the key is property_type_no .
Region	Contains names of the regions and the key is region_no

The Primary Key is given in **bold** in each case.

Agencies are grouped regionally as follows:

Region 1	North
Region 2	South
Region 3	East
Region 4	West

Information is required by property_type, which covers: Domestic, Industrial and Letting. There are no Industrial properties in the South and all Letting properties are in the West. Each estate agency office handles its local properties. As well as distributing data on a regional basis, there is an additional requirement to access the employee data either by personal information (by Personnel) or by salary-related information (by Payroll).

- (a) Draw an Entity-Relationship Diagram for this schema. (5 marks)
- (b) Using this diagram, produce a distributed database design for the system that satisfies the correctness rules for fragmentation and include:
- A suitable fragmentation schema for the system
 - In the case of primary horizontal fragmentation, give a minimal set of predicates
 - The reconstruction of global relations from fragments

Give a full explanation of the reasoning behind each step and state any assumptions necessary to support your design. (20 marks)

3

- (a) Discuss why traditional transaction management protocols are too restrictive for advanced database applications. (8 marks)
- (b) Despite the superior expressive power of Object Database Management Systems (ODBMS) in comparison with established relational systems, the acceptance of the ODBMS will ultimately depend on their performance. The key to this may well lie with how persistent objects are accessed.

Discuss the design goals for the incorporation of persistence in a programming language. (7 marks)

- (c) Object databases have roots in both programming languages and database management. However, not all aspects of these two technologies blend together easily. One area of potential conflict arises when we try to completely separate persistence and type.
- Define the orthogonality of persistence and type
 - Discuss this potential conflict for any two of the following subsystems:
 - Queries
 - Schemas
 - Transactions
 - Existence Semantics
- (10 marks)

4

- (a) Describe the most significant difference between the Data Protection Act (1998) and the 1984 Act. Why is it important for all holders and processors of personal data? (9 marks)
- (b) Give four of the eight Data Protection Principles, showing one major issue that needs to be addressed in an Insurance Company that stores personal data on both policy holders and claimants, to comply with each. (16 marks)