

Faculty of Engineering / Science

End Semester Examination May 2025

CS3CO39 / BC3CO65 Database Management Systems

Programme	:	B.Tech. / B.Sc.	Branch/Specialisation	:	CSE All / CS
Duration	:	3 hours	Maximum Marks	:	60

Note: All questions are compulsory. Internal choices, if any, are indicated. Assume suitable data if necessary.
 Notations and symbols have their usual meaning.

Section 1 (Answer all question(s))				Marks CO BL
Q1. In the basic ER and relational models, which of the following is incorrect?				1 2 2
<input type="radio"/> An attributes of an entity can have more than one value		<input type="radio"/> An attribute of an entity can be composite		
<input checked="" type="radio"/> In a row of a relational table, an attribute can have more than one value		<input type="radio"/> In a row of a relational table, an attribute can have exactly one value or a NULL value		
Q2. In the Entity-Relationship Model, a relationship is typically represented by:				1 1 1
<input type="radio"/> Circle		<input type="radio"/> Diamond		
<input type="radio"/> Rectangle		<input type="radio"/> Ellipse		
Q3. Which of the following is a fundamental operation in relational algebra?				1 1 1
<input type="radio"/> Set intersection		<input type="radio"/> Natural join		
<input type="radio"/> Assignment		<input checked="" type="radio"/> None of the above		
Q4. Which join condition contains an equality operator?				1 1 1
<input checked="" type="radio"/> Equijoins		<input type="radio"/> Cart		
<input type="radio"/> Natural		<input type="radio"/> Left Outer Join		
Q5. In which normal form is a relation if it is in 1NF and all non-key attributes are fully functionally dependent on the primary key?				1 2 2
<input type="radio"/> Fourth Normal Form (4NF)		<input type="radio"/> Fifth Normal Form (5NF)		
<input checked="" type="radio"/> Second Normal Form (2NF)		<input type="radio"/> First Normal Form (1NF)		
Q6. A _____ is an indirect functional dependency, one in which $X \rightarrow Z$ only by virtue of $X \rightarrow Y$ and $Y \rightarrow Z$.				1 2 2
<input type="radio"/> Multivalued Dependencies		<input type="radio"/> Join Dependency		
<input type="radio"/> Trivial Functional Dependency		<input checked="" type="radio"/> Transitive Dependencies		
Q7. In case of any shut down during transaction before commit which of the following statement is done automatically?				1 1 1
<input type="radio"/> View		<input type="radio"/> Commit		
<input checked="" type="radio"/> Rollback		<input type="radio"/> Flashback		
Q8. Consider the following action: TRANSACTION..... Commit; ROLLBACK; What does Rollback do?				1 3 3
<input type="radio"/> Undoes the transactions before commit		<input type="radio"/> Clears all transactions		
<input type="radio"/> Redoes the transactions before commit		<input checked="" type="radio"/> No action		

Q9. What are the steps involved in fetching the data from the database in query processing?

1 2 2

- Parsing and translation
- Optimization
- Evaluation
- All of the above

Q10. Where is data warehousing used?

1 2 2

- Logical system
- Transaction system
- Decision support system
- None of the above

Section 2 (Answer all question(s))

Q11. Explain the concept of data independence with the help of example.

Marks CO BL

2 2 2

Rubric	Marks
Definition of data independence and Examples	2

Q12. What are the advantages of DBMS over traditional file-based systems?

