Indian Institute of Technology Madras Zanzibar

School of Engineering and Science

Z2004: Database Management Systems

BS-DSAI Course Schedule — Even Semester 2026

Z2004 — Database Management Systems

Document 1 of 6 | B.S. Data Science and Artificial Intelligence, Year 2

Even Semester: 2 March 2026 – 24 May 2026 (Instruction) | End-Sem: 29 Jun – 3 Jul 2026

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1. Course at a Glance

Pedagogical Sequence: Blueprint Before Building

This course follows a strict **theory-first** sequence. Students learn to model data (ER diagrams, normalisation, relational algebra) before writing a single SQL statement. SQL is introduced in Week 6, once the conceptual foundations are unshakeable.

Item	Detail	Item	Detail
Course Code	Z2004	Credits	10
Structure	3-1-0-0-6-10	Year / Sem	2nd Year / Even
Lectures	3 per week, 50 min	Tutorials	1 per week, 50 min
Primary DB	SQL Server 2022	Secondary DB	PostgreSQL 16
Quiz 1	Week 6 (Apr)	Quiz 2	Week 12 (May–Jun)
End-Sem	29 Jun – 3 Jul	Project Final	22 Jun 2026

2. Assessment Structure

Component	Weight	Date	Coverage
Quiz 1	15%	Apr 16–18	M1 (ER), M2 (Relational Model), M3 (Rel. Algebra)
Quiz 2	15%	May 23–26	M4–M6 (SQL Basics to Advanced)
End-Sem Exam	40%	Jun 29 – Jul 3	All modules; emphasis M7–M10
Semester Project	20%	Milestones	RAG Pipeline or Recommendation Engine
Assignments (ICA)	10%	Fortnightly	SQL puzzles, schema sketches, think-pair-share
Total	**100%**		

3. Module Overview

#	Module	Weeks	Key Topics
M1	**Foundations and Data Modelling**	1–2	DBMS intro, ER model, weak entities, extended ER
M2	**Relational Model**	3	Relations, schemas, keys, integrity constraints
M3	**Relational Algebra**	4–5	σ, π, $\bowtie$, set ops, division
M4	**SQL Foundations**	6–7	DDL, DML, SELECT, WHERE, ORDER BY
M5	**SQL Intermediate**	8–9	Aggregation, GROUP BY, joins, subqueries
M6	**SQL Advanced**	10	CTEs, window functions, triggers, stored procs
M7	**Normalisation and FD Theory**	11–12	FDs, Armstrong's axioms, 1NF–BCNF, 4NF
M8	**Storage and Indexing**	13	B-Tree, hashing, heap files, buffer pool
M9	**Query Processing and Transactions**	14	Query pipeline, ACID, 2PL, recovery
M10	**Modern and AI Data Systems**	15–17	NoSQL, vector DBs, embeddings, RAG pipelines

4. Week-by-Week Schedule

Holiday Notice

Eid al-Fitr: 19–20 Mar (Thu–Fri). **Good Friday:** 3 Apr. **Easter Monday & Karume Day:** 6–7 Apr. **Union Day:** 26 Apr (Sun — no impact). **Labour Day:** 1 May (Fri). **Eid al-Adha:** 27 May (Wed).
Sessions adjacent to holidays are rescheduled as noted below.

Week	Dates	Sess.	Topic	Activity / Notes
		L1	**Course Introduction; File vs. DBMS**	Why flat files fail; three-schema architecture

