



Sant Dnyaneshwar Shikshan Sanstha's
Annasaheb Dange College of Engineering and Technology,
Ashta
 (An Empowered Autonomous Institute, Affiliated to Shivaji University,
 Kolhapur)



Department of Artificial Intelligence & Data Science

NOTICE 3

ISE-2: Scenario-Based Learning on Database Performance, Concurrency & Recovery (20 Marks)

Academic Year: 2025 - 26	Class SY	Date Sem:	30/04/2026 Course Code: 1ADPC210
Course Name: Database Management System		Course Coordinator: Dr. Asma Shaikh	

All students are hereby informed that ISE-2 for the course 1ADPC210 – Database Management Systems will be conducted as per the following details:

Activity: Scenario-Based Learning on Database Performance, Concurrency & Recovery

Date: 30 April 2026

Mode: Group Activity

Description:

Students are required to:

Analyze real-world database scenarios

Apply concepts of file organization, indexing, concurrency control, and recovery mechanisms

Submit:

Project report

Screenshots/results

Group presentation/demo

★ Note:

Group formation and detailed guidelines will be communicated separately.

This activity carries 20 marks under internal assessment.

— Course Coordinator

Department of Artificial Intelligence & Data Science



Annasaheb Dange College of Engineering and Technology

Ashta, Dist: Sangli-416301

(An Autonomous Institute Affiliated to Shivaji University, Kolhapur)

Department of Artificial Intelligence & Data Science

Rubrics for ISE 2 Activity 1 Assessment

Academic Year: 2025-26	Sem: Even	Class: SY B.Tech	Teaching Scheme: 03 Hrs/Week	Total Credits: 04
Course: Database Management System	Course Code: 1 ADPC210			
Course Coordinator: Dr. Asma Shaikh	Assessment - ISE-2(Activity 1): Scenario based learning			

1ADPC210_4 Apply file organization and indexing techniques to improve system performance, transaction management, and concurrency control in a database system.

1ADPC210_5 Use concepts of indexing, concurrency protocols, and recovery algorithms with real-world examples.

Competencies	CO , POs	Performance Levels				Marks
		Excellent [10]	Very Good [8-10]	Good [6-8]	Satisfactory [3-5]	Poor [0-2]
Knowledge Domain	1ADPC210_4 -Apply file organization and indexing techniques to improve system performance, transaction management, and concurrency control in a database system.	Clearly understands and explains the given database scenario with correct concepts.	Understands the scenario with minor conceptual gaps.	Basic understanding but explanation is partially correct.	Limited understanding of the scenario.	Unable to understand or explain the scenario.
	1ADPC210_5-Use concepts of indexing, concurrency protocols, and recovery algorithms with real-world examples.	Demonstrates correct and optimized SQL queries using DBMS tools effectively.	Demonstrates mostly correct SQL queries with minor errors.	Applies basic concepts but solution is partially correct.	Limited application of database concepts.	Unable to apply relevant database concepts.
Skill Domain	Engineering Tool Usage	Writes fully correct and optimized SQL queries retrieving all required information accurately	Writes mostly correct SQL queries with minor errors	Demonstrates basic SQL queries with partial correctness	Queries are incomplete or incorrect	Unable to write meaningful SQL queries
Affective domain	Communication	Clear explanation, confident presentation, and good use of examples or visuals	Good explanation with minor clarity issues.	Provides partial or limited explanation of SQL queries	Explanation is unclear or poorly linked to the SQL query	Fails to explain the SQL query meaning

Course Coordinator: 	Academic Coordinator: 	Head of Department: 
---	---	---

DBMS Activity: Scenario Bank

Roll no: 1 to 5

1. E-Commerce Flash Sale System

Problem: High traffic during sales.

Issues: Slow queries, duplicate orders, crashes.

Tasks: Indexing, concurrency control, recovery.

Roll no – 6 to 10

2. Banking Transaction System

Problem: Multiple transactions.

Issues: Lost updates, inconsistency, failures.

Tasks: 2PL, ACID, recovery.

