Course title: DATABASES I

Lecturers	Full Prof. Kornelije Rabuzin, Ph.D. Bogdan Okreša Đurić, Ph.D. Maja Cerjan, mag. educ. inf.
Language of instruction	Croatian and English
Study level	Bachelor
Study programme	Information and Business Systems
Semester	2nd (summer)
ECTS	6
Goal	The goal of this course is to familiarize the students with the relational databases technology. Upon completing the course, the students should be able to understand the three components of the relational database management system, i.e., structural, operational and integrity component. In addition, they should be able to create and manage a relational database (including its creation, modification, queries, indexes, security and transactions) by using SQL.
General and specific learning outcomes	1. Keep track of professional literature in Croatian and a foreign language, prepare and independently deliver presentations in Croatian and a foreign language to professional and general public, and critically evaluate a presented professional topic. 2. Understand and apply key aspects of information technology (programming, algorithms, data structures, data and knowledge bases). 3. Understand and apply study skills needed for lifelong learning and continuation of education at the graduate level.
Content	**1. Introduction** Introduction to content and goal of the course, literature, organization of the classes and examination. **2. Database management systems (3 hours)** Introduction to database management systems. Database. Database management system architecture. Data models. Database overview: relational databases, object / relational databases, temporal databases, deductive databases, object-oriented databases. An overview of systems and their features. **3. Basics of relational data model (2 hours)** Relational data model. Relation. Structural component of the relational model. Operational component of the relational model. Integrity component of the relational model. Equality of relations. The key. Entity integrity. Reference integrity. Catalog of relational operators. **4. Introduction to SQL (2 hours)** Overview of relational query languages: RA, SQL, QUEL, QBE. Introduction to SQL: SQL as a standard query language for relational and object / relational database management systems, database creation, database modification, relational algebra and SQL. SQL standard. **5. Creating objects (2 hours)** Creating tables. Data types. Integrity constraints. Indexes. Change tables (ALTER). Users. Roles. Privileges.

	6. Basic queries in SQL (queries over one relation) (2 hours) SELECT. FROM. WHERE. Projection. Selection: NULL, partial relation, arithmetic comparison operators, 3VL logic. Operators: IS [NOT] NULL, IN, BETWEEN, LIKE. **7. Complex queries in SQL (multi-relationship queries) I (2 hours)** Joins: natural join, LEFT JOIN, RIGHT JOIN. Union, cross-section and difference. Horizontal division of the relation (GROUP BY). HAVING clause - group conditions. **8. Complex queries in SQL (queries over multiple relations) II (2 hours)** External reference. Sub queries and conditions (ANY, ALL, EXISTS). Functions. Stored procedures. Triggers. **9. Integrity constraints (2 hours)** Types of integrity constraints. Implementation. Reference integrity. Maintaining referential integrity. Cycle. Database security: database security, database object security. Views. View update. **10. Transactions. (2 hours)** Examples of transactions. A valid transaction. Transaction execution control module. Comparative execution of a set of transactions. Problems when executing transactions. BEGIN. COMMIT. ROLLBACK. ISOLATION LEVEL. **11. Conceptual database design (2 hours)** Graphic languages for conceptual database design. Concepts and reality. Objects. Connecting objects. Graphic languages: ER, ORM, UML. Entity sets. Attributes. Connections. Diagrams. Multiplicity of binary connections. Types of relationships. Roles in relationships. Relationship attributes. Transformation of an n-ary relationship into a binary relationship. **12. UML modeling (2 hours)** Associations. Classification. Generalization. Aggregation. Subtypes and super-types. Partitions. Generalization and inheritance. Weak entities. Constraint modeling: constraint classification, keys, uniqueness, referential integrity, degree of connection. **13. Logical database design (2 hours)** The problem of logical database design. Database schema. Redundancy. Normalization. Database dependencies. Review of normal forms. Translating ER-diagrams into a relational database schema. **14. Logical database design - Part II (2 hours)** Database dependencies. Functional dependencies. Join dependencies. Determining the key. 3NF and BCNF. Decomposition and its properties. The connection between conceptual and logical design. **15. Database management system development trends (2 hours)** NoSQL and New SQL database management systems. Data warehouses. Business intelligence. Business analytics. Big data. Introduction to Databases II.
Exercises	By using an adequate database management system, the students acquire knowledge and skills needed for database administration and management.
Realization and examination	Classes: Lectures, seminars and exercises.

	Examination: Students take two written exams throughout the semester. After presenting their seminar paper and passing laboratory exercises, the students are able to take the final oral exam.
Related courses	1. Monash University, Australia, “Introduction to databases”; 2. Stanford University, USA, “Data Management and Data Systems”; 3. Imperial College London, UK, Computing department, “Introduction to databases”.
Literature	Basic: Lecture slides Abraham Silberschatz, Henry Korth, S. Sudarshan: Database System Concepts, 7th Edition, McGraw Hill, 2019. Elmasri Ramez, Navathe Shamkant: Fundamentals Of Database System, Pearson India, 2017. Additional: Luc Perkins, Eric Redmond, Jim Wilson: Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement, 2nd Edition, Pragmatic Bookshelf, 2018. Maleković M, Rabuzin K: Uvod u baze podataka, FOI, 2016. C. J. Date: An Introduction to Database Systems, Addison Wesley, 2004.