

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF APPLIED SCIENCE
COMPUTER SCIENCE DEPARTMENT
JULY SUPPLEMENTARY EXAMINATIONS 2005

SUBJECT: ADVANCED DATABASE DESIGN AND MANAGEMENT
CODE: SCS4201

INSTRUCTION TO CANDIDATES

This examination paper consists of six [6] questions, all questions carry equal marks

Answer all questions in Section A and any two from Section B.

Time: 3 hours

Section A

QUESTION ONE

- a) A database needs to be developed for a letting agency called RODOR properties. The agency rents out properties to tenants on the behalf of landlords.

Design an entity-relationship diagram that captures, as far as possible, the requirements stated below. If you make any assumptions in your design, please write them down. Assumptions, however, must not contradict the requirements. [14]

- i) The company employs staff. Every member of staff has a unique staff ID. In addition they have a name, a function (like secretary, accountant, etc.), and a monthly salary.
- ii) In order to locate properties, the agency has split Bulawayo into different areas. Each area has a name, by which it can be uniquely identified. For each area, there is a member of staff who is responsible for the properties in the area. For example B.Moyo is responsible for the properties in the Nkulumane area.
- iii) For each property that the agency manages there is a property ID by which it can be identified. Moreover, the agency wants to record the address, the type of the property (like flat, house, garage, etc.), the monthly rate, and the deposit that has to be paid by a tenant. Each property is located in some area.

- iv) Each property is owned by a single landlord. A landlord, however, may own more than one property. A landlord is registered with name, address, and phone number. Each landlord can be uniquely identified by their name and phone number.
- v) A tenant is registered with a tenant ID, a current address, and a phone number.
- vi) A tenant rents a property by signing a lease. The lease specifies the start date, i.e., the time when the contract begins, and the duration of the lease. A lease is always related to a specific property. For a given property, there cannot be two leases with the same start date.

- b) Based on the ER-diagram from above, develop a corresponding relational database schema. For each relation, underline the attribute(s) that make up the primary key. Identify referential integrity constraints (i.e., foreign keys). Ensure that the relations are at least in 2NF. [6]

QUESTION TWO

- a) Concurrency problems arise when several transactions operate on the same data or interdependent data. Give a detailed analysis of such problems and how they can be resolved. [12]
- b) Imagine an online store that maintains customer information in a database. Their Customers table might look something like the one presented below. Analyze this relation and check if it is in 2NF. If its not then transform it into 2NF. [6]

Cust#	FirstName	LastName	Address	City	Country	ZIP
1	John	Dube	12 Main Street	Bulawayo	Zimbabwe	263
2	Alan	Nkomo	82 Fort Street	Bulawayo	Zimbabwe	263
3	Beth	Mokoena	1912 NE 1st St	J' Burg	South.Africa	027
4	Jacob	Wareng	142 Irish Way, G. West	Gaborone	Botswana	267
5	Samuel	Kalunda	412 NE 1st St	Lusaka	Zambia	253

- c) What is a timestamp and how is it generated? [2]

QUESTION THREE

- a) Consider the following relation schema:
Employee (FirstName, Surname, Employee#, DOB, Salary, Dept#, Sex).
Write relational algebraic expressions and the corresponding SQL statements to:
- i) List/ select all the employees who work either in department number CCE01 and earn \$2 500 000, or work in department number Mech03 and earn more than \$4 000 000. [4]
 - ii) Retrieve the firstname, the surname and salary of all employees who work in department number Comp05. [4]
- b) Below is a description of a modification of the Two-Phase Locking protocol. Explain briefly whether or not the modified protocol still guarantees serialisability of schedules.
Modification: There are no more shared locks, but only exclusive locks. Before a transaction can read or write a data item, it has to acquire an exclusive lock. Once an operation is finished, the transaction is free to release the lock. A transaction can acquire a new lock for a data item, provided no other transaction is holding a lock for that item. [4]
- c) When is the concept of a weak entity type useful in data modeling? [4]

Section B

QUESTION FOUR

- a) Briefly describe the fundamental features of OODBs. What are the advantages of such types of database management systems? [10]
- b) With the aid of examples define the following terms:
- i) Specialisation
 - ii) Weak entity type,
 - iii) Recursive relationship,
 - iv) Data model.
 - v) MVD
- [10]

QUESTION FIVE

- a) Every weak entity set can be converted to a strong entity set by adding appropriate attributes. Why, then, do we have weak entity sets? [4]
- b) Discuss the difference between pessimistic and optimistic concurrency control. [6]
- c) Define a distributed database. State any 2 reasons for data distribution? Explain how data distribution can be done. [10]

QUESTION SIX

- a) Give a brief description of any two representational data models. [8]
- b) Consider the following relation for published books:
Book (ISBN, BookTitle, AuthorName, BookType, Price, Publisher, AuthorAffiliation)
ISBN is a unique international number that is assigned to each new book that is published. This number has been used as the primary key for the relation *Book*.
 - (i) Assuming that the following functional dependencies hold on it:
BookTitle → Publisher
BookType → Price
AuthorName → AuthorAffiliation
Decompose *Book* into a set of relations, which are in the 3rd normal form. [8]
 - (ii) What is a deletion anomaly? Give an example of a deletion anomaly that could arise when deleting tuples from the relation *Book* as it stands above. [4]

END OF QUESTION PAPER