**CICT PART II SECTION 3**

**DATABASE SYSTEMS**

WEDNESDAY: 23 May 2018.                                                 Time Allowed: 3 hours.

Answer ALL questions. Marks allocated to each question are shown at the end of the question.

## QUESTION ONE

(a)      Describe six major steps followed in setting up a database.                                (6 marks)

(b)      Explain how database level security differs from other forms of information security.      (2 marks)

(c)      (i)      Distinguish between "index" and "resource" forms of database authorisation.        (2 marks)

         (ii)     Write a statement that gives a user U1 the "select" privileges on a relation "branch" and allows U1 to grant this
                  privilege to others.                                                             (3 marks)

(d)      Users of a database are differentiated by the way we expect them to interact with the systems.

         With reference to the above statement, summarise the expectations of three typical database users.    (3 marks)

(e)      Highlight two reasons why data mining is important to a commercial bank.                   (2 marks)

(f)      Describe two advantages of application integration over data integration.                 (2 marks)

                                                                                          **(Total: 20 marks)**

## QUESTION TWO

(a)      Given the entity below, answer the questions that follow:

| PatientID | Service | Cost (Sh.) |
|-----------|---------|------------|
| MAT001 | Dialysis | 10000 |
| MAT005 | Chemotherapy | 12000 |
| MAT006 | Dialysis | 10000 |
| MAT009 | Transfusion | 40000 |

         (i)      Illustrate the functional dependence notation for the entity above.                (1 mark)

         (ii)     Explain two types of anomalies associated with the entity.                         (4 marks)

         (iii)    Using an illustration, suggest how the anomalies in (a) (ii) above would be solved. (2 marks)

(b)      Using an example, explain the term "derived data" in the context of database systems.      (2 marks)

(c)      Write Structured Query Language (SQL) statements to depict the following types of queries, given the schema below:

                  Student(admno, fname, lname, course, feepaid)

         (i)      A "Range query" to display the students' records whose fee paid is between Sh.20,000 and Sh.100,000.
                                                                                                   (2 marks)

         (ii)     A "Prefix match query" to display all the students whose fname ends with character "a".    (2 marks)

         (iii)    An "ordering query" to sort the students' records from the highest fee paid to the lowest fee paid.    (2 marks)

         (iv)     "Group query" to calculate the total fee paid per course.                         (2 marks)

(d)      Using the schema in (c) above, write a relational algebra to do the following:

         (i)      Display the students whose fee paid is greater than Sh.100,000.                   (1 mark)

         (ii)     Display all records of the students showing only the admno and feepaid.           (2 marks)

                                                                                          **(Total: 20 marks)**

**QUESTION THREE**

(a)     Explain Query By Example (QBE) as used in database systems.                    (2 marks)

(b)     A college offering kasneb courses keeps records about the student courses such as DICT, ATD, CICT and CPA as well as the papers they are taking in each course. Each course has many papers. A student could take many papers but is only allowed to enroll in one course at any given time.

**Required:**
Draw an ER model for the above scenario.                                               (6 marks)

(c)     Databases naturally lend themselves to parallelism.

**Required:**
Assess the four characteristics that lead databases to parallelism.                      (4 marks)

(d)     Explain two steps involved in recovery algorithms.                              (4 marks)

(e)     Outline the semantics of the following operations used in transactions to transfer data items between system buffer blocks and its private work area:

   (i)      read (x).                                                                   (2 marks)

   (ii)     write (x).                                                                  (2 marks)

**(Total: 20 marks)**

**QUESTION FOUR**

(a)     The following two transactions run concurrently on the database R shown below:

R:

| A | B |
|---|---|
| 1 | 10 |
| 2 | 0 |

| Line | T1 | T2 |
|------|----|----|
| 1 | begin transaction; | begin transaction; |
| 2 | insert into R values (3,150) | select sum (B) from R; |
| 3 | commit | select sum (B) from R; |
|   |   | commit; |

Discuss a possible scenario where T2 runs under different values from T1.              (5 marks)

(b)     Explain four features of homogenous distributed databases.                      (4 marks)

(c)     A transaction server in a database is composed of a number of processes:

**Required:**
State the role of each of the following server processes:

   (i)      Database writer.                                                            (2 marks)

   (ii)     Process monitor.                                                            (2 marks)

(d)     The following table shows a list of products ordered by XYZ company:

| Product Code: C001 | Product Name: Sweet Wine | Supplier Name: XYZ | Supplier No. S005 | Item Cost: £20 | |
|---|---|---|---|---|---|
| Order No: 27/17 | Order Date: 3/7/17 | Order Total: £500 | Delivery Code: 8/8/17 | Delivery firm: D11 |
| ... | ... | ... | ... | ... |
| Product Code: C008 | Product Name: Dry Wine | Supplier Name: ABC | Supplier No. S020 | Item Cost: £21 | |
| Order No: 18/17 | Order Date: 5/8/17 | Order Total £750 | Delivery Code: 11/8/17 | Delivery firm D05 |
| ... | ... | ... | ... | ... |
| Product Code: C005 | Product Name: Energy Drink | Supplier Name: JKL | Supplier No. S015 | Item Cost £70 | |
| Order No: 21/17 | Order Date: 21/8/17 | Order Total £600 | Delivery Code 9/9/17 | Delivery firm: D09 |
| ... | ... | ... | ... | ... |

**Required:**

(i) Extract the first normal form (1NF) of the given data. (1 mark)

(ii) Extend the 1NF to second normal form (2NF). (2 marks)

(iii) Determine the third normal form (3NF). (2 marks)

(iv) Suggest the names for the resulting relations after the 3NF. (2 marks)

**(Total: 20 marks)**

## QUESTION FIVE

(a) Query optimisation is key technique for improving the performance of databases.

**Required:**

(i) State underlying structural characteristics of optimisable queries. (2 marks)

(ii) Outline the algorithm for a cost-based optimisation technique. (3 marks)

(iii) Consider the following expression tree:
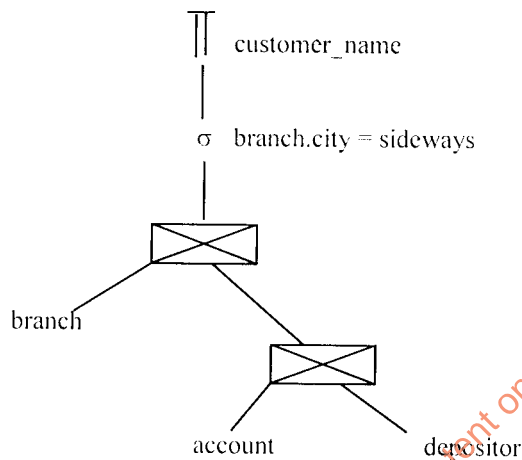


**Required:**
Generate an equivalent (transformed) expression tree. (4 marks)

(b) Explain the following terms:

(i) Primary index. (2 marks)

(ii) Secondary index. (2 marks)

(c) In relational modeling, the use of normalisation using functional dependencies is a major technique for determining whether a given relation is in "good" form or not.

**Required:**

(i) List three goals of decomposition. (3 marks)

(ii) Given the relation, R = (X, Y, Z) with functional dependencies:

$F = \{ X \rightarrow Y, \ Y \rightarrow Z \}$, analyse two ways of decomposing it. (4 marks)

**(Total: 20 marks)**

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