

PAPER CODE NO.  
COMP302

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THE UNIVERSITY  
*of* LIVERPOOL

## SUMMER 2001 EXAMINATIONS

Bachelor of Arts : Year 3  
Bachelor of Science : Year 3  
Bachelor of Science : Year 4  
Master of Science : Year 1

### DATA STRUCTURES AND MAINTENANCE

**TIME ALLOWED : Two Hours**

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#### 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).

- 1a) Explain what is meant by a transaction in a Relational Database Management 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 in a RDBMS 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. (8 marks)
- c) Describe what are generally known as “The Lost Update”, “Uncommitted Dependency” and “Incomplete Analysis” problems. How do these conflict with the ACID properties? (12 marks)
- 2a) Give your definition of an Object-Oriented Database Management System (OODBMS). (5 marks)
- b) What do you consider to be the three most important advantages of a OODBMS over a RDBMS? Justify your selection of the three advantages, giving examples of appropriate applications. (9 marks)
- c) What do you consider to be the two most significant disadvantages of a OODBMS over a RDBMS? Again, justify your choices with examples of suitable applications. (11 Marks)
- 3a) In the context of an online distance learning project that wishes to store complete logging information of all online interactions (including the identities of all participants) discuss the potential implications of each of the Data Protection Principles defined in the Data Protection Act (1998). (16 marks)
- b) What procedures do you consider necessary and appropriate to meet the requirements of the Act? (9 marks)
- 4) An international company, “Mersey Haulers”, has many offices across both the UK and Europe to process customer orders and has decided to distribute its operations across the countries in which it operates. The company also wishes to distribute staff details to the appropriate countries, except that payroll details will remain at the head office on Merseyside.

a) Draw the entity-relation model of the current database, which is structured as follows:

Client	( <b>ClientNo</b> , Cname, Caddress, CtelNo, CfaxNo, OfficeNo)
Unit	( <b>UnitRegNo</b> , UnitDescription, MaxPayLoad, OfficeNo)
Trailer	( <b>TrailerNo</b> , TrailerDescription, TrailerLength, MaxCarryingWt, OfficeNo)
ClientOrder	( <b>OrderNo</b> , ClientNo, DateOrder, CollectDate, CollectAddress, DeliveryDate, DeliveryAddress, LoadWeight, LoadDescription)
TransportReq	( <b>OrderNo</b> , <b>UnitRegNo</b> , TrailerNo)
Staff	( <b>StaffNo</b> , Sname, SAddress, StelNo, Sex, DOB, Position, NIN, TaxCode, Salary, OfficeNo)
Office	( <b>OfficeNo</b> , Oaddress, OtelNo, OfaxNo, CountryNo)
Country	( <b>CountryNo</b> , CountryName)

Where

Client	Contains the details of clients and the client number (ClientNo) is the key. Clients are registered with an office in their country and the nearest to the location of their company.
Unit	Contains details of the unit that pulls one or two trailers and the registration number (UnitRegNo) is the key
Trailer	Contains the description of the trailer that is pulled by the unit and the trailer number (TrailerNo) is the key
ClientOrder	Contains the details of the client orders for the transportation of a load from the collection address (CollectAddress) to the delivery address (DeliveryAddress) and the order number (OrderNo) is the key.
TransportReq	Contains the details of the transportation (units and trailers) required to fill the client order. The client's order number (OrderNo) and the registration number of the unit (UnitRegNo) is the key.
Staff	Contains the details of staff and staff number (StaffNo) is the key.
Office	Contains the details of the offices and the office number (OfficeNo) is the key. Each office has a Manager.
Country	Contains the name of the country and country number (CountryNo) is the key.

(9 marks)

b) The offices of Mersey Haulers are grouped into countries as follows:

Country 1	C1	United Kingdom
Country 2	C2	France
Country 3	C3	Germany
Country 4	C4	Switzerland
Country 5	C5	Spain
Country 6	C6	Italy

Prepare a distributed database design for the Mersey Haulers system based on your entity-relationship diagram that satisfies the correctness rules for fragmentation and includes:

- i) a suitable fragmentation schema for the system
- ii) in the case of primary horizontal fragmentation, give a minimal set of predicates
- iii) a description of the reconstruction of global relations from fragments

Give a full explanation of the reasoning behind each step in your design.

(16 marks)