MACHAKOS UNIVERSITY

University Examinations for 2020/2021

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTING AND INFORMATION TECHNOLOGY

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (COMPUTER SCIENCE)

SCO 304: ADVANCED DATABASE SYSTEMS

DATE: 17/8/2021 **TIME: 2:00 – 4:00 PM**

INSTRUCTIONS

Answer Question One (Compulsory) and ANY other two questions

QUESTION ONE (30 MARKS)

a) Distinguish between the following terms and concepts. (4 marks)

(i) *Data Physical Format* and *Data Logical Format* as applies to **data dependence**.

(ii) *Data Inconsistency* and *Data Anomalies* as applies to **data redundancy**.

b) "The Database Administrator (DBA) must be prepared to recover data to a usable point, no matter what the cause, and to do so as quickly as possible.". Explain the **three** types of data recovery referred to in this statement. (6 marks)

c) When asked by their lecturer why they think studying relational algebra and relational calculus is important in Advance Database Systems, the following students responded as follows. (4 marks)

Janet Relational Algebra provides the relational model with a flexible way to query a database.

Brian Relational Calculus is the foundation of Query-By-Example.

Justify these statements.

d) Outline **three** common characteristics that data models must have in order to be widely accepted. (3 marks)

e) "When implementing a physical database from a logical data model, there is need to consider how the database will perform when applications make requests to access and modify data.". Discuss this statement with emphasis on techniques that are employed to allow data to be accessed in the database more rapidly. (4 marks)

f) Explain **two** ways in which *views* can be used to implement data security. (2 marks)

g) A relational database can be used for text retrieval as follows. The database needs two tables. The first, **Documents**, has two attributes, DID and Text; one is a unique document identifier, the other is the full text of a document. The other, **Words**, also has two attributes, Word and DID; the first is a word (that is, a string), the other is the identifier of a document containing that word.

(i) Explain how a Boolean query on the text of a document could be formulated in SQL on such a database, giving examples. (4 marks)

(ii) Would you expect such querying to be reasonably fast? Why? Consider possible costings and possible queries. (3 marks)

QUESTION TWO (20 MARKS)

a) Outline **two** advantages and **two** disadvantages of *object-oriented database model*. (4 marks)

b) With a specific database management system (DBMS) in mind; (8 marks)

i) Explain any **two** important functions it performs that guarantee the integrity and consistency of data in the database.

ii) **One** technical and **one** non-technical DBMS strategy an organization can adopt in establishing a usable database environment.

iii) **Two** considerations needed in understanding the DBMS requirements and preparation of the environment for the new DBMS in the organization.

iv) **One** benefit and **one** risk in upgrading the DBMS in organizations database environment.

c) Consider the relation R(A,B,C,D,E,F,G,H,I,J,K) which is in First Normal Form (1NF). Suppose its dependencies are A,B→C B,D→E,F A,D→G,H A→J H→K.

i) Identify the key of R. (2 marks)

ii) Decompose R into 2NF relations. (3 marks)

iii) Then decompose R into 3NF relations. (3 marks)

QUESTION THREE (20 MARKS)

a) The following are relations from a database. Use them to answer the questions that follow. (10 marks)

Sailors (<u>sid</u>, sname, rating, age)
Boats (<u>bid,</u> bname, color)
Reserves (<u>sid</u>, <u>bid</u>, day)

Represent the query below in **Relational Algebra**, **Tuple Relational Calculus**, **Domain Relational Calculus** and **Structured Query Language (SQL).**

Find the names of sailors who reserved boat #103.

b) Draw an Entity-Relationship (ER) diagram showing entities, attributes, relationships, cardinality and participation. State any assumptions necessary here. (10 marks)

A worksite at a particular *address* has several *named* workers with *tax file numbers* and *tasks*. Building materials of certain *types* and *quantities* are delivered by *named* trucking companies on a *date* to a *supervisor* at the worksite; there are several manufacturers of each kind of material, each with their own business *name* and *address*.

QUESTION FOUR (20 MARKS)

a) Write an SQL statement to perform each of the following.
   i) Updating one or more records (2 marks)
   ii) Changing attributes characteristics (2 marks)
   iii) Deleting all rows in from a table (2 marks)
   iv) Primary key designation (2 marks)

b) Explain the significance of the **two** basic types of Data Control Language statements as used in database security. (4 marks)

c) Using an SQL statement, explain **two** types of privileges that can be granted and revoked from database users. (4 marks)

d) Write SQL statements that demonstrate the creation of a **trigger** and a **stored procedure** in databases. (4 marks)

QUESTION FIVE (20 MARKS)

a) Explain the **four** important properties of transactions that a DBMS must ensure to maintain data in the face of concurrent access and system failures. (8 marks)

b) Consider database objects A and B and assume that there are two transactions T1 and T2. Transaction T1 reads objects P and Q and then writes object P. Transactions T2 reads object P and Q and then writes objects P and Q. State an example schedule with actions of transactions T1 and T2 on objects P and Q that results in a write-read conflict. (4 marks)

c) Discuss the role of a database administrator enforcing security in database design. (4 marks)

d) Explain the difference between the **two** methods used for accessing relational data from a Java program. (4 marks)