Roll no – 11 to 15

3. Hospital Management System

Problem: Patient data access.

Issues: Slow retrieval, inconsistency, data loss.

Tasks: File organization, indexing, recovery.

Roll no – 16 to 20

4. Railway Reservation System

Problem: Ticket booking.

Issues: Double booking, deadlocks, crash.

Tasks: Concurrency, serializability, recovery.

Roll no – 21 to 25

5. Payment Gateway System

Problem: High volume transactions.

Issues: Duplicate payments, inconsistency, crash.

Tasks: ACID, indexing, log recovery.

Roll no – 26 to 30

6. LMS Platform

Problem: Many users.

Issues: Slow content load, concurrent submissions, crash.

Tasks: Indexing, concurrency, backup.

Roll no – 31 to 35

7. Ride Sharing System

Problem: Driver matching.

Issues: Slow search, duplicate booking, crash.

Tasks: Indexing, concurrency, recovery.

Roll no – 36 to 40

8. Inventory System

Problem: Stock management.

Issues: Incorrect stock, slow query, inconsistency.

Tasks: Indexing, concurrency, recovery.

Roll no – 41 to 45

9. Airline Reservation

Problem: Flight booking.

Issues: Double booking, deadlocks, crash.

Tasks: Locking, deadlock handling, recovery.

Roll no – 45 to 50

10. Online Auction System

Problem: Real-time bids.

Issues: Concurrent bids, wrong winner, crash.

Tasks: Timestamp/locking, recovery.

Roll no – 51 to 55

11. Smart Traffic System

Problem: Real-time data.

Issues: Slow retrieval, concurrency, data loss.

Tasks: Indexing, concurrency, recovery.

Roll no – 56 to 60

12.Digital Library

Problem: Book management.

Issues: Slow search, multiple issuing, inconsistency.

Tasks: Indexing, concurrency, recovery.

Roll no – 61 to 65

13.Online Food Ordering During Peak Hours

Problem: A food delivery platform handles surge orders during peak hours.

Issues: Slow query response, duplicate orders, system crash.

Tasks: indexing for search, concurrency control, recovery mechanism.

Roll no – 66 to 70

14.Stock Market Trading System

Problem: A trading platform processes real-time buy/sell orders.

Issues: High load, concurrent transactions, incorrect trade execution, system failure.

Tasks: indexing, concurrency control (timestamp/locking), recovery.

Roll no – 71 to 73

15.Online Voting System

Problem: Secure voting system for elections.

Issues: duplicate voting, high concurrency, system crash before submission.

Tasks: constraints, transaction management, recovery mechanism.



Annasaheb Dange College of Engineering and Technology, Ashta
(An Empowered Autonomous Institute affiliated to Shivaji University, Kolhapur)
(NAAC A++ Grade Accredited Institute, NBA Accredited Program)
Department of Artificial Intelligence and Data Science

Date : 21/04/2026

Subject : DBMS

ISE 2

Student Worksheet

Activity 3: Scenario-Based Learning on Database Performance, Concurrency & Recovery

Date of Presentation 30/04/2026

Group Details :

Group No: 5

Members Name & Roll No:

1. Sanika Uday Pawar Rollno. :2016
2. Sumit Chandrasen Thorat Rollno. :2017
3. Sarang Satish Patil Rollno. :2018
4. Kunal Maruti Shitole Rollno. :2019
5. Rushikesh Shashik ant Kaware Rollno. :2020

Part A: Scenario Understanding (Knowledge Domain – CO4)

1. Brief Description of Scenario

The Indian Railway Reservation System is a large-scale, high-traffic database application that manages seat availability, ticket bookings, passenger information, train schedules, and payment transactions. Thousands of users simultaneously attempt to book, cancel, or check ticket availability for limited seats on trains. The system must ensure that no two passengers are allotted the same seat (double booking), handle system crashes gracefully without data loss, and resolve conflicts when multiple transactions compete for the same resource — all while maintaining fast query response times.

