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**KIRIRI WOMEN'S UNIVERSITY OF SCIENCE AND TECHNOLOGY**  
**UNIVERSITY EXAMINATION, 2024/2025 ACADEMIC YEAR**  
**THIRD YEAR, SECOND SEMESTER EXAMINATION**  
**FOR THE BACHELOR OF SCIENCE IN COMPUTER SCIENCE**  
**KCS 404 – ADVANCED DATABASE SYSTEMS**

Date: 11<sup>TH</sup> April 2024  
Time: 11:30AM – 1:30PM

**INSTRUCTIONS TO CANDIDATES**

**ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS**

**QUESTION ONE (30 MARKS)**

- a) Using an example, describe how the Lost Update Problem occurs (4 Marks)  
b) Let's assume, a school can store the data of teachers and the subjects they teach. In a school, a teacher can teach more than one subject. Convert the given table into 2NF. (4 Marks)

**TEACHER table**

TEACHER_ID	SUBJECT	TEACHER_AGE
25	Chemistry	30
25	Biology	30
47	English	35
83	Math	38
83	Computer	38

- c) Contrast between a Relational Database and Object-Oriented databases (4 Marks)  
d) Demonstrate the three-tier database architecture working (6 Marks)  
e) Write an SQL program that will list everybody from a database table called *Customers* who belong to the Country called Germany. (4 Marks)  
f) The table below lists the locking information for some transactions. Draw the WFG, explaining whether there is potential for a deadlock. (4 Marks)

Transaction	Data Items locked by Transaction	Data items transaction is waiting to lock
T1	C	A
T2	A	-
T3	F	D,E
T4	D	B,C
T5	B,E	C

- g) Describe the two phases in a Two-phase locking protocol? (2 Marks)  
h) As a database administrator, you may need to automate some administrative tasks to enable you free some time for other duties. Elucidate any TWO administrative tasks that you can automate. (2 Marks)

**QUESTION TWO (20 MARKS)**

- a) Consider the following transaction:

```

T1 : read (A);
    read (B);
    if A= 0 then B:=B+1
        write (B);
T2 : read (B);
    read (A);
    if B = 0 then A: A = 1;
        write (A);

```

Add lock and unlock instruction to transactions T1 and T2, so that they observe the two-phase locking protocol. (8 Marks)

- b) Elaborate on the techniques used for recovery from non-physical or transaction failure? (6 Marks)
- c) Suppose a bank employee transfers Rs 500 from A's account to B's account. This very simple and small transaction involves several low-level tasks. Write down the Transactions that will be happening in the accounts. (6 Marks)

**QUESTION THREE (20 MARKS)**

- a) Let us assume a transaction T1 that transfers money from account A to account B. Before transaction let A = 1000 and B = 1000. The transaction can be represented as follows;

<b>Transaction T1</b>
BEGIN TRANSACTION READ(A); A := A - 500; WRITE(A); READ(B); B := B + 500; WRITE(B); COMMIT; END TRANSACTION;

With the aid of a diagram, relate the states of a transaction with the above transaction (10 Marks)

- b) With an illustration, discuss the four anomalies in a database during data manipulation (4 Marks)
- c) Showing your workings, State whether the following schedule is conflict serializable or not. Justify your answer. (6 Marks)

<b>T<sub>1</sub></b>	<b>T<sub>2</sub></b>
<b>read (A)</b>  <b>write (A)</b>   <b>read (B)</b> <b>write (B)</b>	   <b>read (B)</b> <b>write (B)</b>   <b>read (A)</b> <b>write (A)</b>

**QUESTION FOUR (20 MARKS)**

- a) Using the ACID properties of the transaction, Explain serializability with suitable example (8 Marks)
- b) Sketch the Steps in Database Query Processing diagram explaining each one of them. (10 Marks)
- c) Explain two conditions for a deadlock to occur. (2 Marks)

**QUESTION FIVE (20 MARKS)**

- a) Let us assume that a transaction T1 transfers 5000 from, say account A to account B. Also assume that the initial balance of A is 10000 and B is 10000. Show a diagram that shows the actual implementation of Transaction T1 transfer of money from one account to the other clearly indicating the transaction states. (8 Marks)
- b) Discuss five reasons that may lead to transaction failure (10 Marks)
- c) Define the term anomaly as used in databases (2 Marks)