Bihar Engineering University, Patna

B.Tech 5th Semester Examination, 2024

Course: B.Tech   Time: 03 Hours
Code: 105502   Subject: Database Management Systems   Full Marks: 70

Instructions:-
(i) The marks are indicated in the right-hand margin.
(ii) There are NINE questions in this paper.
(iii) Attempt FIVE questions in all.
(iv) Question No. 1 is compulsory.

Q.1 Choose the correct option / answer the following (Any seven question only):   [2 x 7 = 14]

(a) Which of the following is *not* a feature of the relational database model?
(i) Tables with rows and columns   (iii) Pre-defined data access paths
(ii) Use of SQL   (iv) Data independence

(b) Which SQL command is used to remove a table from a database?
(i) REMOVE   (iii) DROP
(ii) DELETE   (iv) CLEAR

(c) Which of the following is used for indexing in database systems?
(i) Transaction log   (iii) Views
(ii) B-tree   (iv) Triggers

(d) In ACID properties, which component ensures that once a transaction is committed, it remains so?
(i) Atomicity   (iii) Isolation
(ii) Durability   (iv) Consistency

(e) SQL injection attacks can be prevented by:
(i) Dynamic SQL   (iii) Prepared Statements
(ii) Input trimming   (iv) Using DELETE statements

(f) Which access control model assigns permissions to roles instead of individual users?
(i) DAC   (iii) RBAC
(ii) MAC   (iv) Firewall

(g) Which of the following is an example of a DML command in SQL?
(i) CREATE   (iii) DROP
(ii) SELECT   (iv) ALTER

(h) Which of the following ensures no data is lost after a system crash?
(i) Commit log   (iii) Recovery manager
(ii) View   (iv) Trigger

(i) 2NF removes which kind of dependency?
(i) Transitive   (iii) Functional
(ii) Partial   (iv) Multivalued

(j) Which of the following is true about object-oriented databases?
(i) They use tables only   (iii) No support for complex data
(ii) They allow encapsulation   (iv) Only support numeric data

Q.2 (a) Consider the relation R (P, Q, S, T, X, Y, Z, W) with the following functional dependencies. [7]

$PQ \rightarrow X$; $P \rightarrow YX$; $Q \rightarrow Y$; $Y \rightarrow ZW$

Consider the decomposition of the relation R into the constituent relations according to the following two decomposition schemes.

D1 : R = [(P, Q, S, T); (P, T, X); (Q, Y); (Y, Z, W)]
D2 : R = [(P, Q, S); (T, X); (Q, Y); (Y, Z, W)]

Identify whether it is and lossy decomposition and justify your answer.

(b) Employee (ename, street, city) [7]
Worksfor (ename, company_name, salary)
Company (Company_name, city)
Construct the SQL statements for the following
(i) Create the above given tables with suitable data types and size.
(ii) Find the name of employees who live in the same city where they work.
(iii) Find the name of employees who have salary more than Rs. 50000.
(iv) Find the name of employees who don't work in "tcs" company.
(v) Find all employees whose name has second letter 'A'.
(vi) Find the employee's name having second highest salary.

Q.3 (a) Consider the following relational schemes for a library database: Book (Title, Author, Catalog_no, Publisher, Year, Price), Collection (Title, Author, Catalog_no) with in the following functional dependencies: [7]
I. Title Author --> Catalog_no
II. Catalog_no --> Title, Author, Publisher, Year
III. Publisher Title Year --> Price
Analyze and find the highest normal form of the relation Book and Collection.

(b) Consider the following schema for institute library: [7]
Student (RollNo, Name, Father_ Name, Branch)
Book (ISBN, Title, Author, Publisher)
Issue (RollNo, ISBN, Date-of –Issue)
Write the following queries in SQL and relational algebra:
(i) List roll number and name of all students of the branch 'CSE'.
(ii) Find the name of student who has issued a book published by 'ABC' publisher.
(iii) List title of all books and their authors issued to a student 'RAM'.
(iv) List title of all books issued on or before December 1, 2020.
(v) List all books published by publisher 'ABC'

Q.4 (a) Explain schedule and transaction. Define the concepts of recoverable, cascade less, and strict schedules, and compare them in terms of their recoverability. [7]

(b) Consider the three transactions T1, T2, and T3, and the schedules S1 and S2 given below. State whether each schedule is serializable or not. If a schedule is serializable, write down the equivalent serial schedule(s). [7]

T1: r1 (X); r1 (Z); w1 (X);
T2: r2 (Z); r2 (Y); w2 (Z); w2 (Y);
T3: r3 (X); r3 (Y); w3 (Y);
S1: r1 (X); r2 (Z); r1 (Z); r3 (X); r3 (Y); w1 (X); w3 (Y); r2 (Y); w2 (Z); w2 (Y);
S2: r1 (X); r2 (Z); r3 (X); r1 (Z); r2 (Y); r3 (Y); w1 (X); w2 (Z); w3 (Y); w2 (Y);

Q.5 (a) Describe Armstrong's axioms in detail. What is the role of these rules in database development process? [7]

(b) Describe the term MVD in the context of DBMS by giving an example. Discuss 4NF and 5NF also. [7]

Q.6 (a) What are indices in database systems? Explain the need and advantages of indexing. Describe various types of indexing techniques including primary index, secondary index, clustered and non-clustered indexes with the help of suitable diagrams. **[7]**

(b) What is a B-tree? Explain its structure, order, and properties. How is a B-tree used in database indexing? Demonstrate insertion and search operations in a B-tree with a proper example. Also compare B-tree with binary search tree in context of database performance. **[7]**

Q.7 (a) Discuss 2 phase commit (2PC) protocol and time stamp-based protocol with suitable example. How the validation-based protocols differ from 2PC? **[7]**

(b) Discuss the procedure of deadlock detection and recovery in transaction? **[7]**

Q.8 (a) Explain the concept of database recovery in detail. Discuss various recovery techniques such as log-based recovery, shadow paging, checkpointing, and recovery using deferred and immediate update strategies with suitable examples. **[7]**

(b) What is DAC, MAC, and RBAC models in databases? Compare and contrast these models based on their policy mechanisms, user flexibility, and real-world applicability. Also explain which model is most suited for large enterprise systems and why. **[7]**

Q.9 (a) Explain the concepts of Authentication, Authorization, and Access Control in database systems. How do these mechanisms work together to ensure database security? Support your answer with real-world examples and discuss how they are implemented in modern DBMS platforms. **[7]**

(b) Explain the concepts of Object-Oriented Databases (OODBMS) and Object-Relational Databases (ORDBMS). **[7]**