2. Identify Problems

Problem Identified	Type	Impact on System
Double booking of same seat by two concurrent users	Concurrency	Data inconsistency; passenger conflict and financial loss
Deadlock between transactions (User A waits for Seat B; User B waits for Seat A)	Concurrency	System hangs; no booking confirmed; poor user experience
Slow queries on large Booking/Passenger tables during peak hours	Performance	High response time; bottleneck; users drop off
System crash mid-transaction (payment deducted, seat not allocated)	Recovery	Partial update; loss of payment data; inconsistent state

Part B: Solution Design (Application Domain – CO5)

3. Proposed Database Design Solutions

Component	Selected Technique	Justification (Why?)
File Organization	Clustered B+ Tree on Train_No	Booking records for same train stored physically together — reduces disk I/O for availability queries
Indexing Technique	B+ Tree on (Train_No, Journey_Date); Bitmap on Seat_Status	B+ Tree supports efficient range scans; Bitmap suits low-cardinality status column with bitwise operations
Concurrency Control	Strict 2PL + Wait-For Graph (Deadlock Detection)	Strict 2PL guarantees serializability; Wait-For Graph detects deadlocks and aborts victim transaction
Recovery Mechanism	ARIES with Write-Ahead Logging + Checkpointing	WAL guarantees durability; checkpointing reduces REDO scan length during crash recovery

4. How the Solution Solves the Problem

Double booking is prevented by acquiring an Exclusive Lock (SELECT FOR UPDATE) before any seat update — two transactions can never write the same seat simultaneously. Deadlocks are resolved by the Wait-For Graph: when a cycle is detected, the youngest transaction is aborted and retried. Performance is improved via B+ Tree indexes on Train_No and Journey_Date, eliminating full-table scans. For crash recovery, WAL ensures every change is logged before it touches data pages. On restart, ARIES runs Analysis → REDO → UNDO phases, restoring committed data and rolling back partial transactions — guaranteeing full ACID compliance.

Part C: SQL / Implementation (Skill Domain)

5a. Table Creation

```
--
-- QUERY 1: TABLE CREATION ||
--

-- Table 1: Train
CREATE TABLE Train (
  Train_No  INT      PRIMARY KEY,
  Train_Name VARCHAR(100) NOT NULL,
  Source    VARCHAR(50),
  Destination VARCHAR(50),
  Total_Seats INT      NOT NULL
);

-- Table 2: Passenger
CREATE TABLE Passenger (
  Passenger_ID INT      PRIMARY KEY,
  Name         VARCHAR(100) NOT NULL,
  Age          INT,
  Contact      VARCHAR(15)
);
```

```

    Passenger_ID = 1001
WHERE  Train_No  = 12345
    AND  Journey_Date = '2026-05-01'
    AND  Seat_No   = 42
    AND  Seat_Status = 'Available';

```

```

-- SHRINKING PHASE: All locks released on COMMIT (Strict 2PL)
COMMIT;

```

```

-- —— Result ——

```

```

-- T2 was waiting → now reads Seat_Status = "Booked" → cannot book → no double booking.

```

5d. Recovery – COMMIT / ROLLBACK (WAL + ARIES)

```

--
-- QUERY 4: RECOVERY (WAL + ARIES) ||
--

```

```

-- Scenario: User pays ₹850. If crash occurs before seat is allocated,
-- ARIES must roll back both steps to keep DB consistent.

```

```

BEGIN TRANSACTION;

```

```

-- STEP 1: Deduct payment from wallet
-- WAL: Log record written to DISK before data page is updated

```

```

UPDATE Wallet
SET  Balance = Balance - 850
WHERE Passenger_ID = 1001;

```

```

-- STEP 2: Confirm seat booking
-- WAL: Another log record written before this data page update

```

```

UPDATE Booking
SET  Seat_Status = 'Booked',
     Passenger_ID = 1001
WHERE Train_No  = 12345
    AND  Journey_Date = '2026-05-01'
    AND  Seat_No   = 42;

```

```

-- —— If both steps succeed ——

```

```

COMMIT; -- LSN flushed; checkpoint updated; changes are DURABLE

```

```

-- —— If system crashes before COMMIT ——

```

```

-- ARIES Recovery runs automatically on restart:

```

```

--
-- Phase 1 – ANALYSIS : Scan log from last checkpoint.
--                      Identify dirty pages & active transactions.
--

```

```

-- Phase 2 – REDO    : Replay ALL logged operations (even uncommitted)
--                      to reach the exact state at crash time.
--

```

```

-- Phase 3 – UNDO    : Roll back all uncommitted transactions
--                      using Compensation Log Records (CLRs).
--

```

```

-- Result: Wallet balance RESTORED; Seat_Status = "Available" again.

```

```

-- —— Explicit rollback on application-level error ——

```

```

ROLLBACK; -- Undoes all changes; releases all locks

```

Total	35	
-------	----	--

Instructions: Fill all sections clearly | Avoid copy-paste | Justify your answers | Write at least 4 SQL queries | Be ready to present



Railway Reservation System

A Database Management System (DBMS) Project

1. Sanku, Uday Pawar

2. Shrutika Chaudhary, Jyoti

3. Srujan, Shubham, Prady

4. Rishabh, Anshuman, Anshu

5. Rishabh, Shashank, Satish

102B01032

102B01034

102B01035

102B01036

102B01048

Subject: Database Management Systems (DBMS)

Introduction to Railway Reservation System



- A Railway Reservation System allows passengers to book, cancel, and manage train tickets online.
- It handles millions of transactions daily across thousands of routes.
- Core operations: seat availability check, ticket booking, payment processing, and cancellation.
- Data is stored in a structured database — records of passengers, trains, seats, and bookings.
- DBMS ensures that all transactions are accurate, consistent, and secure.
- Modern systems like IRCTC handle 7–8 lakh bookings per day in India alone.

7 lakh daily bookings

8000+ train routes

Real-time availability

Online booking

Importance of Database in Reservation Systems



Centralized Data Storage

- All passenger, train, and booking data stored in one place
- Eliminates data duplication
- Easy retrieval and updates



Data Integrity

- Ensures only valid data is stored
- Constraints prevent wrong entries
- Maintains accuracy of records



Multi-User Access

- Thousands of users can book simultaneously
- DBMS handles concurrent requests
- No conflicts or data loss



Security & Authorization

- Only authorized users access sensitive data
- Role-based access control
- Transaction logs for auditing

Problem Statement — Ticket Booking Challenges

Without a proper DBMS, railway reservation faces critical problems:

 Double Booking	Two passengers may get the same seat due to simultaneous booking.
 Deadlocks	Two transactions waiting for each other's resources — system freezes.
 System Crash	Power failure during booking leaves data in inconsistent state.
 Data Inconsistency	Seat count may not reflect actual bookings without proper control.
 Concurrency Issues	Multiple agents booking the last seat simultaneously causes errors.

Double Booking — Explained with Example

What is Double Booking?

- Occurs when two users book the same seat at the same time
- Without locking, both transactions read 'Available' and proceed
- Both get confirmed — but only one seat exists!
- Prevented using Locks, Semaphores, or MVCC in DBMS

Transaction Flow

✓ Locking is used to prevent double booking

Deadlock — Explained with Example

What is a Deadlock?

- A state where two or more transactions are waiting for each other
- Each transaction holds a lock that the other needs — infinite wait
- System neither completes a lock back — it is stuck
- DBMS must detect and resolve deadlocks automatically

Solutions to Deadlock:

- Wait-Die / Wound-Wait Schemes
- Timeout-based rollback
- Deadlock Detection Graphs (Wait-for Graph)
- Lock ordering — always lock resources in same order

Deadlock Diagram

System Crash — Impact & Recovery

What is a System Crash?