Week	Dates	Sess.	Topic	Activity / Notes
		L2	**DBMS Architecture and Roles**	Components; DBA vs. end-user; data independence
1	2–6 Mar	L3	**Data Models Survey**	Hierarchical, network, relational, object — visual timeline
		T1	**Lab 1: Environment Setup**	Install SQL Server 2022 + SSMS; explore sample DB
		L4	**ER Model: Entities and Attributes**	Strong/weak entities; simple/composite/multivalued attrs
		L5	**ER Model: Relationships**	Cardinality ratios; participation; role names
2	9–13 Mar	L6	**Extended ER: ISA, Aggregation**	Specialisation; aggregation design decisions
		T2	**Lab 2: ER Design Practice**	Design ER for university; draw in draw.io; map to tables
		L7	**Relational Model Fundamentals**	Relation; tuple; domain; schema; instance
		L8	**Integrity Constraints**	Entity, referential, domain; superkey; candidate key
3	16–20 Mar	L9	**ER to Relational Mapping**	All 8 mapping rules; worked hospital example
		T3	**Lab 3: Mapping and DDL**	Map ER to DDL; form groups; shortlist project topics
		L10	**Relational Algebra I**	σ, π, ρ, union, intersection, difference
		L11	**Relational Algebra II**	Natural join, theta join, outer joins; expression trees
4	23–27 Mar	L12	**Relational Algebra III**	Division; query equivalence; ICA: write algebra for 5 queries
		T4	**Lab 4: Algebra Drill**	Translate 15 English queries to algebra; verify with SQL; **Milestone 0**: Registration due (27 Mar)
		L13	**Tuple Relational Calculus**	TRC syntax; safe expressions; equivalence with algebra
		L14	**Domain Relational Calculus**	DRC; QBE visual language; comparison with TRC
5	30 Mar–3 Apr	L15	**SQL Introduction: DDL**	`CREATE`, `ALTER`, `DROP`; data types in T-SQL
		T5	**Lab 5: First SQL Statements**	Write DDL for university DB; insert 20 rows; query structure

Week	Dates	Sess.	Topic	Activity / Notes
		L16	**SQL DML: Basic SELECT**	`SELECT`, `FROM`, `WHERE`, `ORDER BY`, `DISTINCT`
		L17	**SQL DML: INSERT, UPDATE, DELETE**	`INSERT`, `UPDATE`, `DELETE`; `TRUNCATE`; transactions
6	6–10 Apr	QUIZ 1 — Thu 16 Apr & Fri 17 Apr		**Coverage: M1–M4. 60 min. Closed book.**
		T6	**Lab 6: DML Practice**	20-query lab on university DB; INSERT/UPDATE/DELETE tasks; **Milestone 1**: Schema & DDL due (10 Apr)
		L18	**SQL Aggregation**	`COUNT`, `SUM`, `AVG`, `MAX`, `MIN`; `NULL` handling
		L19	**GROUP BY and HAVING**	`GROUP BY`; `HAVING`; execution order; common errors
7	13–17 Apr	L20	**SQL JOINs (Inner, Outer, Self)**	`INNER JOIN`, `LEFT/RIGHT/FULL OUTER JOIN`, `SELF JOIN`; visual diagrams
		T7	**Lab 7: Aggregation and Joins**	3 debugging exercises; sales summary report; **Quiz 1 results returned**
		L21	**Subqueries**	Scalar, row, table; `IN`, `EXISTS`, `ALL`, `ANY`
		L22	**Correlated Subqueries**	Step-by-step execution trace; vs. join performance
		L23	**Views and Indexes**	`CREATE VIEW`; updatable views; `CREATE INDEX`
		T8	**Lab 8: Subqueries and Views**	Rewrite 5 queries using subqueries; create and test views
		L24	**CTEs and Recursive Queries**	`WITH`; recursive CTE; org-chart / hierarchy example
		L25	**Window Functions I**	`ROW_NUMBER`, `RANK`, `DENSE_RANK`, `NTILE`
		L26	**Window Functions II**	`LAG`, `LEAD`, `SUM OVER`, `PARTITION BY`
		T9	**Lab 9: Advanced SQL Challenge**	Competitive 5-problem SQL contest; window + CTE tasks
10	11–15 May	L27	**Stored Procedures and Triggers**	`CREATE PROCEDURE`; parameters; `CREATE TRIGGER`; AFTER/INSTEAD OF

