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MAIN EXAMINATION

MAY – AUGUST 2021

FACULTY OF SCIENCE

DEPARTMENT OF COMPUTER AND INFORMATION SCIENCE

REGULAR PROGRAMME

CMT 302: ADVANCED DATABASE SYSTEMS

Date: AUGUST 2021	**Duration: 2 Hours**
INSTRUCTIONS: Answer QUESTION I and any other TWO questions	

Question 1 (30 marks)

a) Explain the difference between a primary index and a cluster index? **(4 Marks)**

b) What are log files used for? What is the relationship between backup files and log files?

(4 Marks)

c) Using an example relation of your choice, explain the output of the following operations

i. Projection **(2 Marks)**
ii. Selection **(2 Marks)**
iii. Cartesian product **(2 Marks)**

d) A relation NDDR is defined as follows:
NDDR = (name, street, city, state, postal_code)
Where name is unique, and for any given postal code, there is just one city and state

i. Give a set of FDs for this relation **(2 Marks)**
ii. What are the candidate keys? **(2 Marks)**
iii. Is NDDR in 3NF? 2NF? Explain why? **(3 Marks)**
iv. If NDDR is not in 3NF, normalize it into 3NF relations **(3 Marks)**

e) There are four enforceable desirable properties of transactions. Discuss these four properties and outline whose responsibility it is to ensure that it is enforced.

(6 Marks)

Question 2(20 Marks)

a) Consider the following two transactions, each updating data items X and Y:

T1	T2
read_item(X)	read_item(Y)
X:= X – 10	Y:= Y - 20
write_item(X)	write_item(Y)
read_item(Y)	read_item(X)
Y:= Y + 10	X:= X + 20
write_item(Y)	write_item(X)

i. Transactions can interfere with each other in many ways. Briefly describe the temporary update/dirty read problem using the two transactions. **(4 Marks)**

ii. A possible solution to the problem in i) above is to prevent the two transactions from accessing the data items concurrently through the use of locks. Briefly explain two types of locks used in database systems. **(4 Marks)**

iii. How can the introduction of the two-phase locking (2PL) lead to deadlock as two transactions attempt to update a data item? Illustrate using the above example. **(4 marks)**

iv. Discuss briefly the differences between the basic two-phase locking scheme and the strict two-phase locking scheme. **(4 Marks)**

b) Briefly explain the steps that are followed when a query is processed by a relational database management system. **(4 Marks)**

Question 3(20 Marks)

a) Differentiate between time-stamping and dead-lock prevention mechanism. **(4 Marks)**

b) A certain company lost data as a result of sabotage and an application software error. This led to the corruption of some of the data. Describe at least three facilities the DBMS should have to assist with recovery of the data? **(6 Marks)**

c) Triggers are procedures that are automatically invoked by the DBMS in response to specified changes to the database and are typically specified by the DBA. A DBA created the following tables:

Client:

CName	CCode	CAddress	BankBalance	BNo

Branch:

BName	BNo	TotalBrBalance	ManagerSSN

The TotalBrBalance in Branch could change based on the following four actions:

i. Inserting (one or more) new client records
ii. Changing the bank balance of (one or more) existing employees
iii. Changing one or more existing clients from one branch to another
iv. Deleting (one or more) client records

All the above events require a trigger to automatically change the **TotalBrBalance** in Branch if the Client's **BankBalance** were to change.
Required: Develop trigger statements for any **TWO** of the above stated actions. **(10 Marks)**

Question 4(20 Marks)

a) Outline any **FOUR** considerations a DBA would have to consider in the development of a data warehouse. **(8 Marks)**
b) Normalization is one of the most important techniques in database design. Consider the following relation and answer the questions that follow.
Client_Interview relation

ClientNo	InterviewDate	InterviewTime	StaffNo	RoomNo
CR76	13-May-14	1030 Hrs	SG5	G101
CR56	13-May-14	1200 Hrs	SG5	G101
CR74	13-May-14	1200 Hrs	SG37	G102
CR56	1-Jul-14	1030 Hrs	SG5	G102

i. In what normal form is the above relation? Why? **(3 Marks)**
ii. Normalize the relation to the highest possible normal form. **(5 Marks)**

c) Explain what is meant by the following terms as they relate to Database Systems:
   i. Compensating transaction **(2 Marks)**
   ii. Stored procedure **(2 Marks)**

Question 5(20 Marks)

Consider a company database with the following relation schemas where primary keys are underlined:

employee (firstname, lastname, idno, birthday, gender, salary,supervisoridno, departmentno)
department (departmentname, departmentno, manageridno)
department locations (departmentno, departmentlocation)
project (projectname, projectno, project location, departmentno)
works on (idno, projectno, hours)

Write SQL statements to accomplish the following tasks:

a) Retrieve the names of all employees in the 'Research' department who work more than 10 hours per week on the 'ProductX' project. **(5 Marks)**
b) Find the names of employees who are directly supervised by 'Alfred Kasiano'. **(4 Marks)**

c) For each department whose average employee salary is more than K.Shs. 50,000, retrieve the department name and the number of employees working for that department. **(5 Marks)**

d) Remove employees whose salary is more than 100,000. **(3 Marks)**

e) Increase the pay of all employees in the 'Accounts' department by 5%. **(3 Marks)**