KATHMANDU UNIVERSITY
End Semester Examination
January/February 2024

Marks Scored:

Level : B.E./B.Sc.
Year : II

0 5 FEB 2024

Course : COMP 232
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date :

SECTION "A"

[20Q. × 0.5 = 10 marks]

Choose and encircle the most appropriate option from each set of choices

1. Which of the following is not a part of database management systems?
   a. DML compiler
   b. Authorization manager
   c. Data analytics engine
   d. DDL interpreter

2. Which of the following is **CORRECT**?
   a. SQL queries automatically eliminate duplicates.
   b. SQL queries will not work without indexing.
   c. SQL queries allow us to retrieve data from multiple tables.
   d. SQL queries will not work if there are NULL values in the table.

3. Which of the following database objects does not exist physically?
   a. View b. Table c. Index d. Materialized view

4. In an ER diagram, attributes are represented by _____
   a. a rectangle b. a square c. an ellipse d. a parallelogram

5. Which of the following is **NOT** the responsibility of the query processor in database management systems?
   a. Interpret DDL statements
   b. Translate DML statements into an evaluation plan
   c. Perform query optimization
   d. Ensure the atomicity and durability properties of transactions

6. Consider the schema instructor(ID, name, age, salary). Which of the following SQL queries will not work?
   a. SELECT * FROM instructor
   b. SELECT age, average(salary) FROM instructor
   c. SELECT name FROM instructor WHERE age > 50
   d. SELECT age, max(salary) FROM instructor

7. What does a double rectangle indicate in an ER diagram?
   a. Strong entity set
   b. Weak entity set
   c. Relationship between a weak entity set and a strong entity set
   d. Relationship between strong entity sets

8. Which of the following query is equivalent to the one below?
SELECT name FROM student WHERE grade IN ('A', 'A-');
   a. SELECT name FROM student WHERE grade = 'A' OR grade = 'A-'
   b. SELECT name FROM student WHERE grade = 'A' AND grade = 'A-'
   c. SELECT name FROM student WHERE grade = 'A' UNION SELECT name FROM student WHERE grade = 'A-'
   d. SELECT name FROM student WHERE grade = 'A' UNION ALL SELECT grade FROM student WHERE grade = 'A-'

9. A check pointing system is needed to _____
   a. ensure system security
   b. recover from transient faults
   c. ensure system integrity
   d. ensure system privacy

10. Which of the following statements is **INCORRECT**?
   a. Domain constraints specify the set of possible values that may be associated with an attribute.
   b. Integrity constraints ensure that changes made to the database do not make database inconsistent.
   c. Referential integrity ensures that a value in one relation can be referenced by another relation.
   d. Foreign key constraints are not mandatory.

11. What is a blind write?
   a. Writing of uncommitted data
   b. Reading of uncommitted data
   c. Writing the data after commit
   d. Writing a data without reading it

12. Given the following set F of functional dependencies on schema (A, B, C, D, E), which functional dependency does not have extraneous attributes?
F = { A → BC, B → C, B → AC, A → DE, AB → C, A → B }
   a. A→ BC
   b. B → AC
   c. A → DE
   d. AB → C

13. The relational algebra operations enable a user to specify basic _____ requests.
   a. retrieval
   b. modification
   c. construct
   d. deletion

14. Which of the following statements is **CORRECT**?
   a. The two-phase locking protocol permits release of exclusive locks only at the end of transaction.
   b. The strict two-phase locking protocol allows a transaction to lock a new data after unlocking another data in the same transaction.
   c. The strict two-phase locking protocol releases all locks only at the end of the transaction.
   d. The two-phase locking protocol ensures serializability.

15. Consider the following log records. What will be the value of A and B after recovery?
<T0 start>
<T1 start>
<T0, A, 10, 20>
<T2, B, 10, 25>
<T0 commit>
<T1, C, 40, 60>
   a. A=20, B=10
   b. A=20, B=25
   c. A=10, B=10
   d. A=10, B=25

16. What does the following Cypher query do?
CREATE (p:Person)-[:LIKES]->(t:Technology)
   a. It creates one LIKES node and two relationships of label Person and Technology.
   b. It creates one node of label Person and connects it to an existing node of label Technology and value t.
   c. It looks for the pattern consisting of two nodes connected through a LIKES relationship.
   d. It creates two nodes and connects them.

