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Paper Code : OECAIML 601A Database Management System

UPID : 006923

Time Allotted : 3 Hours *Full Marks :70*

The Figures in the margin indicate full marks.
Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer *any ten* of the following : [1 x 10 = 10]

(I) Concurrency control is used for access to _____.

(II) What is meant by Data Manipulation Operations?

(III) What do the logical databases designed to provide?

(IV) What is Data Definition Language (DDL)?

(V) What is Tuple Relational Calculus?

(VI) Hashing is used to index _____.

(VII) Locking and timestamp based schedulers are used for _____ in a database.

(VIII) Data warehousing is the process of collecting, storing, and managing data from _____.

(IX) Data mining is the process of extracting _____.

(X) What are Integrity Constraints?

(XI) What is commonality in Relational Database Management Systems?

(XII) What is an Entity-Relationship model?

Group-B (Short Answer Type Question)

Answer *any three* of the following : [5 x 3 = 15]

2. (a) Explain Data Abstraction and how it is helpful in Database Management Systems. [5]
(b) Discuss the different types of data models used in Database Management Systems, and explain how the Relational Data Model is different from other models.

3. Consider the following relation R with four attributes A, B, C, and D, and the functional dependencies {AB → C, BC → D}. Is R in 3NF, and why? If not, decompose it into 3NF. [5]

4. Consider a hash table with 500 slots and a hash function that distributes the keys uniformly over the slots. If the load factor of the hash table is 0.8, how many keys can the hash table store before it becomes necessary to resize the hash table? [5]
Assuming that the hash table is initially empty, calculate the average number of probes required to search for a key value that is not in the hash table.

5. Explain the differences between logical and physical data independence. [5]
Describe the significance of data independence in database design.

6. Describe the architectural difference between Discretionary Access Control (DAC) and Mandatory Access Control (MAC) models in database security. [5]
Explain the concept of Role-Based Access Control (RBAC) and its advantages over DAC and MAC models.
Suppose that a database system uses MAC model for access control. Explain the steps involved in granting a user access to a database object.

Group-C (Long Answer Type Question)

Answer *any three* of the following : [15 x 3 = 45]

7. (a) Consider a large dataset containing billions of records, stored in a relational database. The table has an index on a frequently used column, but the query optimizer is not using it. Explain why this could be happening and suggest some techniques to encourage the optimizer to use the index. [8]
(b) Suppose the table is partitioned horizontally across multiple disks for better performance. Describe how the use of indexes might be affected by this partitioning strategy. [7]

8 (a) Explain the ACID properties of transactions and why they are important in a database system. [7]
(b) Discuss the differences between two-phase locking and timestamp ordering protocols in concurrency control. Which protocol is better and why? [8]

9. (a) Explain the difference between authentication and authorization in a database system. Discuss the importance of authentication and authorization for maintaining database security. [7]

   (b) Discuss the limitations of access control based on user roles and permissions. Describe an alternative approach to access control that can address these limitations. [8]

10. (a) Define the distributed databases. What do you mean by homogeneous and heterogeneous distributed databases? [4]

    (b) Explain the advantages and the disadvantages of DDBMS. [4]

    (c) What is fragmentation? Discuss horizontal and vertical fragmentation techniques with the help of examples. [7]

11. A bank is designing a new database system to store sensitive customer information. The bank wants to implement a multi-level security approach to ensure the confidentiality, integrity, and availability of the data. Provide a detailed plan for implementing the security measures, including authentication, authorization, and access control, DAC, MAC, and RBAC models. Also, discuss the importance of intrusion detection and SQL injection prevention in ensuring the security of the database system. [15]

*** END OF PAPER ***