- Unexpected failure: power cut, hardware fault, network error
- Transaction in-progress is left incomplete
- Seat may be deducted but booking not confirmed
- Passenger charged but no ticket issued — data inconsistency
- Without recovery, database may become permanently corrupted

Recovery Techniques Used:

✓ Write-Ahead Log (WAL)	✓ Checkpoint Recovery	✓ UNDO / REDO Operations	✓ Shadow Paging
-------------------------	-----------------------	--------------------------	-----------------

Impact of System Crash

Refund processing overhead	Unconfirmed bookings at peak hours	Inconsistent data availability	System unavailable for recovery
----------------------------	------------------------------------	--------------------------------	---------------------------------

Real-Life Scenario — Ticket Booking Story

Scenario: Booking the Last Seat on Mumbai–Delhi Rajdhani Express

She opens IRCTC — sees 1 seat left in 3A coach on Mumbai–Delhi train.	At the same moment, Rahul opens the same train — also sees 1 seat available.	Two concurrent transactions T1 (Priya) and T2 (Rahul) both initiate booking.
Exclusive lock granted to T1 first. T2 is made to wait until T1 commits.	T1 commits — seat marked Booked. T2 needs updated data. No seats available.	T2 is rolled back. Rahul sees 'Seat Not Available' — integrity maintained!

Rollback Identified

Limitations & Challenges

High Setup Cost

DBMS software, hardware infrastructure, and DBA expertise require significant investment.

Performance Overhead

Locking, logging, and concurrency control add overhead — especially under peak load.

Peak Load Issues

Traffic booking time causes millions of hits — server slowdowns still occur (e.g., JRCTC).

Complexity

Schema design, normalization, indexing, and query optimization demand trained professionals.

Single Point of Failure

Centralized DB server — if it goes down, entire booking system becomes unavailable.

Data Security Risks

Sensitive passenger and payment data is a target for cyberattacks and data breaches.

Conclusion

- ✓ Railway Reservation Systems rely heavily on DBMS for reliable, real-time operations.
- ✓ Concurrency Control prevents double booking and data conflicts in high-traffic scenarios.
- ✓ Recovery mechanisms ensure data consistency and business continuity after failures.
- ✓ Serializability guarantees that concurrent transactions produce logically correct results.
- ✓ Together, these DBMS features make reservation systems safe, fast, and trustworthy.

Advantages of DBMS in Railway Reservation



Data Consistency

- All booking records stay accurate.
- No duplicate or conflicting data.
- ACID transactions ensure integrity.



Multi-User Support

- Lakhs of users served simultaneously.
- Concurrent transactions handled safely.
- No degradation in performance.



Fast Recovery

- Logs enable crash recovery in minutes.
- No data loss after system failures.
- Checkpoints reduce recovery time.



Security

- Role-based access (admin, agent, user).
- Encrypted passwords and payment data.
- Audit logs of all transactions.



Reporting & Analytics

- Generate daily booking reports easily.
- Track occupancy per route and date.
- Helps in planning train frequency.



Scalability

- Database scales as demand grows.
- Handles festive season booking spikes.
- Cloud-ready architecture supported.



Annasaheb Dange College of Engineering and Technology,
Ashta, Tal. Walwa, Dist. Sangli, MS, 416301

An empowered autonomous institute affiliated with Shivaji University, Kolhapur.
[Accredited by NAAC with A++, Cycle Second]

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

A. Utilization of KPIs: Faculties

KPI	2025-26	2024-25	2023-24	2022-23	Total
Faculty with Industry exposure(Industry institute interaction, Industry supported projects) (26)	8	6	4	1	19
Faculty Awards & Recognition	8	3	0	0	11

B. Utilization of KPIs: Students

KPI	2025-26	2024-25	2023-24	2022-23	Total
Academic Award recipients	26	1	0	0	27
Internship completion	73	71	0	0	144
Domain specific trainings	1	1	1	0	3
Student club Activities	19	0	0	0	19

C. Quality Assurance Initiatives and Impact

Quality Assurance Practices:

KPI	2025-26	2024-25	2023-24	2022-23	Total
Industry MOUs	2	4	2	0	8
Industry Expert Sessions	7	3	7	1	18
Domain Certification Completion (No. of students)	71	71	131	0	273
Innovation Prototypes Completed	3	2	0	0	5

D. Faculty Contributions

Faculty Professional Contributions:

