

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF APPLIED SCIENCES
COMPUTER SCIENCE DEPARTMENT
DECEMBER EXAMINATIONS, 2004

COURSE: ADVANCED DATABASES
CODE: SCS 5106

INSTRUCTIONS TO CANDIDATES

This examination paper consists of seven (7) questions, all questions carry equal marks.

*Answer **ALL** questions in **Section A** and **any Two (2)** questions from **Section B***

3 HOURS

Section A

QUESTION ONE

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.

- a) 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) With the aid of appropriate examples of integrity constraints define the terms
- i) Referential integrity constraint.
 - ii) Entity Integrity constraint. [8]
- b) Explain how the concept of normalization fits into the database design process. Why might a database be implemented with data structures that are not fully normalized? [6]
- c) Consider the following relations for a database that keeps track of business trips of salespersons in a sales office:
- SALESREP (Sales_rep#, Name, Start_Year, Dept_No, Trip_ID, Account#, Amount)
- TRIP (Sales_rep#, From_Place, To_Place, Departure_Date, Return_Date, Trip_ID)
- Specify the foreign keys for this schema, stating any assumptions you make. Are the two relations in 3NF? Support your answer. [6]

QUESTION THREE

- a) Define the term normalization and briefly explain the role of functional dependencies in the normalization process. [6]
- b) An Entity Relationship model is a conceptual model that mediates between users' perceptions and the technical specification of a database system. Discuss. [6]
- c) The following relations are part of a relational database maintained by Speciss College. The primary key of each relation is underlined.
- Lecturer (Lecturer Initials, Name, Title, Department, Email_Address)
- Course (Course code, Course_Title)
- Teaches (Lecturer Initials, Course code)
- Class (Course code, Day, Time, Place, Term)
- Registration (Student ID, Course Code)
- Write expressions in both relational algebra and in SQL to retrieve each of the following:
- A list of Ids of students taking the course "AI"
 - Email addresses of lecturers in the department of "Engineering"
 - A list showing the names of lecturers and the titles of the courses they teach. [6]
- d) What is the function and importance of conceptual data modelling? [2]

Section B

QUESTION FOUR

- a) Describe two different approaches to database recovery. Explain why database recovery is so important in a DB environment. [5]
- b) Discuss the three different kinds of data fragmentation for the distribution of a global relation in a distributed database. State and explain 3 rules of data fragmentation. [10]
- c) When are voting and elections used in distributed databases? [5]

QUESTION FIVE

- a) What are the benefits of OODBs and what are the limitations of OODBMSs? [6]
- b) Discuss the characteristics of relations that make them different from ordinary tables and files? [4]
- c) For concurrency control and recovery purposes, numerous problems arise in distributed DBMS environments that are not encountered in a centralised DBMS environment. State and explain each of these problems. [10]

QUESTION SIX

- a) What type of locks are needed for insert and delete operations? [6]
- b) Discuss the deferred update technique of recovery. What is the main advantage of this technique? [5]
- c) Identify typical lists of transactions that are maintained by the recovery subsystem. [5]
- d) What is the difference between controlled and uncontrolled redundancy. [4]

QUESTION SEVEN

- a) With the aid of an appropriate illustration explain the lost update problem as applies to database transaction processing. [5]
- 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) Describe the main advantages and the main disadvantages of data replication in a distributed database management system. [4]
- d) Discuss the 2 Phase Commit. [7]

END OF QUESTION PAPER

GOOD LUCK!