



Shirpur Education Society's
R. C. PATEL INSTITUTE OF TECHNOLOGY, SHIRPUR

An Autonomous Institute
(Affiliated to Dr. Babasaheb Ambedkar Technological University, Lonere)



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Programme: B.Tech in Computer Science and Engineering (Data Science) **Year: II/Semester III (A.Y: 2024-2025)**

Subject: Database Systems

Time: 02:30 pm - 04:30 pm (02:00 Hrs.)

Date: 22 Mar 2025

Max Marks: 60

RE END SEMESTER EXAMINATION ODD SEM-III March-2025

Instructions:

1. This question paper contains 4 pages
2. Answer to each new question to be started on a fresh page.
3. Figure in right hand side indicates full marks
4. All questions are compulsory+
5. Assume suitable data if required
6. Draw the neat labelled diagrams, whenever necessary

1. 15
A. Create an ER diagram for a college management system by identifying the main entities, their attributes, and how they are related. Clearly show the connections with the right cardinalities and constraints. 5
B. 10
1. Given an empty B-tree of order 4, insert the following keys one by one: 15, 30, 50, 5, 10, 40, 20. Illustrate each step of insertion, including any necessary node splits, and show the final structure of the B-tree. What are the limitations of hashing? 10

----- **OR** -----

2. 10
1. Given a B+ tree of order 4, insert the keys 3, 8, 14, 18, 22 in sequence. Show the B+ tree at each step. Describe the purpose of a secondary index in improving data retrieval in a database. 10
2. 15
A. Analyze the roles of Data Control Commands (DCL), such as GRANT and REVOKE, compared to Transaction Control Commands (TCL) like COMMIT and ROLLBACK. 5
B. 10
1. Given the following database schema: 10
 - students (student_id, student_name, course_i
 - courses (course_id, course_name
 - grades (grade_id, student_id, grade_valu
 - instructors (instructor_id, instructor_name, course_i

Write SQL queries to:

 1. Find the names of all students along with their course names using a join between students and courses.
 2. Retrieve the names of students who have received grades, including their total grade value, by joining students and grades.
 3. List the names of all courses along with their instructors using a join between courses and instructors. Display all courses, even those that do not have an assigned instructor.
 4. Find the names of students enrolled in the 'Mathematics' course who have received grades greater than 80 using joins between students, courses, and grades.

----- OR -----

2. Given the following database schema:

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- events (event_id, event_name, organizer_id)
- organizers (organizer_id, organizer_name)
- attendees (attendee_id, event_id, attendance_date)
- venues (venue_id, venue_name, event_id)

Write SQL queries to:

- List the names of events organized by 'Sarah Lee' using a nested query that first selects the organizer_id of 'Sarah Lee' from the organizers table and then uses this result to filter events in the events table.
- Find the names of venues that are hosting at least one event by first selecting unique event_id values from the events table and then using this result to filter the venues table.
- Retrieve the names of events that have attendees using a nested query to select unique event_id values from the attendees table and use these values to filter events in the events table.
- List the names of organizers who have organized at least one event by first selecting unique organizer_id values from the events table and then using this result to filter the organizers table.

3.

15

A. Define serializability in database transactions. Analyze how enforcing serializability ensures correctness in concurrent executions.

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B. .

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1. Analyze the term transitive dependency and explain how it impacts database normalization. Normalize the following table to Third Normal Form (3NF):

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Employee_ID	Department_ID	Department_Name	Manager_ID	Manager_Name
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Assume the following functional dependencies are given:

1. **Employee_ID → Department_ID, Manager_ID**
(Each employee is assigned to a specific department and manager)
2. **Department_ID → Department_Name, Manager_ID**
(Each department has a unique name and manager)
3. **Manager_ID → Manager_Name**
(Each manager has a unique name)

----- OR -----

2. Describe the Second Normal Form (2NF) and analyze how it differs from 1NF in terms of dependency elimination. For the table below normalize it to 2NF:

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Student_ID	Course	Instructor	Instructor_Office	Course_Hours
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Functional dependencies:

- Student_ID, Course → Instructor, Instructor_Office, Course_Hours
- Course → Instructor, Instructor_Office, Course_Hours

4. • 15

A. Give a comparative analysis between ACID and BASE in terms of consistency and scalability. 5

B. 10

1. Explain the STAR schema design. Describe its key principles and highlight its main 10

advantages. Scenario: A retail chain wants a simplified data structure to analyze sales data, ensuring high query performance and user-friendly navigation for business analysts.

Design a STAR schema with at least three dimension tables and one fact table, and briefly describe your design choices.

----- OR -----

2. Compare and contrast the different OLAP models (ROLAP, MOLAP, HOLAP) and 10

highlight the unique advantages of each model. Scenario: An online marketplace wants to analyze its product performance data by category, region, and time. Describe how the roll-up operation could be used to summarize this data and provide an example to illustrate.

