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Course code: IIT 3213 Course Title: **Database Administration and Design**

INSTRUCTIONS

1. The paper contains FIVE questions
2. Answer question one (compulsory) and ANY OTHER TWO questions.

QUESTION ONE   -   COMPULSORY   [30 MARKS]

(a) Below is an excerpt from CNN website about Database Administration. Read and use it to answer the questions that follow.

As businesses accumulate more and more data, Database Administrators (DBAs) are in demand everywhere."If you are concerned about having a job that will be around for a while, database administration is the way to go," says Patt Patterson Jones, 52, a DBA for 17 years, including six years with Baltimore fund manager T. Rowe Price.

   (i)   Do you agree with the above statement? Explain your choice.   [2 Marks]

   (ii)   Give TWO reasons why you should learn database administration. [2 Marks]

   (iii)   Name any FOUR tasks that a DBA performs in an organization.   [4 Marks]

   (iv)   Some organization may choose to split DBA responsibilities into separate jobs. List any TWO factors that may guide the number of DBAs to be hired in an organization.   [2 Marks]

(b) "When implementing a physical database from a logical data model, there is need to consider how the database will perform when applications makes requests to access and modify data".

    (i)   Name and explain any TWO techniques that can be used to enhance performance of database as hinted in above statement.   [4 Marks]

    (ii)   "Basic fact of data processing is that disk access is slower than memory access" Is the statement true? Explain your answer.   [2 Marks]

(c) With respect to the main phases of query processing, give the name of database management system (DBMS) components that transform a query into a relational algebra expression.   [2 Marks]

(d) Suppose that a project with the ProjID of "pl" has been finished and the information about the project will be removed from the database. Considering the integrity constraints on the database schema, describe the steps to update the database to reflect this action.

    [3 Marks]

(e) What is *functional dependency*?   [1 Mark]

    (i)   You are given the following set of functional dependencies (FDs) for a relation R (A,B,C,D,E,F). FD = {AB $\rightarrow$ C, DC $\rightarrow$ AE, E $\rightarrow$ F}. What are the keys of this relation?   [2 Marks]

    (ii)   Is the relation R in (i) above in BCNF? Support your answer.   [2 Marks]

    (iii)   Referring to (i) above, is the decomposition (A,B,C,D) (B,C,D,E,F) a dependency preserving decomposition? Support your answer.   [2 Marks]

(f) Explain the main objectives to be considered while designing secure database application.

    [2 Marks]

QUESTION TWO [20 MARKS]

(a) In your own words, explain your understanding of the term *database model*. Give any TWO database models that you know.   [4 Marks]

(b) The following statements might be TRUE or FALSE. For each case, state whether TRUE or FALSE and support your choice.   [8 Marks]

(i) Main memory is the fastest and most expensive storage medium, and often quite large in some server systems, to the extent of being able to store an entire database.

(ii) The heap file organization is ideal for supporting high performance applications that involve a large number of updates, including changes to attributes and deletions of tuples.

(iii) Indexes speed up the response to user queries.

(iv) The recovery mechanism in a database management system depends on information about all transactions that are running on the system at a particular time.

(c) Walinzi Company Limited intends to integrate Database Management System (DBMS) into their growing organization network to promote a usable database environment. One of their concerns is to enable their clientele get access to required information *anywhere anytime* irrespective of capacity on demand at one given time. You have been approached to assist in the implementation.

(i) Suggestany FOUR defined DBMS strategies that the company need to consider to successfully implementing their plan. [4 Marks]

(ii) A typical release cycle for DBMS software is 12 to 18 months for major releases. Should the company opt to upgrade the deployed DBMS, give any TWO benefits and TWO risks involved when upgrading DBMS in a network like this. [4 Marks]

QUESTION THREE [20 MARKS]

(a) With respect to a given schema, identify the limitations of the relational model and relational integrity constraints. [2 Marks]

(b) Consider the relation schema below

Account (AccountNo, CustName, branch, balance)

and two transactions that contain the following two SQL commands respectively

```
SELECT sum (balance)FROM Account

WHERE branch = "Bondo"
```

```
INSERT into Account

Values (201,'Anne','Bondo',150
```

Is there any potential conflict in terms of database consistency and / or SQL isolations levels, among the two transactions? Support your answer.   [2 Marks]

(c) Consider the relational schema provided below and use it to answer the questions that follow.

```
SUPPLIER (SNUM, SNAME, STATUS, CITY)

PART (PNUM, PNAME, COLOUR, WEIGHT, CITY)

SUPPLIERPART (SNUM, PNUM, QTY)

JOB (JNUM, JNAME, CITY)

SUPPLIERPARTJOB (SNUM, PNUM, JNUM, QTY)
```

For SUPPLIER, status is a credit rating and city is location of its headquarters

For PART, city is where it is made.