Week	Dates	Sess.	Topic	Activity / Notes
		L28	**Transactions in SQL**	`BEGIN TRAN`, `COMMIT`, `ROLLBACK`; isolation levels
		L29	**SQL Security**	`GRANT`, `REVOKE`; roles; row-level security; SQL injection
		T10	**Lab 10: Procs, Triggers, Transactions**	Write 3 stored procedures; simulate deadlock; **Milestone 2**: Dataset & queries due (15 May)
		L30	**Functional Dependencies**	Definition; trivial/non-trivial; closure algorithm
		L31	**Armstrong's Axioms and Canonical Cover**	Reflexivity, augmentation, transitivity; canonical cover steps
		L32	**Normal Forms 1NF – BCNF**	Anomalies illustrated; 1NF, 2NF, 3NF, BCNF with examples
		T11	**Lab 11: Normalisation Drill**	Decompose 5 unnormalised schemas to BCNF
		L33	**4NF, 5NF and Decomposition**	Multivalued deps; lossless-join test; dependency preservation
		L34	**Storage: Disk, Files, and Buffer Pool**	Storage hierarchy; heap files; slotted pages; buffer manager
			QUIZ 2 — Sat 23 May & Tue 26 May	**Coverage: M4–M7. 75 min. One A4 cheat sheet.**
		T12	**Lab 12: Design Theory Synthesis**	Infer FDs from CSV dataset; normalise; generate DDL
		L35	**B-Tree and B$^+$-Tree Indexing**	Structure; search/insert/delete; clustered vs. unclustered
		L36	**Hashing and Secondary Indexes**	Static/dynamic hashing; dense/sparse indexes; index selection
13	1–5 Jun	L37	**Query Processing Pipeline**	Parsing; relational algebra translation; cost estimation
		T13	**Lab 13: Index Performance**	Measure query time before/after indexing; read EXPLAIN ANALYZE; **Milestone 3**: Performance evidence due (5 Jun)
14	8–12 Jun	L38	**Join Algorithms and Query Optimisation**	NL-join, sort-merge, hash join; heuristic vs. cost-based
		L39	**Transaction Model and ACID**	Transaction states; ACID; schedules; serial vs. concurrent

Week	Dates	Sess.	Topic	Activity / Notes
		L40	**Concurrency Control**	Conflict serializability; 2PL; deadlock detection
		T14	**Lab 14: Concurrency Simulation**	Trigger deadlock; observe lock monitor; resolve
		L41	**Crash Recovery**	Log-based recovery; undo/redo; checkpoints; ARIES overview
		L42	**NoSQL Paradigms**	CAP theorem; key-value, document, column-family, graph
		L43	**Vector Databases and Embeddings**	Cosine similarity; HNSW; pgvector; Pinecone
		T15	**Lab 15: MongoDB and Vector Search**	Insert documents; run aggregation; embed 500 docs; nearest-neighbour query
		L44	**RAG Pipeline Architecture**	Ingest-chunk-embed-store-retrieve-generate; full diagram
		L45	**Cloud Databases (One Lecture)**	AWS RDS, Azure SQL, Google Cloud SQL, Supabase; cost models
			Thu 24 Jun: Last Day of Instruction. Course review and Q&A. Final subm	
		T16	**Lab 16: RAG Pipeline**	Build mini RAG using Python + pgvector; test question-answering

5. Project Milestone Summary

MS	Due	Deliverable	Weight	Notes
M0	Fri 27 Mar 2026	**Group Registration + Topic**	0%	Mandatory; late registrations lose 10 marks
M1	Fri 10 Apr 2026	**Schema + DDL Script**	20%	ER diagram + `schema.sql` runs cleanly
M2	Fri 15 May 2026	**Dataset + Queries**	20%	`data.csv/json` + `queries.sql` + `README.md`
M3	Fri 5 Jun 2026	**Performance Evidence**	20%	Max 5-page PDF + `performance.sql`
Final	Mon 22 Jun 2026	**Full Submission**	40%	GitHub link + 5-minute demo video + Q&A

6. End-Semester Examination Schedule

Session	Date	Coverage
End-Semester Exam	Week of 29 Jun – 3 Jul	**Single 3-hour sitting, 100 marks.** All 10 modules. Section A (20 marks): MCQ; Section B (25 marks): ER, Normalisation, RA; Section C (30 marks): SQL Problem Solving (HospitalDB schema); Section D (25 marks): Transactions, NoSQL, Vector DBs, RAG.

Examination Note

The End-Semester Examination is a **single, continuous 3-hour sitting**. All four sections (A, B, C, D) are answered in the same session on the same day. The exact date within the window 29 Jun – 3 Jul 2026 will be communicated no later than two weeks before the exam.

Subject to revision. Changes announced via LMS with 48 hrs notice.

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