3 2 2

Rubric	Marks
Six advantages of DBMS over traditional file-based systems.	3

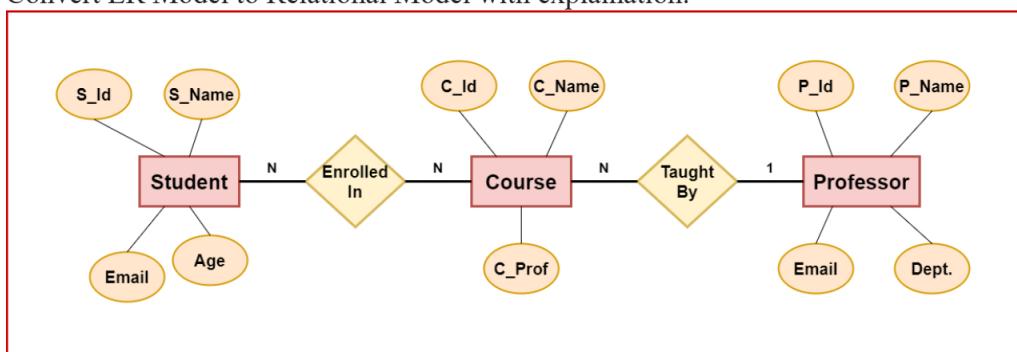
Q13. (a) Explain the overall architecture of database management system with help of diagram.

5 2 2

Rubric	Marks
Overall architecture of database management system and explanation of Overall architecture of database management system	5

(OR)

(b) Convert ER Model to Relational Model with explanation.



Rubric	Marks
Convert ER Model to Relational Model with explanation.	5

Section 3 (Answer all question(s))

Marks CO BL

2 1 1

Q14. Explain any four operation of relational algebra.

Rubric	Marks
Four concepts of relational algebra.	2

Q15. Explain different database language with the help of examples.

3 3 3

Rubric	Marks
Explain five different database language with the help of examples.	3

Q16. (a)

Consider the following schema:

```

Suppliers (sid : integer, sname : string, address : string)
Parts (pid : integer, pname : string, color : string)
Catalog (sid : integer, pid : integer, cost : real)

```

The key fields are underlined and domain of each field is listed after the field name.

Write the relational algebra for following questions.

- (i) Find the name of suppliers who supply some red parts.
- (ii) Find the sids of suppliers who supply some red or green parts.
- (iii) Find the sids of suppliers who supply some red part or are at 221 packer Ave.
- (iv) Find the sids of suppliers who supply some red part and some green part.
- (v) Find the sids of suppliers who supply every part

Rubric	Marks
<p>1. Find the name of suppliers who supply some red parts. We first find the pids of parts that are red in color and then we compute the natural join of this with catalog from this we project sid which gives ids of the supplier who supply some red part, then we take the natural join of this with supplier and project names which gives us the names of suppliers who supply some red part Step 1 : R1 = $\pi_{pid}(\sigma_{color = 'red'} \text{parts})$ Step 2 : R2 = $\pi_{sid}(R1 \bowtie \text{Catalog})$ Step 3 : R3=$\pi_{name}(R2 \bowtie \text{Suppliers})$ Required answer is R3</p> <p>2. Find the sids of suppliers who supply some red or green parts. Step1: R1 = $\pi_{pid}(\sigma_{color = 'red' \vee 'green'} \text{parts})$ Step 2 : R2 = $\pi_{sid}(R1 \bowtie \text{Catalog})$ Same as above one but here we have to choose red or green parts and we have to have sids of suppliers so we can stop after step 2 after choosing parts either in red color or green color</p> <p>Find the sids of suppliers who supply some red part or are at 221 packer Ave.</p> <p>Sids of suppliers who supply some red part Step 1 : R1 = $\pi_{pid}(\sigma_{color = 'red'} \text{parts})$ Step 2 : R2 = $\pi_{sid}(R1 \bowtie \text{Catalog})$ Sids of suppliers who are at 221 packer Ave Step 1 : R3 = $\pi_{sid}(\sigma_{address = '221 packer Ave'} \text{Suppliers})$ Therefore sids of suppliers who supply some red part or are at 221 packer Ave Is R2 U R3</p> <p>Find the sids of suppliers who supply some red part and some green part</p> <p>A) R1 = $\pi_{sid}(\pi_{pid}(\sigma_{color = 'red'} \text{parts}) \bowtie \text{Catalog})$ R2 = $\pi_{sid}(\pi_{pid}(\sigma_{color = 'green'} \text{parts}) \bowtie \text{Catalog})$ From question one we get the sids of suppliers who supply some red part (R1) Similarly R2 is the sids of suppliers who supply some green part Required list of sids who supply some red and some green part is R1 Intersection R2</p> <p>Find the sids of suppliers who supply every part</p> <p>A) R1=$\pi_{sid,pid}(\text{Catalog})$ R2=$\pi_{pid}(\text{Parts})$ R1/R2 give us the required list of sids of suppliers who supply every part</p>	5

(OR)

- (b) Create a database trigger for a table Employee that automatically updates the last_updated timestamp column whenever a record is modified.

