



National University of Engineering (UNI)
School of Computer Science
Syllabus 2026-I

1. COURSE

CS271. Data Management (Mandatory)

2. GENERAL INFORMATION

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|-----------------------------------|---|--|
| 2.1 Course | : | CS271. Data Management |
| 2.2 Semester | : | 4 th Semester. |
| 2.3 Credits | : | 4 |
| 2.4 Hours | : | 2 HT; 4 HP; |
| 2.5 Duration of the period | : | 16 weeks |
| 2.6 Type of course | : | Mandatory |
| 2.7 Learning modality | : | Face to face |
| 2.8 Prerequisites | : | <ul style="list-style-type: none">• CS112. Objects-oriented programming I. (2nd Sem)• CS1D1. Discrete Structures. (2nd Sem) |

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

This course introduces fundamental concepts and techniques in data management, focusing on relational database systems. Students will learn data modeling using entity-relationship diagrams, relational database design principles, normalization theory, and Structured Query Language (SQL). The course covers core database system components, transaction management, and basic query processing. Emphasis is placed on practical skills for designing, implementing, and querying databases, as well as understanding the role of data in organizations and the associated ethical considerations in data management.

5. GOALS

- Design and implement normalized relational databases.
- Formulate complex queries using SQL for data retrieval and manipulation.
- Apply data modeling techniques using entity-relationship diagrams.
- Understand database system architecture and transaction management.
- Recognize ethical and security considerations in data management.
- Utilize basic database administration tools and techniques.

6. COMPETENCES

AG-C09) Design and Development of Solutions: Designs, implements, and evaluates solutions for complex computing problems. (Usage)

AG-C12) Uses systemic approaches to select, develop, apply, integrate, and manage secure computing technologies to achieve user objectives. (Usage)

7. TOPICS

Unit 1: Conceptos Fundamentales de Sistemas de Bases de Datos (8 hours)	
Competences Expected: AG-C09,AG-C12	
Topics	Learning Outcomes
• Propósito y ventajas de los sistemas de bases de datos • Componentes de los sistemas de bases de datos • Diseño de funciones fundamentales de DBMS (por ejemplo, mecanismos de consulta, gestión de transacciones, gestión de búfer, métodos de acceso) • Arquitectura de base de datos, independencia de datos y abstracción de datos • Gestión de transacciones • Normalización • Enfoques para gestionar grandes volúmenes de datos (por ejemplo, sistemas de bases de datos NoSQL, uso de MapReduce) • Cómo soportar aplicaciones solo de CRUD • Bases de datos distribuidas/sistemas basados en la nube • Datos estructurados, semiestructurados y no estructurados • Uso de un lenguaje de consulta declarativo • Sistemas que soportan contenido estructurado y/o de flujo	• Identificar al menos cuatro ventajas que proporciona el uso de un sistema de base de datos [Familiarizarse] • Enumerar los componentes de un sistema de base de datos (relacional) [Familiarizarse] • Explain the advantages of database systems over file systems [Usar]. • Describe the three-schema architecture and data independence [Familiarizarse]. • Identify different types of database users and their roles [Familiarizarse].
Readings : [RG02], [SKS19]	

Unit 2: Modelado de Datos (8 hours)	
Competences Expected: AG-C09,AG-C12	
Topics	Learning Outcomes
• Modelos conceptuales (por ejemplo, entidad-relación, diagramas UML) • Entity sets, relationship sets, and attributes • Cardinality constraints: one-to-one, one-to-many, many-to-many • Weak entity sets and identifying relationships • Extended E-R features: specialization, generalization, aggregation • UML class diagrams for data modeling	• Describir los componentes del modelo E-R (o algún otro modelo no relacional) [Familiarizarse] • Modelar un entorno dado usando un modelo de datos conceptual [Usar] • Design E-R diagrams for real-world scenarios [Usar]. • Convert E-R diagrams to relational schemas [Usar]. • Apply extended E-R features for complex modeling [Evaluar].
Readings : [RG02], [EN15]	

Unit 3: Bases de Datos Relacionales (8 hours)	
Competences Expected: AG-C09,AG-C12	
Topics	Learning Outcomes
• Integridad de entidad y referencial: Clave candidata, superclaves • Diseño de base de datos relacional • Relational algebra operations: select, project, join, union, etc. • Integrity constraints: domain, key, entity, referential • Relational calculus: tuple and domain calculus • Mapping E-R diagrams to relational schemas	• Describir las características definitorias detrás del modelo de datos relacional [Familiarizarse] • Comentar sobre la diferencia entre una clave foránea y una superclave [Usar] • Express queries using relational algebra [Usar]. • Design relational schemas with appropriate constraints [Usar]. • Map complex E-R diagrams to normalized relations [Evaluar].
Readings : [RG02], [EN15]	