For SUPPLIERPART, qty is the quantity of that part available from that supplier.

For JOB, city is the location of the work

For SUPPLIERPARTJOB, qty is the quantity requested of that part from that supplier for that job.

The numbers SNUM, PNUM and JNUM are the keys. SNAME, PNAME and JNAME are names.

(i)   Give an English expression of the following query: [3 Marks]

SELECT colour FROM Part P, SupplierPart SP WHERE P.PNum = SP.PNum GROUP BY Colour HAVING sum (weight) = 20

(ii)   Give an English expression of the following relational algebra expression:

[3 Marks]

PROJECT Sname (SELECT Part.City!=Supplier.City (Supplier NATJOIN SupplierPart NATJOIN Part))

(iii)   Write a query in relational algebra to find the part numbers of red parts with weight less than 100.   [4 Marks]

(iv)   Rewrite the query in (iii) above in SQL.   [3 marks]

(d) "Learning relational algebra and relational calculus makes one aware of conceptual and practical differences between procedural and non-procedural query languages". Do you agree with this statement? Give reason to support.   [3 marks]

QUESTION FOUR [20 MARKS]

(a) Data Modeler is responsible for a subset of database administrator's responsibilities. Identify any TWO of such tasks of a data modeler. [2 Marks]

(b) Differentiate between the following concepts as applies to data modeling. [4 Marks]

    (i)   Recursive Relationships and Ternary Relationships

    (ii)   Participation Constraints and Cardinality Constraints

(c) Draw an ER diagram for a company database from description below. In your ER diagram, you must properly denote all applicable concepts. [6 Marks]

UPS prides itself on having up-to-date information on the processing and current location of each shipped item. To do this, UPS relies on a company-wide information system. Shipped items are the heart of the UPS product tracking information system. Shipped items can be characterized by item number (unique), weight, dimensions, insurance amount, destination, and final delivery date. Shipped items are received into the UPS system at a single retail center. Retail centers are characterized by their type, uniqueID, and address. Shipped items make their way to their destination via one or more standard UPS transportation events (i.e., flights, truck deliveries). These transportation events are characterized by a unique scheduleNumber, a type (e.g, flight, truck), and a deliveryRoute. Please create an Entity Relationship diagram that captures this information about the UPS system. Be certain to indicate identifiers and cardinality constraints.

(d) Map the ER diagram developed in (c) above to a set of relations. For each relation, list the functional dependencies, underline primary keys and asterisk any foreign keys, and give its normal form. [8 Marks]

QUESTION FIVE [20 MARKS]

(a) Distinguish between the following as applies to databases [8 Marks]

    (i)   SQL Rules of Thumb and DBA Rules of Thumb

    (ii)   Data Warehouse and Data Mart

    (iii)   Analytical Processing and Transactional Processing

    (iv)   Full Image Backups and Incremental Image Backups

(b) Consider yourself as the database administrator for Wangwana Holdings Limited. You have created a relation called **Employees** with fields *ename, dept,* and *salary*. For authorization reasons, you have also defined views **EmployeeNames** (with *ename* as the only attribute) and **DeptInfo** with fields *dept* and *avgsalary*. The latter lists the average salary for each department.

    (i)   Show the view definitions for **EmployeeNames** and **DeptInfo**.   [4 Marks]

    (ii)   What privileges should be granted to a user who needs to know only average department salaries for Finance and Security departments?   [4 Marks]

(c) "Temporal databases encompass all database applications that require some aspect of time when organizing their information".

    (i)   How do temporal database systems benefit from relational databases?[2 Marks]

    (ii)   Identify TWO significant shortcomings of relational model regarding temporal data.   [2 Marks]