5 3 3

```
CREATE TABLE Employee (
    emp_id INT PRIMARY KEY,
    emp_name VARCHAR(100),
    department VARCHAR(50),
    salary DECIMAL(10, 2),
    last_updated TIMESTAMP
);
```

Answer the following questions:

- Write a BEFORE or AFTER trigger to automatically update the last_updated column with the current timestamp whenever any row in the Employee table is updated.
- Explain the purpose of the trigger and when it will be fired.

Rubric	Marks
<pre>CREATE TRIGGER update_employee_last_updated AFTER UPDATE ON Employee FOR EACH ROW BEGIN UPDATE Employee SET last_updated = CURRENT_TIMESTAMP WHERE emp_id = OLD.emp_id; END;</pre>	5

Purpose of the Trigger:
 Purpose: The trigger ensures that the last_updated timestamp reflects the time when the record was last modified. This is useful for tracking changes and maintaining an audit trail in the database.
 When it will fire: The trigger will be fired immediately after any update on the Employee table. If any field in the row is updated (including emp_name, department, or salary), the trigger will update the last_updated column for that specific row.

Section 4 (Answer all question(s))

Marks CO BL

- Q17. What do you understand by key concepts of database? Explain different types of key constraints.

2 2 2

Rubric	Marks
Explanation of key concepts of database. Different types of key constraints.	2

- Q18. What is decomposition? Differentiate different type of decompostion and also explain the dependancy preservation.

3 2 2

Rubric	Marks
Explaintion of decomposition. Differentiate different type of decompostion, Explanation of dependancy preservation	3

Q19. (a) Consider the schema R=(A, B, C, D, E, F) on which the following functional dependencies hold:

$$A \rightarrow B$$

$$B,C \rightarrow D$$

$$E,F \rightarrow C$$

$$D \rightarrow A$$

What are the candidate keys of R ?

Rubric	Marks
A set of attributes S is candidate key of relation R if the closure of S is all attributes of R and there is no subset of S whose closure is all attributes of R. Closure of AEF, i.e. $AEF^+ = \{ABCDEF\}$ Closure of BEF, i.e. $BEF^+ = \{ABCDEF\}$ Closure of DEF, i.e. $DEF^+ = \{ABCDEF\}$	5

(OR)

(b) Consider the following unnormalized table storing information about students and their enrolled courses:

StudentID	StudentName	CourseID	CourseName	InstructorName
101	John	CSE101	Database Systems	Dr. Smith
101	John	CSE102	Data Structures	Dr. Brown
102	Alice	CSE101	Database Systems	Dr. Smith
103	Bob	CSE103	Algorithms	Dr. White

Functional Dependencies are $\text{StudentID} \rightarrow \text{StudentName}, \text{CourseID} \rightarrow \text{CourseName}, \text{InstructorName}$

Normalize the given table up to Third Normal Form (3NF). Show all intermediate steps (1NF, 2NF, 3NF) and explain the rationale behind each step.

Rubric	Marks
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1NF

Step 1: Convert to 1st Normal Form (1NF)

1NF: The table must have atomic values (no repeating groups or arrays), and each record must be unique.

Changes:

The table already has atomic values (no repeating groups).

However, the combination of StudentID and CourseID can create duplicates if the same student enrolls in multiple courses. So, we keep the original table as is (since each record is unique based on the combination of columns).