KPI	2025-26	2024-25	2023-24	2022-23	Total
FDPs/ STTPs Attended	51	41	26	4	122
Industry Collaborations	0	0	0	0	0
Professional Society Memberships	15	4	2	2	23
E- Content developed	1	0	1	0	2
Resource Persons/ Invited Talks	6	1	0	0	7
FDPs/ STTPs Organized	2	2	1	0	5
Students Innovation Projects Guided	3	2	0	0	5



Annasaheb Dange College of Engineering and Technology,

Ashta, Tal. Walwa, Dist. Sangli, MS, 416301

An empowered autonomous institute affiliated with Shivaji University, Kolhapur.
[Accredited by NAAC with A++, Cycle Second]

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

E. Student Performance

Student Academic Performance and Achievements:

KPI	2025-26	2024-25	2023-24	2022-23	Total
GATE Qualified Students	1	0	1	0	2
Student Publications	2	5	0	0	7
Student Project Awards	0	0	0	0	0
National/ State Awards	7	0	0	0	7
Industry Certifications	49	29	0	0	78

F. Student Support and Governance

i) Student Support and Engagement

KPI	2025-26	2024-25	2023-24	2022-23	Total
Total No. of students in the department	220 228	224 223	149 146	73 73	602 670
Total No. of faculties in the department	12	11	8	3	34
Mentor Mentee Ratio					

ii) Student Support and Career Development:

KPI	2025-26	2024-25	2023-24	2022-23	Total
Skill Development Programs conducted	1	1	1	0	3
Student Chapters	0	0	0	0	0
Newsletters published	1	1	1	0	3
Technical Magazines Published	1	0	0	0	1
Career Development Activities	2	2	7	0	11

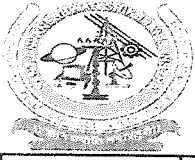
Dr. A.A. Shaikh
HOD, AIDS

Dr. J. M. Kharade
Associate Dean IPQA

Dr. A. A. Jadhav
Dean IPQA

Dr. L. Y. Waghmode
Director

Tejaswini



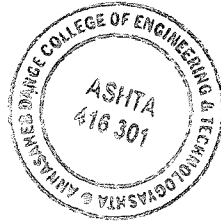
Sant Dnyaneshwar Shikshan Sanstha's
Annasaheb Dange College of Engineering and Technology, Ashta
(An Empowered Autonomous Institute, Affiliated to Shivaji University, Kolhapur)
Department of Artificial Intelligence and Data Science

AD CET

2025 - 2026

Sr.No	Faculty Name	Industry Name	Faculty Supported Name Project
1	Prof.Amruta Awati	Mr.Samdani Iman Khalipha Email – samdanikhali800@gmail.com Contact – 8830359800	Auction Management System
2	Dr. Asma Shaikh	Mr.Prakash Dadaso Jadhav	S/W for inventory management
3	Prof.Smita Patil	Shri Samarth Medical Services	Financial Planning Website Development
4	Prof. Snehal Zargad	Krishna Hari Building, Ground Floor, YCIS Collage Road Near To ST Stand ,Satara	SAHYADRI STUDY CENTER
5	Prof.Priyanka Suryawanshi	Shivaraj Treading Company , Near ST Stand Karad Tal- Karad , Dist- Satara Pin-415110	AI Based Fertilizer Inventory and Sales Management System
6	Dr. Asma Shaikh	Buddy's Mess Ashta, Tal -Walwa, Dist- Sangli Pin 416301	Mess Management System
7	Dr. Krishna Kumar	Sankalp Academy, Near ST Stand , Kasegaon Tal- Walwa , Dist -Sangli pin-415404	Student attendance / data record app"
8	Prof .Vikas Honmane	Near Bharat Bhushan school , miraj , Maharashtra, Pin Code - 416410 . Email – yashodeep00@gmail.com Contact – 9764318010	Academy Website System


Prof. Supriya A. Patil
Mini Project Coordinator [AIDS]




Dr. Asma A. Shaikh
Head of the Department