17. If _____ is issued before the termination of a transaction, the DBMS will restore the database only for that particular transaction, rather than for all transactions.
   a. A commit b. A rollback c. An abort d. A wait

18. Which of the following is not a NoSQL database?
   a. IBM Db2 b. Orient DB c. Redis d. Mongo DB

19. Consider the following set F of functional dependencies on schema (A, B, C, D, E). Which of the following functional dependencies cannot be logically implied using Armstrong's axioms?
F = {A—> B, A —> C, CD —> E, B —> E}
   a. A —> BC b. BCD —> E c. BD —> E d. AB —> E

20. If only one transaction is executed at a time, _____ will be automatically ensured.
   a. serializability and isolation b. serializability and atomicity
   c. atomicity and isolation d. serializability and durability

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Level : B.E./B.Sc.
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05 FEB 2024

Course : COMP 232
Semester : II
F. M. : 40

SECTION "B"
[6 Q. × 4 = 24 marks]

Attempt *ANY SIX* questions.

1. Explain the difference between two-tier and three-tier application architectures. Which is better suited for web applications? Why? [3 + 1]

2. Consider the following relation. List all the non-trivial functional dependencies satisfied by this relation. Determine if this relation is in BCNF. [2 + 2]

ID	**Name**	**Age**	**Dept_name**
100	Alex	23	CSE
101	Elena	24	CSE
102	John	24	PHY
103	Alex	23	CHE
104	Claire	24	CSE
105	Nick	24	PHY
106	Rafael	25	CSE
107	Sean	23	CHE
108	Nick	22	CSE
109	Roger	23	CSE
110	John	23	CHE

3. What type of databases should be used in the following systems? Give your reasoning.
   a. Library management system
   b. Social network such as Facebook, LinkedIn etc.
   c. Payment gateway such as eSewa, Khalti etc.
   d. Data analytics system where a lot of aggregations need to be performed

4. Suppose two users are trying to reserve a seat in a flight reservation system. How does the system prevent both users from selecting the same seat? Write about any two problems that can arise when transactions are allowed to execute concurrently. [2 + 2]

5. Write about authorization mechanisms in relational database systems. Explain the importance of authorization in database systems. [3 + 1]

6. Consider the following schedule. Let the consistency requirement be A = 0 OR B = 0, with A = B = 0 as the initial values.
   a. Is this schedule conflict-serializable? [2]
   b. Check if every serial execution involving these two transactions preserves the consistency of the database. [2]

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

7. Write short notes on *ANY TWO*: [2 + 2]
   a. History of database systems
   b. Types of join
   c. ACID consistency vs. eventual consistency

SECTION "C"
[2 Q. × 8 = 16 marks]

Attempt *ANY TWO* questions.

8. Answer the following questions:
   a. Explain why log records for transactions on the undo-list must be processed in reverse order, whereas redo is performed in a forward direction. [2]
   b. What are the advantages of having checkpoints in the log records? [2]
   c. Consider the following log records. During the recovery after system failure, which transactions will be redone and which transactions will be undone? What will be the value of the data items A, B, C, and D after recovery? [2 + 2]

<T0 start>
<T0, B, 2000, 2050>
<T0, C, 700, 600>
<T1 start>
<T1, C, 600, 400>
<T0, C, 400, 500>
<T2 start>
<T1 commit>
<T0, A, 400, 10>
<checkpoint {T0, T2}>
<T0, B, 2050, 4000>
<T3 start>
<T2 commit>
<T3, D, 200, 2000>

9. Consider the following tables:
movie(id, title, genre)
book(id, title, category)
user(id, name, gender)
book_rating(user_id, book_id, rating)
movie_rating(user_id, movie_id, rating)
based_on(movie_id, book_id)

a. The table user_rating contains users' ratings for books. The rating values can be 1, 2, 3, 4 or 5. Write an SQL script to create this table. Constraints on rating values, as well as other constraints must be clearly specified. [2]

b. Give an expression in relational algebra for the following query: [2]
   i. Find the name of all female users.
   ii. Find the title of all movies that have received 5-star rating.

c. Give an expression in SQL for the following queries: [2 + 2]
   i. Find all movies that are based on at least one book with 5-star rating.
   ii. Find genre-wise rating of movies.

10. Construct an ER diagram for a university library considering the following constraints:
- A book can be added or removed from the library.
- Only members can borrow books.
- It is mandatory to make a payment for the membership.
- Two different types of memberships are offered - General and Premium.
- Each member can check out at most 10 books.
- General members will have to return a book after 1 month whereas Premium members will have 3 months to return a book. If they fail to return the book by the due date, they will have to pay a certain amount as penalty.
- Members are also allowed to request the library to purchase books not available in the library.

Your ER model should have at least 4 entity sets. Clearly show mapping cardinalities, primary keys, and participation types. [5]

Identify the following in your ER diagram: [1 + 1 + 1]

a. Weak entity sets and strong entity sets
b. many-to-many relationships, many-to-one relationships, and one-to-one relationships
c. Total and partial participation of entity sets in a relationship