

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**  
**FACULTY OF APPLIED SCIENCE**  
**COMPUTER SCIENCE DEPARTMENT**  
**MAY EXAMINATIONS 2005**

**SUBJECT: DATABASE CONCEPTS**  
**CODE: SCS1202**

**INSTRUCTIONS TO CANDIDATES**

This Examination paper consists of **SIX** questions (6)  
Answer **ALL** questions in **SECTION A** and ANY **THREE** from **SECTION B**

**Time: 3 hours**

**SECTION A**

**QUESTION ONE**

Consider the following requirements for a university library database:

The library is organized into sections based on subject areas. Each section is identified by a code, has a name related to the subject area, a location, and a librarian responsible for the section (manager).

- The library is composed of books, periodic, and CDs located in different sections. Each book is described by a number, has title, authors, version, year, edition, subject area, and location. A book can be classified either as a consultation only item or as a loan item. The books that can be borrowed have an associated maximum period for loan. The loan period is different for each type of user of the library. The library database maintains record of the total number of copies for a certain book and the number of copies that are on loan.
- Periodic items are for consultation only. Each periodic is classified by a number and is described by title, volume, number, year, location, and related subject area. The CDs are also identified by a number. A CD can be of type music, computer game, or related to a periodic. Music and game CDs can be borrowed and have a title and associated singers/authors. The library database maintains record of the total number of copies for a certain CD. Periodic CDs are only for consultation and have a title.

- The library users include students, academics, university staff, and people from outside the university (interlibrary loan). Each user is unique identified by an ID code and name. They also have an address and telephone number. For each type of users there is a maximum number of items that the user of this type can borrow for a certain period of time. Information about an item that was borrowed need to be known at any instance of time, including the date that the item was borrowed and the date that it is supposed to be returned. A fine of Z\$2 000 per day is charged for each day that a user delays on returning an item of the library. Information about fines is registered for each related user.
- The library contains its own staff member (librarian). Each librarian is described by an ID code, name, address, date of birth, sex, salary, function, and related working section. A librarian is allocated to a unique section.

*Questions:*

- a. Design an ER-diagram for the above database. Your diagram should specify entities, relationships, attributes, keys, mapping cardinalities, participation constraints, and existential dependencies [34]
- b. Translate the ER-diagram of item (a) into a set of relations following the guidelines discussed in the lecturers. Make sure that you identified all the primary and foreign keys [6]

**SECTION B**

**QUESTION TWO**

- a) Discuss the main characteristics of the database approach and how it differs from traditional file system. [12]
- b) Define the following terms:
  - i. Database
  - ii. Candidate key
  - iii. Entity
  - iv. Timestamp
  - v. Canned transaction [5]
- c) What is the difference between a file organization and an access method? [3]

**QUESTION THREE**

- a) What are the goals of database design? [3]
- b) Briefly describe the types of failures that may occur in a database environment. Explain why it is important to provide a recovery mechanism. [7]
- c) State the six phases of database design. Which of the six phases are considered the main activities of the database design process itself and why? [10]

**QUESTION FOUR**

- a) Discuss the implications of the database approach? [10]
- b) Discuss the differences between pessimistic and optimistic concurrency control. [4]
- c) Explain what is meant by a transaction. Why are transactions important units of operation in a DBMS? [4]
- d) What do you understand by the term; attribute? [2]

**QUESTION FIVE**

- a) Give a brief description of the properties of a transaction. [8]
- b) How do optimistic concurrency control techniques differ from other concurrency control techniques? Why are they also called validation or certification techniques? Discuss the typical phases of an optimistic concurrency control method. [12]

**QUESTION SIX**

- a) Outline the difference between primary and secondary storage. [4]
- b) Discuss the Relational model constraints. [3]
- c) Why are tuples in a relation not ordered? [3]
- d) Discuss the factors that influence the choice of a DBMS package for the information system of an organization. [10]

**END OF QUESTION PAPER**

**GOOD LUCK!**