Unit 4: Construcción de Consultas (8 hours)	
Competences Expected: AG-C09,AG-C12	
Topics	Learning Outcomes
• Formación de Consultas SQL: – Ejecución interactiva de SQL – Ejecución programática de una consulta SQL • Data definition language: CREATE, ALTER, DROP • Data types and domain constraints reation and man-agement • View definition and materialized views • Database schema design and implementation	• Componer consultas SQL que incorporen selección, proyección, unión, intersección, diferencia de conjuntos y división de conjuntos [Usar] • Definir, en SQL, un esquema de relación, incluyendo todas las restricciones de integridad y activadores de eliminación/actualización [Usar] • Create and modify database schemas using SQL DDL [Usar]. • Implement integrity constraints at schema level [Usar]. • Design and create appropriate indexes for perfor-mance [Evaluar].
Readings : [RG02], [Bea09]	

Unit 5: Construcción de Consultas (8 hours)	
Competences Expected: AG-C09,AG-C12	
Topics	Learning Outcomes
• Complex SQL queries: nested subqueries, correlated subqueries • Aggregation functions and GROUP BY operations • Set operations: UNION, INTERSECT, EXCEPT • JOIN operations: inner, outer, natural, cross joins • Data manipulation: INSERT, UPDATE, DELETE • Transaction control: COMMIT, ROLLBACK, SAVEPOINT	• Determinar cuándo una consulta SQL anidada está correlacionada o no [Usar] • Componer una consulta SQL para actualizar una tu-pla en una relación [Usar] • Formulate complex queries with multiple joins and subqueries [Usar]. • Apply aggregation for data analysis and reporting [Usar]. • Implement data modification operations with trans-action control [Evaluar].
Readings : [RG02], [Bea09]	

Unit 6: Bases de Datos Relacionales (8 hours)	
Competences Expected: AG-C09,AG-C12	
Topics	Learning Outcomes
• Introducción a la teoría de dependencias funcionales • Teoría de Normalización: – Descomposición de un esquema; propiedades de unión sin pérdida y preservación de dependencias de una descomposición – Formas normales (BCNF) – Desnormalización (para eficiencia) • Functional dependencies and inference rules • Normal forms: 1NF, 2NF, 3NF, BCNF • Decomposition algorithms: lossless-join and dependency-preserving • Practical considerations in normalization	• Describir cómo la teoría de dependencias funcionales generaliza la noción de clave [Familiarizarse] • Detectar qué forma normal produce una descomposición dada [Usar] • Identify functional dependencies in relational schemas [Usar]. • Normalize relations to BCNF [Evaluar]. • Evaluate decompositions for lossless-join and dependency preservation [Evaluar].
Readings : [RG02], [EN15]	

Unit 7: Internos de DBMS (8 hours)	
Competences Expected: AG-C09,AG-C12	
Topics	Learning Outcomes
• Gestión de Transacciones: – Niveles de Aislamiento – ACID – Serializabilidad – Transacciones Distribuidas • Control de Concurrency: – Bloqueo en 2 Fases – Estrategias de manejo de bloqueos mutuos – Modelos de consistencia basados en quórum • ACID properties: Atomicity, Consistency, Isolation, Durability • Serializability and conflict serializability • Lock-based concurrency control: two-phase locking • Deadlock detection and prevention • Isolation levels and their trade-offs	• Describir las cuatro propiedades para un gestor de transacciones correcto [Familiarizarse] • Esbozar el principio de serializabilidad [Familiarizarse] • Explain ACID properties and their importance [Usar]. • Analyze transaction schedules for serializability [Evaluar]. • Apply locking protocols for concurrency control [Usar].
Readings : [RG02], [BHG87]	

Unit 8: Seguridad y Privacidad de Datos (8 hours)	
Competences Expected: AG-C09,AG-C12	
Topics	Learning Outcomes
• Diferencias entre seguridad de datos y privacidad de datos • Información de identificación personal (PII) y su protección • Consideraciones éticas para asegurar la seguridad y privacidad de los datos • Database security: authentication, authorization, encryption • SQL injection attacks and prevention • Introduction to NoSQL databases and big data • Data governance and compliance	• Describir las diferencias en los objetivos para seguridad de datos y privacidad de datos [Familiarizarse] • Identificar y mitigar riesgos asociados con diferentes enfoques para proteger datos [Usar] • Implement basic database security measures [Usar]. • Prevent SQL injection vulnerabilities [Evaluar]. • Discuss ethical considerations in data collection and use [Evaluar].
Readings : [RG02], [EN15]	

8. WORKPLAN

8.1 Methodology

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

8.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

8.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

9. EVALUATION SYSTEM

***** EVALUATION MISSING *****

10. BASIC BIBLIOGRAPHY

- [BHG87] Philip A. Bernstein, Vassos Hadzilacos, and Nathan Goodman. *Concurrency Control and Recovery in Database Systems*. Addison-Wesley, 1987.
- [RG02] Raghu Ramakrishnan and Johannes Gehrke. *Database Management Systems*. 3rd. McGraw-Hill, 2002.
- [Bea09] Alan Beaulieu. *Learning SQL*. 2nd. O'Reilly Media, 2009.
- [EN15] Ramez Elmasri and Shamkant B. Navathe. *Fundamentals of Database Systems*. 7th. Pearson, 2015.
- [SKS19] Abraham Silberschatz, Henry F. Korth, and S. Sudarshan. *Database System Concepts*. 7th. McGraw-Hill, 2019.