1NF

Table:

StudentID	StudentName	CourseID	CourseName	InstructorName
101	John	CSE101	Database Systems	Dr. Smith
101	John	CSE102	Data Structures	Dr. Brown
102	Alice	CSE101	Database Systems	Dr. Smith
103	Bob	CSE103	Algorithms	Dr. White

2NF

Step 2: Convert to 2nd Normal Form (2NF)

2NF: The table is in 1NF and does not contain any partial dependencies. A partial dependency occurs when a non-prime attribute depends on part of a candidate key.

Identify the candidate key:

The candidate key is (StudentID, CourseID) because it uniquely identifies each record.

Partial Dependency:
StudentName depends only on StudentID.

CourseName and InstructorName depend only on CourseID.

This means StudentName is partially dependent on StudentID, and CourseName and InstructorName are partially dependent on CourseID.

Remove Partial Dependencies:
We split the original table into two tables:

A Student Table containing student information (StudentID and StudentName).

A Course Table containing course information (CourseID, CourseName, InstructorName).

2NF

Tables:

Student	Table:
StudentID	StudentName
101	John
102	Alice
103	Bob

Course	Table:
CourseID	CourseName

CourseID CourseName InstructorName	5
CSE101 Database Systems Dr. Smith	
CSE102 Data Structures Dr. Brown	
CSE103 Algorithms Dr. White	

Enrollment Table:

StudentID CourseID
101 CSE101
101 CSE102
102 CSE101
103 CSE103

3NF

Step 3: Convert to 3rd Normal Form (3NF)

3NF: The table is in 2NF and does not contain any transitive dependencies. A transitive dependency occurs when a non-prime attribute depends on another non-prime attribute.

Transitive Dependencies:

In the Course Table, InstructorName depends on CourseID, which is fine. However, there are no transitive dependencies within this schema, as InstructorName is directly related to CourseID.

Since there are no transitive dependencies, the schema is already in 3NF.

Final 3NF Tables:

Student Table:

StudentID StudentName
101 John
102 Alice
103 Bob

Course Table:

CourseID CourseName InstructorName
CSE101 Database Systems Dr. Smith
CSE102 Data Structures Dr. Brown
CSE103 Algorithms Dr. White

Enrollment Table:

StudentID CourseID
101 CSE101
101 CSE102
102 CSE101
103 CSE103

Section 5 (Answer all question(s))

Q20. What is a database transaction? Explain its ACID properties.

Marks CO BL
3 2 2

Rubric	Marks
Explanation of database transaction. Explanation of ACID properties	3

Q21. (a) Discuss the concepts of "Recoverability" and "Serializability" in database systems. How do these concepts ensure the correctness and consistency of transactions in multi-user environments? Provide examples.

7 4 4

Rubric	Marks
Discuss the concepts of "Recoverability" and "Serializability" in database systems, How do these concepts ensure the correctness and consistency of transactions in multi-user environments? Provide examples.	7

(OR)

(b) Explain the different locking protocols used in database systems for concurrency control. Discuss the following types of locks: Shared lock, Exclusive lock, and Intention lock. How do these protocols help avoid common concurrency problems like "lost updates," "temporary inconsistency," and "uncommitted data"?

Rubric	Marks
Explain the different locking protocols used in database systems for concurrency control. Discuss the following types of locks: Shared lock, Exclusive lock, and Intention lock. How do these protocols help avoid common concurrency problems like "lost updates," "temporary inconsistency," and "uncommitted data"?	7

Section 6 (Answer any 2 question(s))

Marks CO BL

Q22. What is query optimization in database systems? Explain the key strategies used for query optimization, including the use of indexes, cost-based optimization, and heuristic-based optimization.

5 5 2

Rubric	Marks
What is query optimization in database systems. Explain the key strategies used for query optimization, including the use of indexes, cost-based optimization, and heuristic-based optimization.	5

Q23. Explain the concept of a hash function in database systems. Discuss the differences between static and dynamic hashing techniques.

5 5 2

Rubric	Marks
Explain the concept of a hash function in database systems. Discuss the differences between static and dynamic hashing techniques.	5

Q24. What do you understand by data warehouse and data mining?

5 5 2

Rubric	Marks
Explain Data Warehouse, Explain Data Mining	5
